



South Coast
AQMD

Proposed Amended Rule 1134 Working Group #2

April 26, 2018

Agenda

- Summary of previous working group meeting
 - Emissions from PAR 1134 Turbines
- Initial BARCT Assessment
- Initial Rule Concepts

Previous Working Group Meeting

- Presented current Rule 1134 applicability and requirements
- Examined potential universe of equipment subject to PAR 1134
 - Received request from stakeholders to include emission information
- Provided overview BARCT determination process

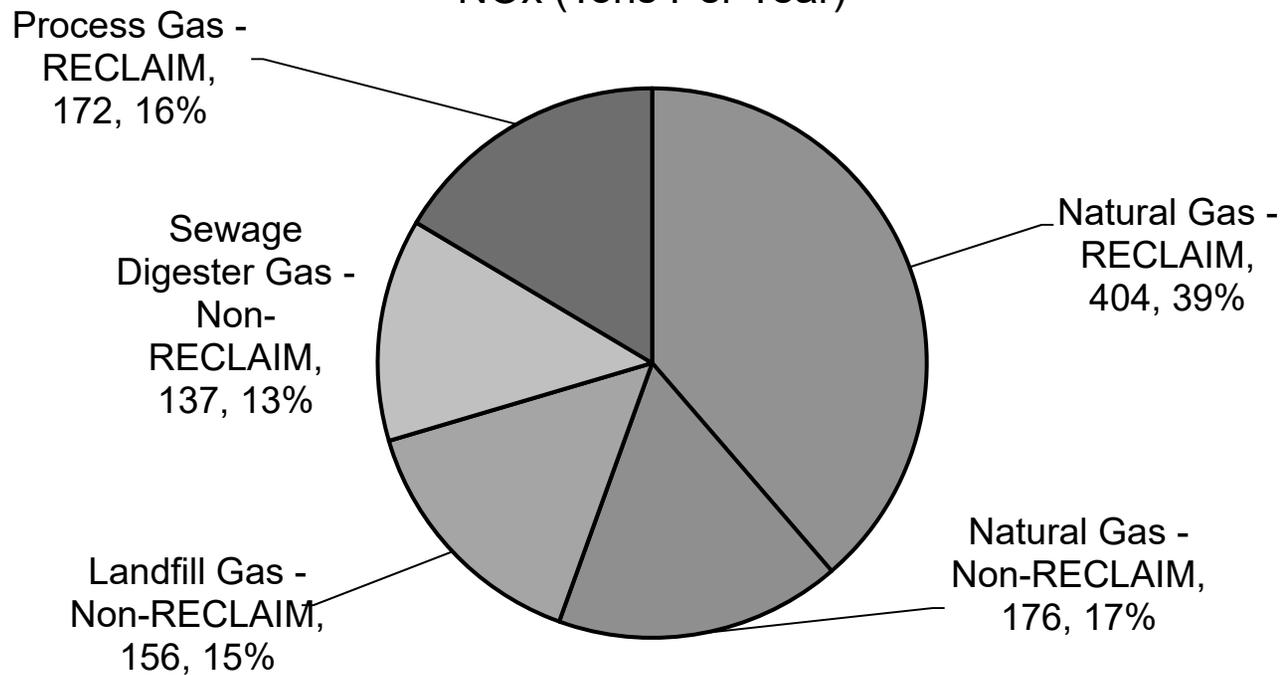
**Emissions from PAR
1134 Turbines**

Emissions from PAR 1134 Turbines - Overview

- Per a stakeholder request, presenting annual emission information for gas turbines subject to PAR 1134
 - ▷ Turbines reviewed by RECLAIM versus non-RECLAIM and fuel type
 - ▷ Natural gas, landfill gas, sewage digester gas, and process gas
- Total NOx emissions from PAR 1134 equipment is approximately 1,000 tons per year (2015 data)
 - ▷ Not including data for emergency turbines (20 units)
 - ▷ Data missing from one simple cycle turbine (no data since 2001)

Overall PAR 1134 Emissions

NOx (Tons Per Year)



Total PAR 1134
NOx inventory
approximately
1,045 tons per
year (2015 data)

Initial BARCT Assessment

BARCT

- Is defined in the California Health and Safety Code Section 40406
 - ▷ “...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.”
- BARCT is reassessed periodically and is updated as technology advances

Guiding Principles for Establishing BARCT Levels

- Consistent with state law, BARCT levels will take into account:
 - ▷ Environmental impacts;
 - ▷ Energy impacts; and
 - ▷ Economic impacts
- Must adhere to Health and Safety Code Section 40920.6, which establishes requirements prior to adopting rules or regulations regarding retrofit control technologies

Guiding Principles for Establishing BARCT Levels (continued)

- In addition to the overall cost-effectiveness, additional considerations for:
 - ▷ Outliers
 - ▷ Stranded assets
 - ▷ Incremental cost-effectiveness
 - ▷ Accounting for recent installations – implementation of previous requirements – BARCT or BACT

Background on BARCT Assessment for Turbines

- Rule 1134 BARCT Assessment
 - ▷ 1989, with the adoption of Rule 1134
- 2014 Norton Engineering analysis indicated 2 ppm NO_x level can be achieved by retrofit with catalyst modifications and additions
 - ▷ One PAR 1134 natural gas combined cycle turbine currently permitted at ≤ 2 ppm NO_x
- Decision to conduct a new BARCT assessment for this rulemaking

BARCT Analysis Approach for PAR 1134

Identify Emission Levels Achieved In Practice

Assess Rules in Other Air Districts Regulating Same Equipment

Technology Assessment

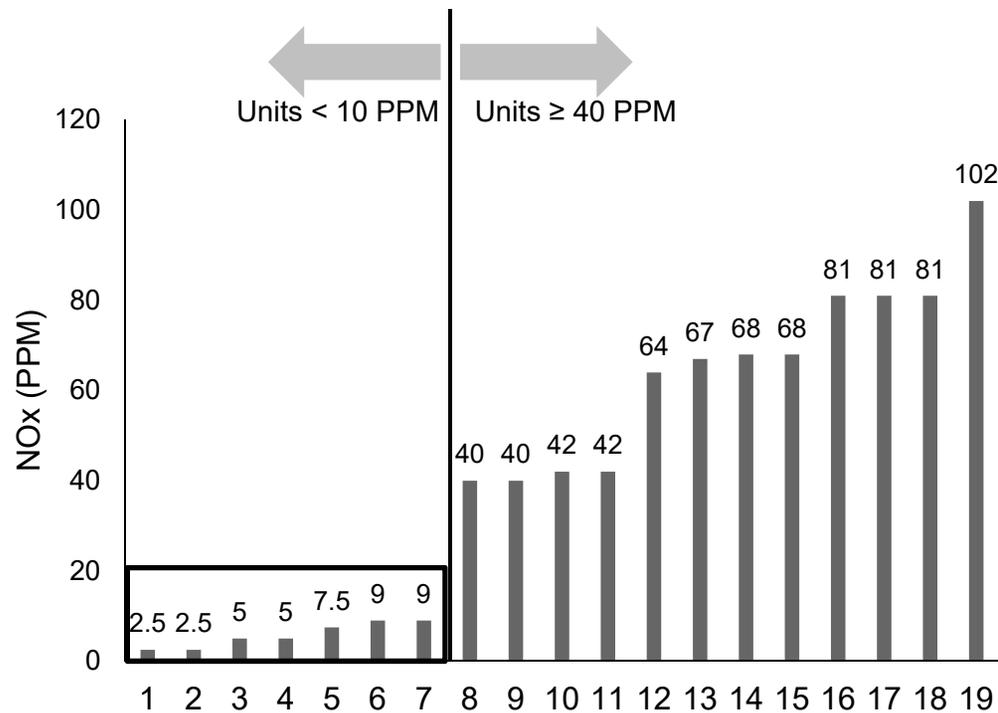
Establishing the BARCT Emission Limit and Other Considerations

Cost-Effectiveness

Overview of Achieved In Practice Equipment

- Identified turbines by lowest permit emission limit
- Grouped equipment by
 - ▷ Fuel type – natural gas, landfill gas, sewage digester gas, process gas
 - ▷ Equipment type – simple cycle, combined cycle
- Identified equipment with type of control
- Identified if emission limit is based on retrofit or replacement
- Identified year emission limit achieved
- Did not distinguish between RECLAIM and non-RECLAIM

Overview of Simple Cycle Natural Gas Turbines



Summary for Natural Gas Simple Cycle Turbines

- 19 natural gas simple cycle turbines
- 13 turbines ≥ 40 ppm
- 7 turbines < 10 ppm
- BARCT analysis will focus on 7 turbines < 10 ppm

NOx Levels for Simple Cycle Natural Gas Turbines

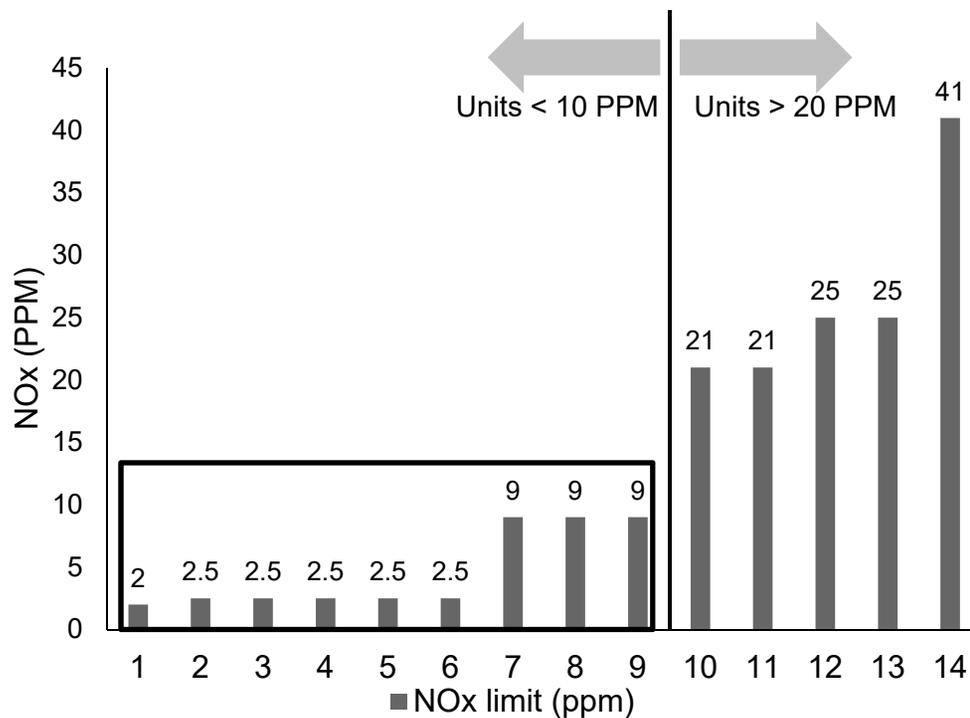
Simple Cycle Natural Gas					
Size (MMBtu/hr)	Output (MW)	NOx Limit (ppm)	Year Limit Achieved	Control Configuration	Replacement or Retrofit
407.7*	39	2.5	2002	Water Injection and SCR	Replacement
126	10	2.5	2002	SCR	Replacement
472.5	39	5	2002	Water Injection and SCR	Replacement
43.8	4.6	5	2009	Ultra Lean Premix	Replacement
1080	158	7.5	1989	Water Injection and SCR	Replacement
250.6	23.1	9	1988	Water Injection and SCR	Replacement
229	22.4	9	1987	Water Injection and SCR	Replacement

*Not in operation since 2017, still representative of "Achieved in Practice"

Summary NOx Concentration and Pollution Controls for Natural Gas Simple Cycle Turbines

2.5 PPM	Replacement using SCR or SCR and water injection (2 units)
5 PPM	Replacement using SCR and combustion modifications (2 units)
7.5 PPM	Replacement using SCR and water injection (1 unit)
9 PPM	Replacement using SCR and water injection (2 units)

Overview of Combined Cycle Natural Gas Turbines



Summary for Natural Gas Combined Cycle Turbines

- 14 natural gas combined cycle turbines
- 5 turbines ≥ 20 ppm
- 9 turbines < 10 ppm
- BARCT analysis will focus on 9 turbines < 10 ppm

NOx Levels for Combined Cycle Natural Gas Turbines

Combined Cycle Natural Gas					
Size (MMBtu/hr)	Output (MW)	NOx Limit (ppm)	Year Limit Achieved	Control Configuration	Replacement or Retrofit
173	13.5	2.0	2013	SCR	Replacement
162	13.4	2.5	2010	SCR	Replacement
57	3.2	2.5	2005	SCR	Replacement
57	3.2	2.5	2005	SCR	Replacement
113.8	5.6	2.5	2005	SCR	Replacement
113.8	5.6	2.5	2005	SCR	Replacement
221	21.7	9	1990	Water Injection and SCR	Replacement
46.2	2.8	9	1992	Water Injection and SCR	Replacement
49.1	2.9	9	1992	Water Injection and SCR	Replacement

Summary NOx Concentration and Pollution Controls for Natural Gas Combined Cycle Turbines

2 PPM	Replacement using SCR (1 Unit)
2.5 PPM	Replacement using SCR (5 Units)
9 PPM	Replacement using Water Injection and SCR (3 Units)

NOx Levels for Landfill Gas Turbines

Landfill Gas								
Turbine Type	Turbines at Location	Size (MMBtu/hr)	Output (MW)	NOx Limit (ppm)	NOx Limit Tested (ppm)	Year Limit Achieved	Control Configuration	Replacement or Retrofit
Simple	2	53	4.6	25	5	2013	Ultra Lean Premix	Replacement
Simple	5	61	4.9	12.5	6	2017	None listed	Replacement
Combined	2	216	14.4	6	6	1996	Water Injection/ SCR	Replacement
Simple	3	52	4.6	25	7	2013	Lean mix	Replacement

Summary NOx Concentration and Pollution Controls for Landfill Gas Turbines

5 PPM	Replacement using Ultra Lean Premix (2 Units)
6 PPM	Replacement - no SCR (5 units)
6 PPM	Replacement using Water Injection and SCR (2 units)
7 PPM	Replacement using Lean mix (3 units)

NOx Levels for Sewage Digester and Process Gas Turbines

Sewage Digester Gas							
Size (MMBtu/hr)	Output (MW)	Original NOx Limit (ppm)	NOx Limit (ppm)	Installation Date	Retrofit Date	Control Configuration	Replacement or Retrofit
137.5*	11.4	25	18.8	2011	2014	SCR	Retrofit

* Three identical units at one facility

Process Gas					
Size (MMBtu/hr)	Output (MW)	NOx Limit (ppm)	Year Limit Achieved	Control Configuration	Replacement or Retrofit
62.7	5.7	5	2009	Dry low NOx/SCR	Replacement

NOx Limits Achieved in Practice - Summary

Turbine Type	Achieved In Practice – Retrofit (NOx ppm @ 15% O2)	Achieved In Practice – Replacement (NOx ppm @ 15% O2)	Percent of Turbines Meeting Achieved in Practice Limits
Natural Gas			
Combined Cycle	None	≤ 9	64% (9 turbines)
Simple Cycle	None	≤ 9	50% (7 turbines)
Landfill Gas	None	≤ 9	75% (12 turbines)
Sewage Digester Gas	≤ 18.8	None	50% (3 turbines)
Process Gas	None	≤ 5	14% (1 turbine)

- Since 1989, only one set of PAR 1134 turbines have undergone retrofit to reduce NOx emissions
 - ▷ Three sewage digester gas turbines in 2014
- Over same time period, 29 turbines have been replaced

NOx Turbine Rule Limits in Other Districts

BAAQMD Reg 9 – Rule 9 (2006)*

Retrofit NOx limits effective in 2010

Turbine Heat Input Rating (MM Btu/hr)	Natural Gas (ppm @ 15% O ₂)	Refinery Gas, Waste Gas, LPG (ppm @ 15% O ₂)	Non-gaseous Fuel (ppm @ 15% O ₂)
5 - 50	42	50	65
>50 - 150	25 - 42	50	65
>150 – 250	15	15	42
>250 – 500	9	9	25
> 500	5	9	25

*Currently under review

SJVAPCD Rule 4703 (2007)

Retrofit NOx limits effective in 2009

Turbine Output Rating (MW)	Approximate Heat Input Rating (MM Btu/hr)**	Gas Fuel (ppm @ 15% O ₂)	Liquid Fuel (ppm @ 15% O ₂)
< 3	< 35	9	25
< 3 – 10 Pipeline	< 35 - 130	8 steady and 12 non-steady	25
< 3 – 10	< 35 - 130	5	25
> 10	> 130	3 - 5	25 - 42

**Non-regulatory: For comparison purposes only

BACT - Combined Cycle Natural Gas Turbines

Year	Regulation		Limit
2004	(major sources)	Combined Cycle Gas Turbine	2.0 ppm @ 15% O ₂ , 1-hour rolling average
2016	Part D (minor source)	Gas Turbines, Natural Gas Fired ≥ 3 MWe and < 50 MWe	[2.5 ppm @ 15% O ₂] x [efficiency (%)/34%]
2016	Part D (minor source)	Gas Turbines, Natural Gas Fired ≥ 50 MWe	2.5 ppm @ 15% O ₂ , 1-hour rolling avg; OR [2.0 ppm @ 15 % O ₂ , 3-hour rolling avg.] x [efficiency (%)/34%]

BACT - Simple Cycle Natural Gas Turbines

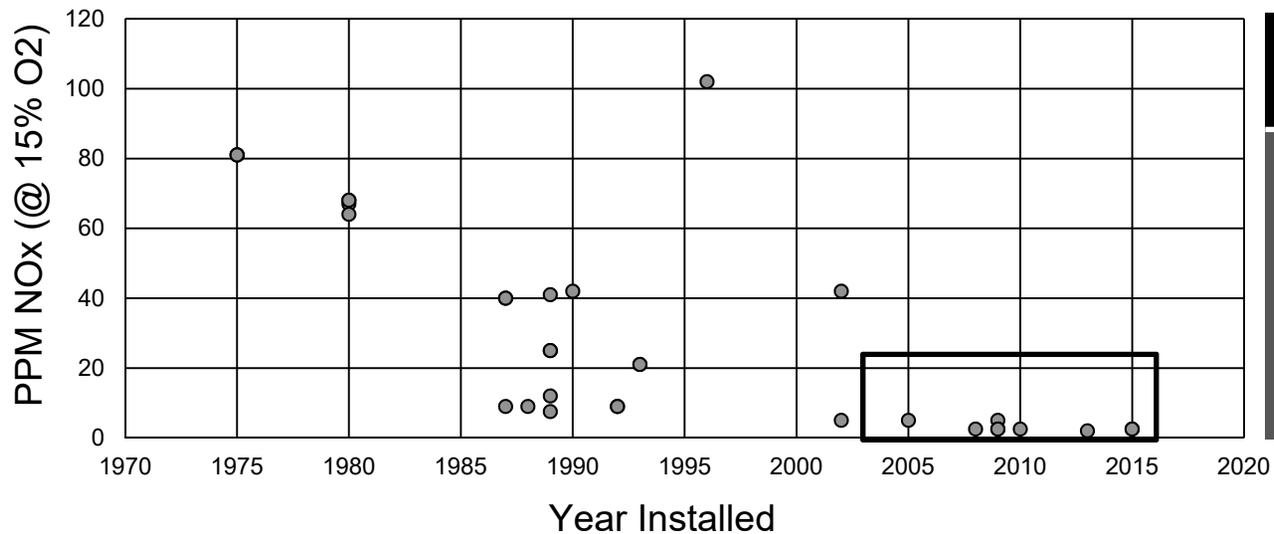
- 2004 SCAQMD LAER (major sources)
 - ▷ 3.5 ppm @ 15% O₂, 3-hour rolling average
- 2016 BACT Guidelines Part D (minor source)
 - ▷ Gas Turbines, Natural Gas Fired, ≥ 3 MWe and < 50 MWe
 - ▷ [2.5 ppm @ 15% O₂] x [efficiency (%)/34%]
 - ▷ Gas Turbines, Natural Gas Fired, ≥ 50 MWe
 - ▷ 2.5 ppm @ 15% O₂, 1-hour rolling avg; OR
 - ▷ [2.0 ppm @ 15 % O₂, 3-hour rolling avg.] x [efficiency (%)/34%]

BACT - Other Turbines

- Currently under review by SCAQMD BACT Team
- 2003 SCAQMD BACT/LAER
 - ▷ Gas Turbines, Digester Gas Fired
 - ▷ 25 ppm @ 15% O₂
 - ▷ No landfill gas fired turbine listed
 - ▷ No process gas fired turbine listed

Natural Gas Turbine Limit Progression

NOx Permit Limits Over Time



Summary NOx Permit Limits Over Time

- Since 2005, 11 replacement turbines permitted at ≤ 5 ppm
- Since 2009, 8 replacement turbines permitted at ≤ 2.5 ppm

BARCT Assessment Summary

- Achieved in practice limits have been demonstrated for several years for all fuel types
- BARCT assessment will focus on lowest emitting achieved in practice turbines
- BARCT assessment will consider replacement of turbines as well as retrofitting with additional control
 - ▷ Nearly all lowest emitting turbines have been replacements
 - ▷ Three sewage digester gas turbines have been retrofits
- Will present proposed BARCT limits and cost-effectiveness data at next working group meeting

Initial Rule Concepts

Initial Rule Concepts - *Overview*

- Initial rule concepts are provided to promote discussion
- Stakeholder input and further information can change initial concepts as they are developed into rule language
- Rule language likely to be provided at next working group

Initial Rule Concepts - *Applicability*

- All gas turbines and associated duct burners ≥ 0.3 MW
 - ▷ Duct burners included because they exhaust gas through same stack
 - ▷ In this case, facility based landing rules supersede general equipment rule
- Refineries covered under Rule 1109.1 and Electricity Generating Facilities covered under Rule 1135 will be excluded from PAR 1134
 - ▷ Rules 1109.1 and 1135 may reference the emission limits for equipment covered under PAR 1134

Initial Rule Concepts – *Emission Limits*

- Achieved in practice limits will be important factor in determining proposed limits
- Limits to allow for retrofit or replacement of turbines
- Cost-effectiveness and incremental cost-effectiveness information will be incorporated into proposal
- Limits averaged over one hour at 15% O₂
- Ammonia emission limit likely for new units
- Effective date still under consideration
 - ▷ AQMP goal of 5 tons per day of NO_x reductions by 2025
 - ▷ AB 617 requirement of BARCT implementation by 2023

Initial Rule Concepts – *Exemptions*

- Remove Southeast Desert Air Basin (SDAB) and San Clemente Island exemptions
 - ▷ SDAB no longer part of SCAQMD
 - ▷ San Clemente Island no longer has turbines
- Maintain exemption for emergency units used less than 200 hours per year

Further Considerations

- Potential Start-Up and Shutdown requirements for new units
- Address low-use turbines operating less than 400 hours in calendar year
- Dual fuel turbines operating in location where natural gas is not available
- Others?

Schedule

Current Tentative Schedule

- Next Working Group Meeting May 2018
- Public Workshop 3rd Quarter 2018
- Stationary Source Committee July 20, 2018
- Set Hearing September 7, 2018
- Public Hearing October 5, 2018

Contacts



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