Proposed Rule 1150.3
Emissions of Oxides of Nitrogen from Combustion Equipment at Landfills

Working Group Meeting #4

February 12, 2020

Teleconference Information

Dial-In Number: 1-866-705-2554

Participant Passcode: 220103

Agenda

- Working Group Meeting #3
  - Summary
  - Stakeholder Comment
- Rule Applicability for Engines
  - Survey Summary
  - Results
- BARCT Assessment
  - Previous Working Group Meetings
  - Cost-Effectiveness Analysis
    - Methodology and Assumptions
    - Approach
    - Boilers
    - Simple Cycle Turbines
    - Combined Cycle Turbines

Working Group Meeting #3

Working Group Meeting #3: Summary

- Summary of Working Group Meeting #2
- BARCT Assessment
  - Technology Assessment
    - Assessment of Pollution Control Technologies
  - Initial NOx Emission Limits and Other Considerations
  - Cost-Effectiveness Analysis

Working Group Meeting #3: Stakeholder Comment

Stakeholder Comment	Staff Response
Cost estimates from South Coast AQMD biogas toolkit may not be representative of real world gas clean up system costs	• Biogas toolkit information will not be used to obtain cost information • Cost information will rely on data obtained from facilities and suppliers

Rule Applicability for Engines

Background

- Currently, landfill gas-fired engines are applicable to Rule 1110.2 – Emissions from Gaseous- and Liquid-Fueled Engines
- Some stakeholders have requested that landfill gas-fired engines be included in PR 1150.3 instead of Rule 1110.2
- Rule 1110.2 was amended on November 1, 2019, staff is not proposing changes to the emission limits or monitoring, reporting, or recordkeeping requirements
- In December 2019, sent to 3 facilities with 10 landfill gas engines to seek input regarding including landfill gas-fired engines in PR 1150.3 or Rule 1110.2

Engines Survey: Summary

Updated Slide

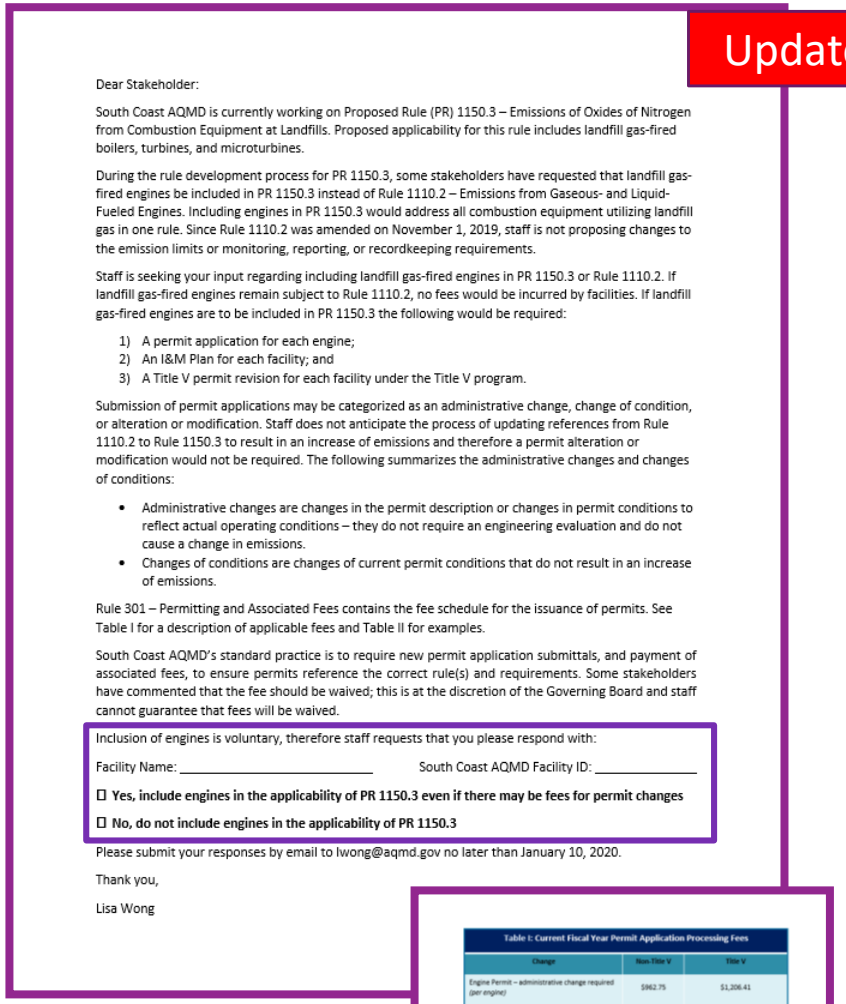
- Clarification that even if landfill engines were to be moved from 1110.2 to PR 1150.3, there would be no changes to emission limits or monitoring, reporting, or recordkeeping requirements
- Requirements for permits and plans and associated fees if engines were to be moved from Rule 1110.2 to PR 1150.3 Changes
- Explanation that some stakeholders are requesting fees be waived, but staff cannot guarantee this outcome because it is at the discretion of Governing Board
- Survey Question

Inclusion of engines is voluntary, therefore staff requests that you please respond with:

Facility Name: _____ South Coast AQMD Facility ID: _____

☐ **Yes, include engines in the applicability of PR 1150.3 even if there may be fees for permit changes**

☐ **No, do not include engines in the applicability of PR 1150.3**



Dear Stakeholder:

South Coast AQMD is currently working on Proposed Rule (PR) 1150.3 – Emissions of Oxides of Nitrogen from Combustion Equipment at Landfills. Proposed applicability for this rule includes landfill gas-fired boilers, turbines, and microturbines.

During the rule development process for PR 1150.3, some stakeholders have requested that landfill gas-fired engines be included in PR 1150.3 instead of Rule 1110.2 – Emissions from Gaseous- and Liquid-Fueled Engines. Including engines in PR 1150.3 would address all combustion equipment utilizing landfill gas in one rule. Since Rule 1110.2 was amended on November 1, 2019, staff is not proposing changes to the emission limits or monitoring, reporting, or recordkeeping requirements.

Staff is seeking your input regarding including landfill gas-fired engines in PR 1150.3 or Rule 1110.2. If landfill gas-fired engines remain subject to Rule 1110.2, no fees would be incurred by facilities. If landfill gas-fired engines are to be included in PR 1150.3 the following would be required:

1) A permit application for each engine;
2) An I&M Plan for each facility; and
3) A Title V permit revision for each facility under the Title V program.

Submission of permit applications may be categorized as an administrative change, change of condition, or alteration or modification. Staff does not anticipate the process of updating references from Rule 1110.2 to Rule 1150.3 to result in an increase of emissions and therefore a permit alteration or modification would not be required. The following summarizes the administrative changes and changes of conditions:

- Administrative changes are changes in the permit description or changes in permit conditions to reflect actual operating conditions – they do not require an engineering evaluation and do not cause a change in emissions.
- Changes of conditions are changes of current permit conditions that do not result in an increase of emissions.

Rule 301 – Permitting and Associated Fees contains the fee schedule for the issuance of permits. See Table I for a description of applicable fees and Table II for examples.

South Coast AQMD's standard practice is to require new permit application submittals, and payment of associated fees, to ensure permits reference the correct rule(s) and requirements. Some stakeholders have commented that the fee should be waived; this is at the discretion of the Governing Board and staff cannot guarantee that fees will be waived.

Inclusion of engines is voluntary, therefore staff requests that you please respond with:

Facility Name: _____ South Coast AQMD Facility ID: _____

☐ **Yes, include engines in the applicability of PR 1150.3 even if there may be fees for permit changes**

☐ **No, do not include engines in the applicability of PR 1150.3**

Please submit your responses by email to lwong@aqmd.gov no later than January 10, 2020.

Thank you,

Lisa Wong

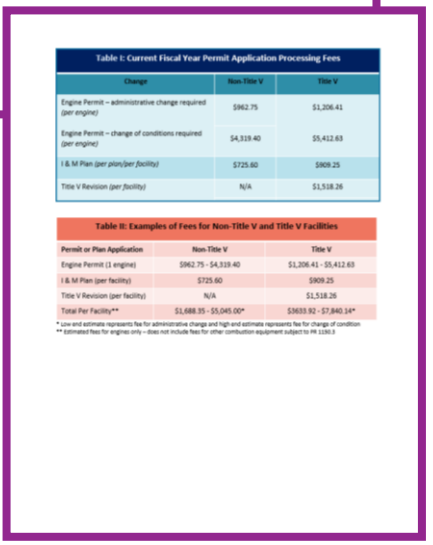


Table I: Current Fiscal Year Permit Application Processing Fees

Change	Non-Title V	Title V
Engine Permit – administrative change required *(per engine)*	$962.75	$1,206.41
Engine Permit – change of conditions required *(per engine)*	$4,319.40	$5,412.63
I & M Plan *(per plan/per facility)*	$725.60	$909.25
Title V Revision *(per facility)*	N/A	$1,518.26

Table II: Examples of Fees for Non-Title V and Title V Facilities

Permit or Plan Application	Non-Title V	Title V
Engine Permit (1 engine)	$962.75 - $4,319.40	$1,206.41 - $5,412.63
I & M Plan (per facility)	$725.60	$909.25
Title V Revision (per facility)	N/A	$1,518.26
Total Per Facility**	$1,688.35 - $5,045.00*	$3633.92 - $7,840.14*

* Low end estimate represents fee for administrative change and high end estimate represents fee for change of condition
** Estimated fees for engines only – does not include fees for other combustion equipment subject to PR 1150.3

Updated Slide

Engines Survey: Results

Stakeholder Response

- No response from one out of the three facilities
- Two out of the three facilities responded:
  "No, do not include engines in the applicability of PR 1150.3"

Staff Recommendation

- Landfill gas engines to remain applicable to Rule 1110.2

BARCT Assessment

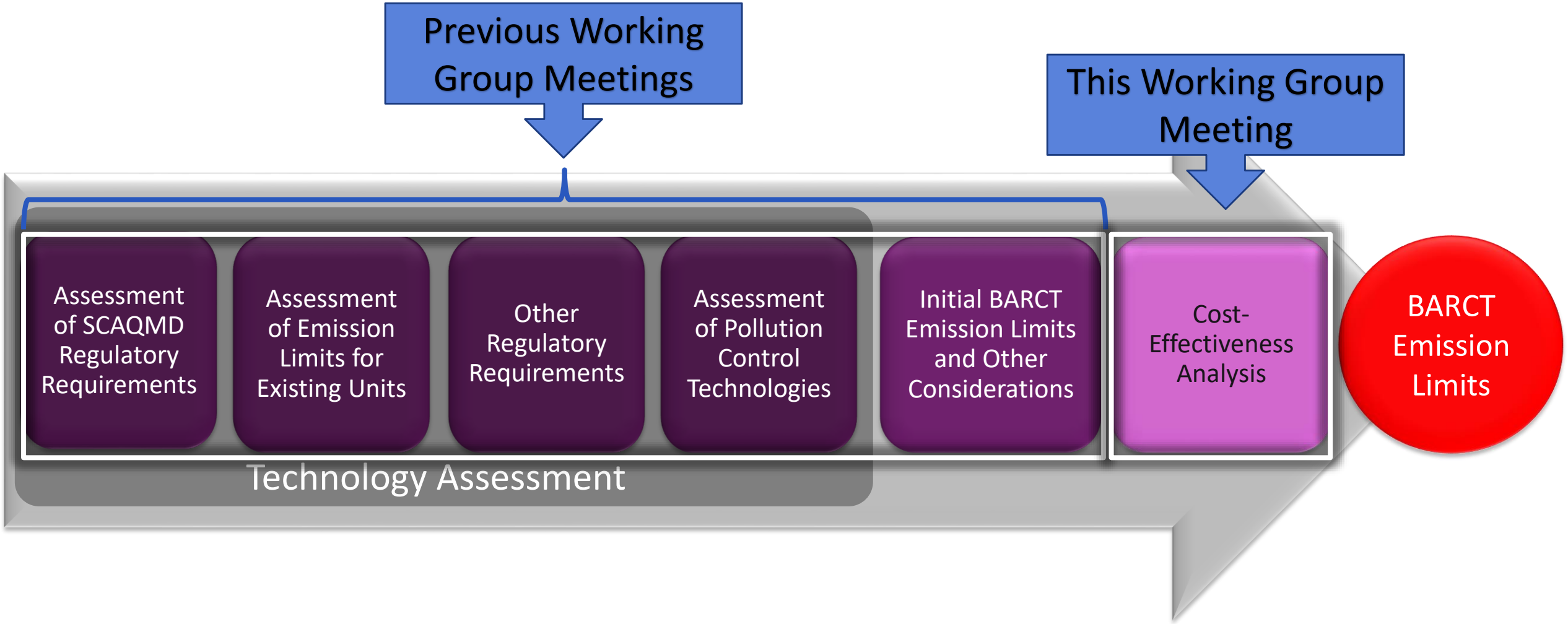
Best Available Retrofit Control Technology (BARCT)

California H&SC §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."

- Includes a technology assessment and cost-effectiveness analysis
- Applicable to equipment retrofits and replacement

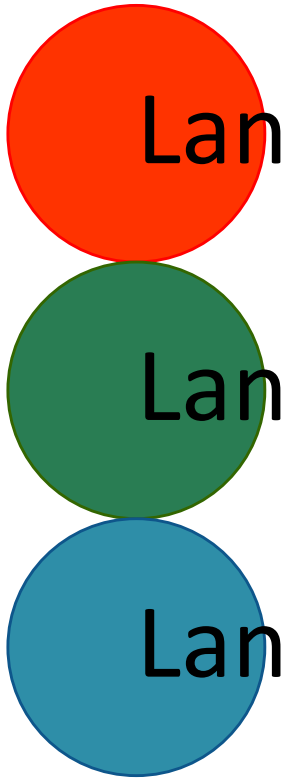
BARCT Assessment



*BARCT analysis is conducted for each equipment category and fuel type

BARCT Assessment: Previous Working Group Meetings

Proposed Applicable Equipment



- Landfill Gas Boilers
- Landfill Gas Simple Cycle Turbines
- Landfill Gas Combined Cycle Turbines

Current Status of BARCT Assessment

	South Coast AQMD Regulatory Requirements	Source Test Results	Other Regulatory Requirements	Pollution Control Technologies	Initial BARCT Emission Limits
Boilers*	21 – 24	16.8 – 22	5 – 15	5	5
Simple Cycle Turbines**	12.5 – 18.5	3.1 – 7.6	5 – 25	2.5	2.5
Combined Cycle Turbines**	25	22.5 – 23.8	5 – 25	2	2

* ppmv NOx at 3% O_2, dry

** ppmv NOx at 15% O_2, dry

***** Cost-effectiveness analysis will take into consideration cost of landfill gas treatment system and operating and maintenance of the SCR, if necessary**

Cost-Effectiveness Analysis

Cost-Effectiveness Analysis: Methodology and Assumptions

Overview

- Cost-effectiveness analysis is conducted on the initial BARCT emission limit
- Cost-effectiveness is the cost (capital plus annual operating costs) over the emission reductions for the life of the equipment
- Staff uses the 2016 AQMP cost-effectiveness threshold of $50,000 per ton of NOx reduced as guidance for establishing the BARCT emission limit
- Staff is using a “bottom up approach” and analyzing the cost-effectiveness for each unit; the average cost-effectiveness is based on the data from each unit within the class and category of equipment

Cost-Effectiveness Calculation

Calculated using Discounted Cash Flow Method

- *Cost-Effectiveness* = $\frac{Present\ Value}{Emission\ Reductions\ Over\ Equipment\ Life}$
  - Present Value = $Capital\ Cost + (Annual\ Operatin\ Costs\ * Present\ Value\ Formula)$
  - Present Value Formula = $\frac{(1+\mathrm{r})^n - 1}{r * (1+r)^{(n-1)}}$
    - r = real interest rate
    - n = equipment life

Elements of Capital and Annual Operating Costs

Capital Costs

- Equipment needed to achieve the Initial BARCT Limit
- Installation (including construction)

Annual Operating Costs

- Labor
- Maintenance
- Electricity
- Catalyst (*SCR only*)
- Reagent (*SCR only)*
- Gas treatment media
- Monitoring, Reporting, and Recordkeeping
- Source Testing

Updated Slide

Other Cost Considerations

Stranded Assets

- Accounts for costs associated with the replacement of equipment before the assumed life
  - Existing equipment age based on installation date
- For equipment replacement, cost analysis accounted for stranded assets
- Additional cost calculated by:
  - $Total\ New\ Equipment\ Cost = (New\ Equipment\ Cost) + (Stranded\ Asset\ Cost)$
  - $Stranded\ Asset\ Cost = \left(\frac{Equipment\ Life - Existing\ Equipment\ Age}{Equipment\ Life}\right) * (Existing\ Equipment\ Cost)$

Real Interest Rate

- 4%

Other Cost Considerations *(continued)*

Equipment Useful Life

- 25 years

Equipment Replacement

- Equipment replacement is normal component of business operations
  - Replacing equipment after equipment life is not expected to add any additional cost
  - No additional operating & maintenance costs for replacing equipment with similar equipment

Estimating Emission Reductions

Timeframe	Emission reductions calculated over same timeframe as remaining equipment life
Baseline NOx	Baseline NOx concentration obtained from source test results
Baseline Throughput	Baseline throughput obtained from Annual Emissions Report (AER)

Obtaining Costs

- SCR Retrofit
  - Costs determined using U.S. EPA's Air Pollution Control Cost Estimation Spreadsheet for Selective Catalytic Reduction (SCR)[1]
    - Methodology based on U.S. EPA Clean Air Markets Division Integrated Planning Model
    - Size and costs of SCR based on unit size, fuel burned, NOx removal efficiency, reagent consumption rate, and catalyst costs
- Burner Replacement
  - Costs based on average equipment and installation cost for Rule 1146 and 1146.1 boiler units
- Assumptions
  - Capital costs annualized over 25 years at 4% interest rate
  - Values reported in 2015 dollars
- Stakeholders are welcome to provide staff with their own costs and cost-effectiveness calculations

[1] https://www.epa.gov/sites/production/files/2017-12/documents/scrcostmanualchapter7thedition_2016revisions2017.pdf

Cost-Effectiveness Analysis: Approach

Implementation Approach

Overall Goal

- Apply emission limit to equipment via the most cost-effective schedule
- Staff aimed to reduce stranded asset costs and only require replacement when cost-effective to do so

Approach

- Evaluated cost-effectiveness for all units
- Evaluated average cost-effectives of units
  - If ≤ $50,000/ton of NOx reduced, Fixed-Date Approach
  - If > $50,000/ton of NOx reduced, Phase-In Approach

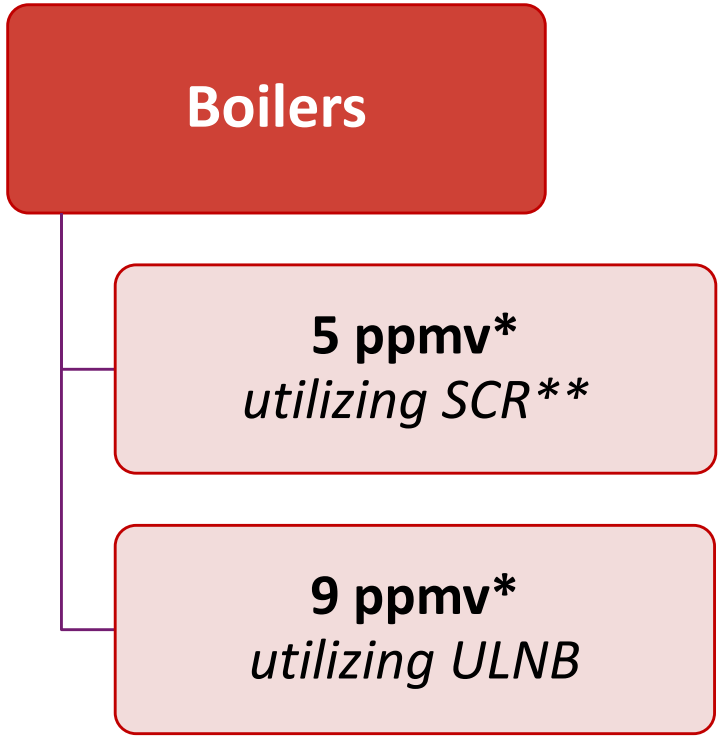
Proposed Compliance Approach

	Fixed-Date Approach Emission limit effective at a set point in time	**Phase-In Approach** Emission limit effective upon end of equipment life
Applicability	Cost-Effectiveness ≤ $50,000/ton of NOx reduced	Cost-Effectiveness > $50,000/ton of NOx reduced
Compliance Schedule	1/1/2024	At the time equipment is replaced or when equipment is ≥ 25 years old

Cost-Effectiveness Analysis: Boilers

Initial BARCT NOx Limits

- Based on technology assessment, initial BARCT NOx emission limits:



* At 3% $O_{2,}$ dry

**Cost-effectiveness analysis will include cost of landfill gas treatment system

Cost-Effectiveness Analysis for Boilers

Initial BARCT NOx Emission Limit (ppmv @ 3% O_2)	Boiler Size (MMBtu/hr)	Cost-Effectiveness ($/ton NOx reduced)	Average Cost-Effectiveness ($/ton NOx reduced)
5 *(SCR and landfill gas treatment system)*	115	$637,611	**$446,988**
	335	$351,676	
	335	$351,676	
9 *(using ULNB)*	115	$9,024	**$8,711**
	335	$8,555	
	335	$8,555	

- 5 ppmv is not cost-effective at $446,988/ton NOx reduced
- 9 ppmv is cost-effective at $8,711/ton NOx reduced
- Proposed BARCT NOx Emission Limit for Boilers: 9 ppmv @ 3% O_2

Cost-Effectiveness Analysis: Simple Cycle Turbines

Initial BARCT NOx Limit

- Based on technology assessment, initial BARCT NOx emission limits:

Simple Cycle Turbines

2.5 ppmv* utilizing SCR**

* At 15% $O_{2,}$ dry

**Cost-effectiveness analysis will not include cost of landfill gas treatment system, all simple cycle turbines currently have a landfill gas treatment system

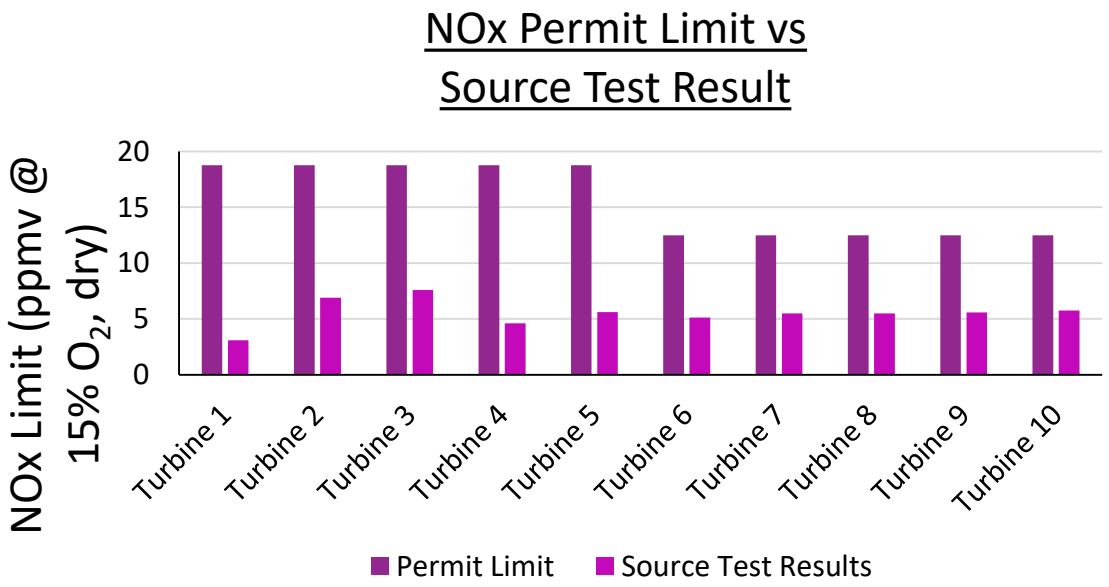
Cost-Effectiveness Analysis for Simple Cycle Turbines

Turbine Size (MMBtu/hr)	Cost-Effectiveness ($/ton NOx reduced)	Average Cost-Effectiveness ($/ton NOx reduced)
51.6	$987,764	**$365,924**
51.6	$987,764	
51.6	$987,764	
53.13	$71,691	
53.13	$56,851	
61	$100,391	
61	$106,038	
61	$141,867	
61	$112,766	
61	$106,346	

- 2.5 ppmv is not cost-effective at $365,924/ton NOx reduced

Source Test Results of Simple Cycle Turbines from Working Group Meeting #2

- 10 landfill gas simple cycle turbines
- Source test results range from 3 – 8 ppmv NOx @ 15% O_2



- 2.5 ppmv is not cost-effective at $365,924/ton NOx reduced
- Proposed BARCT NOx Emission Limit for Simple Cycle Turbines: 12.5 ppmv @ 15% O_2

Cost-Effectiveness Analysis: Combined Cycle Turbines

Cost-Effectiveness Analysis for Combined Cycle Turbines

- Turbines installed in 2012
  - Utilizing SCR
  - Original installation cost of approximately $126 million
    - Significant stranded asset costs
- Replacement cost estimated at $53 million (7 smaller simple cycle turbines)

System	Capital Cost	Stranded Assets	Emission Reduction (Tons over 25 years)	Cost-Effectiveness ($/ton of NOx reduced)
New Simple Cycle Turbines	$53 million	$71 million	1,650	$75,100

- 12.5 ppmv is not cost-effective at $75,100/ton NOx reduced
- Proposed BARCT NOx Emission Limit for Simple Cycle Turbines: 12.5 ppmv @ 15% O_2 at time of turbine replacement (end of current power purchase agreement)

New Slide

Summary of BARCT Assessment

Boilers*	21 – 24	16.8 – 22	5 – 15	5	5	$446,988	9
Simple Cycle Turbines**	12.5 – 18.5	3.1 – 7.6	5 – 25	2.5	2.5	$365,924	12.5 (at replacement)
Combined Cycle Turbines**	25	22.5 – 23.8	5 – 25	2	2	$75,100	12.5 (at replacement)

* ppmv NOx at 3% O_2, dry
** ppmv NOx at 15% O_2, dry

Schedule

Rule Schedule

Action	Target Dates
Next Working Group Meeting	4 – 6 Weeks
Public Workshop	2nd Quarter of 2020
Set Hearing	3rd Quarter of 2020
Public Hearing	3rd Quarter of 2020

Contacts

PR 1150.3 Development Questions

Lisa Wong
Assistant Air Quality Specialist
lwong@aqmd.gov
909-396-2820

Uyen-Uyen Vo
Program Supervisor
uvo@aqmd.gov
909-396-2238

Mike Morris
Planning and Rules Manager
mmorris@aqmd.gov
909-396-3282

General Questions

Susan Nakamura
Assistant Deputy Executive Officer
snakamura@aqmd.gov
909-396-3105

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