

# VENTURA COUNTY APCD

## FINAL STAFF REPORT

### Proposed Amendments to Rule 74.23, Stationary Gas Turbines

November 2019

#### EXECUTIVE SUMMARY

Staff is proposing amendments to Rule 74.23 to reduce Oxides of Nitrogen (NOx) and ammonia emissions from stationary gas turbines with a rated output of 0.3 megawatt (MW) or greater and operate on gaseous and/or liquid fuel. The newly proposed emissions limits are based on the recently revised Rule 1134 by South Coast Air Quality Management District (SCAQMD), which lowered the acceptable emission limits of NOx and ammonia for stationary gas turbines within their District.

This rule development will implement an All Feasible Measure as required by the California Clean Air Act, California Health and Safety Code (CHSC) Section 40914. Ventura County Air Pollution Control District's (VCAPCD) 2016 Air Quality Management Plan (AQMD) relies on adopting All Feasible Measures to help attain the state ambient ozone air quality standard. In addition, the adoption of amendments to this rule helps satisfy Assembly Bill (AB) 617, which was approved on July 26, 2017 by Governor Jerry Brown, which requires each local air district that is nonattainment for one or more air pollutant(s) to adopt an expedited schedule for the implementation of Best Available Retrofit Control Technology (BARCT) to each industrial source that, as of January 1, 2017, was subject to a specified market-based compliance mechanism (Cap and Trade Program) and gives highest priority to those permitted units that have not modified emissions-

related permit conditions for the greatest period of time. The adoption of the proposed amendments to 74.23, Stationary Gas Turbines, is the District's first step in implementing the expedited rule adoption schedule approved by the Ventura County Air Pollution Control Board to satisfy requirements of AB 617.

Currently, there are there are 11 permitted gas turbines (Appendix A) subject to the proposed lower NOx and ammonia standards. Of these 11 permitted gas turbines, 6 turbines have permitted emissions above the proposed new NOx standards and would need to be retrofit or adjusted in order to comply. Due to the unique characteristics of certain stationary gas turbines within the district, staff is proposing separate, higher emission limits which are not as stringent and are specific to 5 unique turbines. The State Implementation Plan (SIP) creditable emission reductions by implementing the proposed emission limits is estimated at 24.5 tons of NOx per year. The proposed amendments to Rule 74.23 also include an alternative compliance option available to facilities with unfavorable cost-effectiveness and is expected to produce additional NOx reductions estimated at 74.7 tons per year.

Additional changes are proposed by staff which improve rule clarity and improve District's ability to verify compliance for affected units.

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#### BACKGROUND

##### Introduction

Rule 74.23, Stationary Gas Turbines applies to all stationary gas turbines rated at 0.3 MW or greater that operates on gaseous or liquid fuels. The main purpose of this rule is to limit NOx emissions which are precursors to ground-level ozone formation. Ventura County is currently designated as "serious" nonattainment for federal National Ambient Air Quality Standards and designated nonattainment for state Ambient Air Quality Standards for ground level ozone. Ventura County is required by the California Clean Air Act (California Health and Safety Code

Section 40914) to adopt "every feasible measure" as an alternative requirement to reducing precursor emissions by a minimum of five percent per year. The District considers this proposal a feasible measure that will reduce NOx emissions.

##### Regulatory History

Rule 74.23 was adopted on March 14, 1995, pursuant to the 1994 Ventura County Air Quality Management Plan (AQMP) Control Measure N-101, Gas Turbines. The measure originated from both the 1987 and the 1991 AQMPs. The initial rule adoption required a

reduction of NOx emissions from gas turbines by using water injection and selective catalytic reduction (SCR) technology. Rule 74.23 also satisfied a federal Clean Air Act requirement for NOx Reasonably Available Control Technology (RACT) requirements on gas turbines. The rule was revised October 10, 1995 to correct an emergency operation requirement.

On May 21, 2001, Rule 74.23 was amended to increase the NOx emissions limit requirements for one General Electric (GE) LM-2500 turbine at Procter & Gamble (P&G) in Oxnard, as found in subsection B.5. The tough access to, age of the unit, and utilization of the exhaust in multiple processes in paper product manufacturing made SCR installation an unreasonable requirement at the time. The estimated emission reductions from the LM-2500 was offset by reducing NOx emissions limits for a second, larger, turbine located at P&G, an LM-5000 to less than the unit's original permitted limit, as found in the current subsection B.6. This resulted in no net change of NOx emissions from the facility.

At the time of the initial rule adoption in 1995, there were a total of 23 stationary gas turbines operating in Ventura County. Of these, 10 required new or additional controls to meet the NOx emission limits established by Rule 74.23. At the time of the 2001 rule amendment, there were 18 stationary gas turbines operating in Ventura County. All the turbines were in compliance with the rule amendment in 2001. Currently, there are 11 permitted gas turbines subject to Rule 74.23. (Appendix A), of which 6 have permitted NOx emission limits above the new proposed limits.

#### Assembly Bill 617

On July 26, 2017, AB 617 was approved by Governor Jerry Brown and focuses on reducing criteria pollutants and toxic air contaminants from stationary sources. Among the requirements of AB 617 is an expedited schedule for implementing BARCT to each industrial source that, as of January 1, 2017, was subject to a specified market-based compliance mechanism (Cap and Trade Program) and gives highest priority to those permitted units that have not modified emissions-related permit conditions for the greatest period of time. The highest priority would be given to older, higher polluting units that will need to install retrofit emission control technology.

#### BARCT Implementation

In response to amendments by AB 617, CHSC Section 40920.6(c) requires that on or before January 1, 2019, each local air district that is nonattainment for one or more air pollutants must adopt an expedited schedule for the implementation of BARCT by the earliest feasible date. On December 11, 2018 the Ventura County Air Pollution Control Board approved an expedited rule adoption schedule. This expedited schedule includes a tentative adoption date deadline of December 1, 2019 for amendments to Rule 74.23, Stationary Gas Turbines.

Staff conducted an assessment of BARCT for stationary gas turbines. BARCT is defined in the CHSC Section 40406 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." Consistent with state law, BARCT emission limits take into consideration environmental impacts, energy impacts, and economic impact. In addition to NOx reductions sought in the proposed amended rule, other potential environmental effects of the proposed rule were evaluated through the California Environmental Quality Act (CEQA) process.

BARCT emission limits for stationary gas turbines were determined by examining the recently amended Rule 1134 of SCAQMD, a neighboring air quality management district, and comparing their newly established limits with permitted facilities in Ventura County.

All facilities, subject to Rule 74.23, which currently have permitted emission limits exceeding the proposed lower limits were reviewed for feasibility of emission reductions and cost-effectiveness in the rule development process.

#### NOx Emission Sources

NOx emissions from stationary gas turbines permitted prior to 1995 are regulated by VCAPCD's current Rule 74.23, Stationary Gas Turbines. Under Rule 74.23, the NOx emission concentration limits are determined by turbine size, efficiency, and fuel used as shown in Table 1.

Table 1 Current Rule 74.23 NOx Concentration Limits

Unit Rating	Gaseous Fuel	Liquid Fuel
Megawatts (MW)	NOx Emissions (ppmv)	NOx Emissions (ppmv)
0.3 to <2.9	42	65
2.9 to <10.0	25 x E/25	65
>10.0 with SCR	9 x E/25	25 x E/25
>10.0 without SCR	15 x E/25	42 x E/25
4.0 and up, less than 877 hours per calendar year	42	65

Staff examined all current stationary gas turbines located in VCAPCD. Emission limits are established at the time of permitting, which include concentration limits for NOx, ammonia if utilizing SCR as an add-on control, and other criteria pollutants as applicable. All permitted stationary gas turbines within the District are a simple-cycle design, with some units utilizing the heat from the exhaust for various industrial processes. This excludes the use of exhaust heat to power a secondary steam turbine unit. The status of VCAPCD permitted turbines are as follows: one turbine is shut down, one turbine is permitted at 2

ppmv NOx, five turbines are permitted at 2.5 ppmv NOx, and the remaining four turbines have NOx emission limits between 9 and 24 ppmv. Nine turbines are utilizing SCR systems to control NOx emissions. Seven of these turbines have an ammonia emission limit at 20 ppmv and two turbines have ammonia emission limits of 5 ppmv. All concentrations are referenced at 15% oxygen, dry, at standard atmospheric conditions. Table 2 lists information regarding all permitted stationary gas turbines.

Table 2 VCAPCD Permitted Stationary Gas Turbines

Manufacturer	Model	MW	Number of Units	Emissions Controls	Permitted NOx Emission Limit (ppmv*)	Actual Annual NOx Emissions (TPY)	Ammonia Permit Limit (ppmv*)
General Electric	LM-2500	22.7	1	Water Injection	24	67.09	N/A
General Electric	LM-2500	29	1	Steam Injection & SCR	12	42.00	20
General Electric	LM-2500	21.5	1	SCR with steam injection	9	18.69	20
General Electric	Saturn	0.847	1	SCR & Oxidation catalyst	9	0.00**	20

General Electric	LM-6000	49.9	1	SCR & Oxidation catalyst	2.5	18.94	20
Allison	501-K	4	3	SCR with water injection	2.5/5***	1.80	20
General Electric	LM-6000	49.9	1	SCR & Oxidation catalyst	2.5	1.98	5
General Electric	LM-6000	48	1	SCR & steam injections	2	4.63	5
N/A	N/A	143	1	Shutdown	0	0.00	N/A

\*All concentrations referenced at 15% oxygen, dry, and at standard atmospheric conditions

\*\*Turbine has not been operational for the past 5 years

\*\*\*Turbine permitted emission of 2.5 ppmv when operating >30% capacity, 5 ppmv when operating <30% capacity

#### Initial BARCT Emission Limits and Other Considerations

The recommendation for the NOx BARCT emission limits are established using information gathered from existing VCAPCD Regulations, existing permitted units in the District, regulatory requirements for other air districts, and the technology assessment. Both retrofit and new installations are considered. Once the initial limits are established, a cost-effectiveness determination is made at that initial limit. If the initial limit is not cost-effective, an alternative limit may be recommended. Unique circumstances are taken into consideration to distinguish alternative limits, provide alternative means for emission reductions, or to create provisions in the rule to address equipment where retrofit or replacement would otherwise not be cost-effective.

#### Pre-Combustion NOx Emission Control Technologies

Dry low-NOx combustors are designed to pre-mix gaseous fuel and compressed air prior to combustion to minimize localized hot zones, which produce elevated combustion temperatures. The pre-mixed fuel blend results in more evenly distributed heat which reduces NOx formation. The combustion is in a staged process, which utilizes thorough mixing of a fuel-lean mixture upstream of the combustor. Twice as much air is supplied as is stoichiometrically required to burn the fuel. The excess air prevents the high temperatures which result in thermal NOx formation. This technology has demonstrated NOx

emissions as low as 9 ppmv at 15% oxygen, dry, without any other controls. This technology is not available as a “retrofit” technology and the turbine must be specifically designed for such application.

Water or steam injection is an alternative pre-combustion emission control technology that is currently available. Demineralized water is injected into the combustor through the fuel nozzles to lower flame temperature and reduce NOx emissions. The resulting steam provides a heat sink which lowers flame temperature. However, there is difficulty in achieving a homogeneous mixture resulting in hot zones, in turn resulting in NOx formation, so this control method is not as effective as the previously mentioned dry low-NOx combustor technology. Even then, NOx levels in natural gas turbines can be lowered by 80% to 25 ppmv at 15% oxygen on a dry basis. The addition of water increases the mass flow resulting in a small amount of additional power. Water and steam injection increase carbon monoxide emissions and there is an added cost to demineralize the water used. Turbines using water or steam injection have increased maintenance cost due to accelerated erosion and wear. Many turbines in VCAPCD utilize this control technology already.

#### Post-Combustion NOx Emission Control Technology

Selective Catalytic Reduction (SCR) is the primary post-combustion technology for NOx reduction and is widely used in turbines. SCR can reduce NOx emissions by 95% or greater. In many cases, the NOx reduction is limited by the release of other

pollutants (ammonia and carbon monoxide), space constraints, or by reaching the practical limit of the NOx measuring device. Further reductions may be possible by increasing the surface area of the catalyst by adding catalyst modules with higher pore density. Most turbines in VCAPCD would require construction to increase the available space for additional catalyst modules.

Ammonia is injected into the flue gas upstream of the catalyst beds and reacts with NOx to form nitrogen and water. Catalysts are made from ceramic materials and active catalytic components of base metals, zeolites, or precious metals. The catalyst may be configured into plates, but many new systems are configured into honeycombs to ensure uniform dispersion and reduce ammonia emissions (ammonia slip) to below 5 ppmv. The reductant, ammonia, is available as anhydrous ammonia, aqueous ammonia, or urea. There are benefits and drawbacks for each

source of ammonia; most notably, anhydrous ammonia is toxic, and urea requires conversion to ammonia prior to injection.

SCR catalysts have optimum operating temperatures between 400°F and 1075°F. During start-up and shutdown, the temperature will be below optimal range greatly reducing the effectiveness. Thus, NOx concentration limits are not applicable during start-up or shutdown.

Catalysts are susceptible to “poisoning” if the flue gas contains certain contaminants. These include sulfur compounds, particulates, reagent salts, or siloxanes; contaminants which are readily found in landfill gas, sewage digester gas, and other biogases. However, all affected turbines in Ventura County operate on Public Utilities Commission (PUC) quality gas and will not require mitigation for catalyst poisoning.

### PROPOSED AMENDMENTS TO RULE 74.23

#### Applicability (Section A)

The proposed amendments include clarification of the rule applicability to more effectively define the minimum size for gas turbines which will be affected by Rule 74.23, improving rule clarity.

#### Emission Requirements (Section B)

Sunsetting dates were added to Section B.1, and B.2, formerly B.4. Section B.3 provides emission limits for turbines after the sunseting date of December 31, 2023. Effective January 1, 2024, the new NOx limit for stationary gas turbines operating on natural gas will be 2.5 ppmv at 15% oxygen and standard atmospheric conditions. Ammonia slip is also proposed to be lowered to 10 ppmv at standard conditions from all stationary gas turbines. The summary of proposed emission limits is summarized in Table 3. These limits are based on the NOx and ammonia limits established by the District’s BARCT emission evaluation and supersedes any requirements outlined in Section B.1 and B.4 in the current version of Rule 74.23. No limits are being proposed for field gas and landfill gas as no existing turbines in the District utilize any of those fuels and any new units are subject to Rule 26, New Source Review’s Best Available Control Technology (BACT) requirements.

Section B.4 was created to clarify requirements of an annual source test for all units subject to Rule 74.23 emission limits, and annual Relative Accuracy Test

Audits (RATA) for all turbines with continuous emission monitoring systems (CEMS).

Table 3 Proposed Emission Limits for Stationary Gas Turbines

Fuel type	NOx (ppmv)	Ammonia (ppmv)
Liquid Fuel	30	10
Natural Gas	2.5	10
Digester Gas	9	10

Section B.5, formerly B.2, clarifies District requirements for installation, operation, and maintenance of monitoring equipment. Turbines with no CEMS will be required to perform bi-annual source tests to correlate operating system parameters with measured NOx emissions and require availability of operating system records for any regulatory agency to use and determine compliance. A clarification for the clause requiring Air Pollution Control Officer (APCO) approval for all monitoring equipment was made to improve rule clarity.

Section B.6, formerly B.3, outlines the requirement of a compliance plan which must be submitted to the District by January 1, 2021. Information in the plan will include turbine information, NOx control system

proposed, and a compliance schedule. Alternatively, if the cost of compliance exceeds the District's BARCT cost-effectiveness threshold, a facility may elect to produce equivalent emission reductions at an equal or lesser dollar amount per ton reduced at its' own site or at any other nearby sites as approved by the APCO. These equivalent emission reductions are in lieu of retiring marketable Emission Reduction Credits (ERC), and must be real, quantifiable, permanent, enforceable, and surplus as required by the CHSC Section 40920.6(e). This alternative is required pursuant to CHSC Section 40920.6(f).

District offers facilities electing to comply with this alternative option to provide the District with the funds needed to produce these equivalent emission reductions in the communities where the source is located, specifically if the area is identified as low income and/or a disadvantaged community. The equivalent amount calculated is based on the cost of ERC needed to produce equivalent emission reductions as approved by the APCO. District will only use funds obtained by this alternative to reduce emissions within the community that would have experienced a benefit from retrofitting the unit subject to the BARCT limit, through a public outreach process.

Section B.7, formerly section B.4, extends a higher emission limit for one (1) smaller GE LM-2500 turbine located at P&G, which was incorporated into the original Rule 74.23 language in 1995. The reasons for the continuance of an exemption are due to the following:

1. Space limitations: The LM-2500 turbine is located inside the facility, where turbine exhaust is used in paper manufacturing. A portion of the hot air duct system is located on the roof above the turbine and adjacent areas; both staff and P&G believe this the best place for an SCR unit. Also, because of the centralized location of the turbine within the plant, plant operation will be significantly disrupted during SCR construction.
2. Process disruption: The installation of an SCR would disrupt the exhaust which is routed to various processes in paper manufacturing. To compensate for the disruption of an SCR system being installed, other retrofits would add additional capital costs.

3. Installation cost: Due to the location of the proposed SCR catalyst, it would add an additional cost by opening the roof and utilize special equipment to hoist the SCR and auxiliary ducting. Of the control technologies available, the high temperature SCR was the most cost-effective alternative. However, the high-temperature SCR would also require more frequent catalyst replacement and has a higher cost for each instance of catalyst replacement. The increased weight of the post-combustion control equipment will likely require retrofits to the structure to support the heavy SCR equipment.

The unique circumstances for this specific turbine complying using the high temperature SCR alternative would result in a cost-effectiveness of between \$20.15 and \$24.85 per pound of NOx reduced, which exceeds Districts threshold of \$9 per pound of NOx. Other options evaluated had higher cost-effectiveness values. In lieu of complying with the proposed lowered NOx limits, P&G has proposed an alternative compliance option that produce equivalent emission reductions to the affected community, pursuant to CHSC Section 40920.6(f). To comply with this option, P&G will provide District with the funds needed to produce equivalent emissions reductions in the near communities, specifically if the area is identified as low income/disadvantage community. The amount of the fund is calculated based on the cost of ERC needed to reduce equivalent emissions reductions as approved by APCO. District will use this fund to reduce emissions within the community that would have experienced a benefit from retrofitting the unit subject to BARCT limit, through a public outreach. This is in compliance with CHSC requirements, as an "alternative means of producing equivalent emission reductions at an equal or lesser dollar amount per ton reduced." and this alternative complies with CHSC Section 40914(b)(1) requirements as confirmed by California Air Resource Board (CARB).

Section B.8 provides a separate emission limit for a specific set of turbines operating on Platform Gail, located in the Outer Continental Shelf (OCS) territory. Platform Gail has three (3) 4.0 MW Allison natural gas turbines with diesel as a backup fuel source. The turbines have a permitted NOx emission limit of 5 ppmv at 15% oxygen on a dry basis while operating at under 30% capacity and a 2.5 ppmv NOx limit at 15% oxygen, dry, when above 30% capacity. Platform Gail has entered a decommissioning phase, with turbine use expecting to permanently cease

within approximately 8 years. While in this decommissioning phase, only one turbine operates at a time, and at loads less than 30%, which results in annual emissions of less than 5 tons per year. Due to the anticipated sunsetting date, the minimal emission reductions, and the high cost of retrofit, the District proposes to not require these units to meet the lower emission limits proposed in amendments to this rule.

Section B.9 provides a separate emission limit for an LM-2500 turbine located at New-Indy. This turbine is rated at 29.0 MW and is fired only on natural gas. The turbine utilizes steam injection and SCR for NOx reduction and currently has a permitted NOx emission limit of 12 ppmv at 15% oxygen on a dry basis and an ammonia slip of 20 ppmv. The estimated cost of compliance to meet 2.5 ppmv NOx is \$21 per pound of NOx which is more than the current cost effectiveness threshold of \$9 per pound and exceeds the proposed increased threshold of \$19.50 per pound. District has made the determination that if New-Indy retrofits its' LM-2500 to meet the 5 ppmv NOx limit, which results in a NOx reduction of 24.5 TPY, they will satisfy the BARCT requirements.

Section B.10 provides increments of progress as guidance for turbines owners required to comply with lower emission limits. By July 1, 2022, VCAPCD must receive an Authority to Construct application, by January 1, 2023, equipment installation or modification must begin, and by January 1, 2024, or before operations resume after that date, turbine owners must demonstrate compliance with proposed emission limits.

#### Exemptions (Section C)

Section C.1.d provides a clarification for the exemption of rule requirements for turbines in emergency operation. Emergency operation is limited to 200 hours per calendar year and only in the event of force majeure emergencies. This is consistent with the Environmental Protection Agency's recommendation during the rule development process.

#### Recordkeeping Requirements (Section D)

Recordkeeping requirements were amended, requiring that records be maintained for 5 years

instead of 2 years. This is consistent with the Environmental Protection Agency's recommendation during the rule development process.

#### Test Methods (Section F)

Section F.3 outlines standard reference conditions to include the lower proposed emission limit requirements.

Section F.4 updates the ASTM testing methods used to determine the heating value of fuels and adds RATA test methods for turbines which have CEMS equipment installed.

#### Violations (Section G)

Section G.3 includes language which clarifies requirements for units which exceed hourly requirements of sections B.1 for turbines with a rated output equal to or greater than 4.0 MW that operates less than 877 hours per calendar year, and C.1.c which provide an exemption to rule requirements for turbines operating less than 200 hours per calendar year.

#### Definitions (Section H)

Three definitions were added to the Definitions (Section H) portion of Rule 74.23 as part of the proposed amendments. The newly included definitions are as follows:

- "Best Available Retrofit Control Technology" or "BARCT": 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 40406).
- "Outer Continental Shelf Area (OCS)": Any offshore waters for which the District has been designated the corresponding onshore area by the U.S. Environmental Protection Agency, Anacapa Island, and San Nicolas Island.
- "TPY": Tons per year.

## COMPARISON OF PROPOSED RULE REQUIREMENTS WITH OTHER AIR POLLUTION CONTROL REQUIREMENTS

CHSC Section 40727.2 requires Districts to compare the requirements of a proposed revised rule with other air pollution control requirements. These other air pollution control requirements include federal New Source Performance Standards (NSPS), BACT, and any other District rule that applies to the same equipment.

A summary of other air pollution control requirements is presented in Table 4. All proposed

NOx limits are as or more stringent than either the federal standards or neighboring district requirements. A review of current BACT determinations from SCAQMD and CARB indicated that BACT for this source category is based on existing SCAQMD Rule 1134. In summary there are no conflicts between proposed amendments to Rule 74.23 and any other pertinent air pollution control regulations.

Table 4 Comparison of Proposed Rule Requirements

Turbine Size Category	NSPS for Modified Turbine	NSPS for New Turbines	SJVAPCD Rule 4703	SCAQMD Rule 1134	VCAPCD Proposed Rule 74.23
> 2 MW and < 10 MW			25 ppmv NOx	2.5 ppmv NOx	2.5 ppmv NOx
<= 15MW	150 ppmv NOx	42 ppmv NOx			2.5 ppmv NOx
> 10 MW			3 ppmv NOx	2.5 ppmv NOx	2.5 ppmv NOx
> 15MW and <= 250 MW	42 ppmv NOx	25 ppmv NOx			2.5 ppmv NOx

All limits are referenced at 15% oxygen, dry, at standard atmospheric conditions.

### IMPACTS OF THE PROPOSED RULE

#### NOx Emissions Impacts

Of the six (6) turbines with permitted NOx emissions which exceed the proposed limit of 2.5 ppmv, three (3) are located in OCS territory and will have a higher limit of 5 ppmv, one (1) is expected to limit annual operation to less than 200 hours which will be enforced through a permit condition, and will therefore be exempt to rule emission limit requirements, and one (1) turbine's cost of compliance exceeds District's cost-effectiveness thresholds and will elect to produce alternative emission reductions pursuant to section B.6.d. One (1) Unit is expected to comply with reduced emission limits, which is estimated to result in NOx emission reductions of 24.5 tons per year. The emission reductions are summarized in Appendix A - Gas Turbines in Service in 2019.

These reductions from this source category are significant, and all emission reductions are needed to reach the federal and state ambient ozone air quality

standards. Requiring retrofit for the remaining turbine to upgrade their SCR system is feasible and cost-effective to control NOx emissions.

#### Cost-Effectiveness

VCAPCD Staff calculated cost-effectiveness with estimates provided by affected facilities and as calculated using Environmental Protection Agency's (EPA) Air Pollution Control Cost Estimation Spreadsheet for Selective Catalytic Reduction. Staff estimated NOx emission reduction using annual fuel usage and the reported emission concentrations. Estimations used an equipment lifespan of 30 years and the capital recovery factor used 6% real interest to estimate annual cost of compliance. Using these variables, staff calculated the cost-effectiveness for the one (1) LM-2500 turbine to be \$4.75 per pound of NOx reduced, or \$9,500 per ton of NOx per year with 24.5 tons per year of NOx reduction. This is below the District's current cost-effectiveness threshold of \$9 per pound of NOx.

### Incremental Cost-Effectiveness Analysis

CHSC Section 40920.6(a) requires districts to identify one or more potential control options, assess the cost-effectiveness of those options, and calculate the incremental cost-effectiveness. CHSC Section 40920.6 also requires an assessment of the incremental cost-effectiveness for proposed regulations relative to ozone, carbon monoxide (CO), sulfur oxides (SO<sub>x</sub>), nitrogen oxides (NO<sub>x</sub>) and their precursors.

Incremental cost-effectiveness is defined as the difference in control costs divided by the difference in emission reductions between two potential control options achieving the same emission reduction goal of a regulation.

An incremental cost-effectiveness analysis was performed by SCAQMD in their 2019 rule analysis for Rule 1134, NO<sub>x</sub> Emissions from Stationary Gas Turbines. The alternative control option for stationary gas turbines identified in their evaluation was to eliminate the low-use exemption for turbines that operate at less than ten percent of their annual capacity. The estimated incremental cost-effectiveness calculated by SCAQMD staff for this alternative was \$343.50 per pound of NO<sub>x</sub> reduced. The high cost of this alternative control option disqualifies it as a cost-effective control measure. For that reason, the proposed rule amendments do not eliminate VCAPCD's low-use exemption.

### Socio-Economic Impact

The provisions of Section 40728.5 of the California Health and Safety Code requires a socioeconomic impact analysis whenever the air quality or emissions limitations will be significantly affected. The Board must evaluate the following socioeconomic information on proposed revisions to Rule 74.23.

- (1) The type of industries or businesses, including small business, affected by the rule or regulation.

The amendments to this rule may directly affect the following facilities:

- Electricity generation
- Sanitary paper product manufacturing
- Paperboard mill
- Crude oil production
- Specialty food/spice manufacturing

- (2) The impact of the rule amendments on employment and the economy of the region.

Revisions to this rule are not expected to have a negative impact on either employment or the economy of Ventura County. Worst-case cost estimates for the end user are not significant enough to impact employment.

- (3) The range of probable costs, including costs to industry or business, including small business, of the rule or regulation.

Based on staff analysis, the probable cost-effectiveness of \$4.75 per pound of NO<sub>x</sub> reduced may be expected when requiring retrofit on turbines to utilize updated SCR control equipment. Since this rule only impacts a few existing turbines owned and operated by large corporations, the proposed amendments will have no impact on small business.

- (4) The availability and cost-effectiveness of alternatives to the rule or regulation being proposed or amended.

Proposed revisions to Rule 74.23 implement the most cost-effective control options, which involves the use of SCR control equipment with greater designed efficiency. Other control alternatives, such as removing the exemption for low-use turbines are not cost-effective for this source category.

- (5) The emissions reduction potential of the rule.

The anticipated emission reduction potential of the proposed rule is approximately 24.5 tons of NO<sub>x</sub> per year. These emission reductions result from increased efficiency of modern SCR technology.

- (6) The necessity of adopting, amending, or repealing the rule or regulation in order to attain state and federal ambient air standards pursuant to Chapter 10 (commencing with Selection 40910).

Ventura County is classified as a nonattainment area for both the state and federal Ambient Air Quality Standards for

ozone. These proposed rule amendments will reduce NOx emissions which are precursors to the formation of ozone. According to the District's 2016 AQMP, these emissions reductions will help the

District in its effort to attain the standards. CHSC Section 40914(b)(2) requires that the District adopt every feasible measure to reduce ozone precursors.

### ENVIRONMENTAL IMPACTS OF METHODS OF COMPLIANCE

California Public Resources Code Section 21159 requires the District to perform an environmental analysis of the reasonably foreseeable methods of compliance. The analysis must include the following information on proposed amendments to Rule 74.23

- (1) An analysis of the reasonably foreseeable environmental impacts of the methods of compliance.
- (2) An analysis of the reasonably foreseeable mitigation measures.
- (3) An analysis of the reasonably foreseeable alternative means of compliance with the rule or regulation.

All reasonably foreseeable compliance methods, the environmental impacts of those methods, and measures that could be used to mitigate the environmental impacts are summarized in Table 5 below.

Table 5 Environmental Impacts and Mitigations of Methods of Compliance

<b>Compliance Methods (including all reasonably foreseeable alternative means of compliance)</b>	<b>Reasonably Foreseeable Environmental Impacts</b>	<b>Reasonably Foreseeable Mitigation Measures</b>
Increased Utilization of Selective Catalytic Reduction Technology	Air Quality Impacts: Increased use of SCR technology may result in increased ammonia emissions.	Staff recommended reducing ammonia slip limit to reduce impacts of increased emissions.
Increased Utilization of Selective Catalytic Reduction Technology	Solid Waste Disposal: More frequent catalyst replacement may result in more solid waste.	Ammonia limits were increased from the proposed 5 ppmv to 10 ppmv to result in less frequent catalyst replacement.
Shut-Down of Turbine Units	Air Quality Impacts: May result in greater emissions from other equipment offsetting production requirements.	Cost-effectiveness was used to determine viability of lowered NOx limits for each individual unit.
Shut Down of Business	Air Quality Impacts: May result in increased emissions from mobile sources as imports increased.	Cost-effectiveness was used to determine viability of lowered NOx limits for each individual unit.

This analysis demonstrates that the adoption of amendments to Rule 74.23 will not have a significant effect on the environment due to unusual circumstances.

## References

“Final 2016 Ventura County Air Quality Management Plan”, Ventura County Air Pollution Control District, February 2017

“Staff Report Proposed Rule 74.23 Stationary Gas Turbines”, Ventura County Air Pollution Control District, February 1995.

“Final Staff Report - Revisions to Rule 74.23 Stationary Gas Turbines”, Ventura County Air Pollution Control District, May 2001.

“Original 1995 staff report Alternative Control Techniques Document— NOx Emissions from Stationary Gas Turbines EPA”, Environmental Protection Agency, January 1993.

“Standards of Performance for Stationary Gas Turbines; Standards of Performance for Stationary Combustion Turbines”, Environmental Protection Agency, August 2012.

“Proposed Amended Rule 1134 – Emissions of Oxides of Nitrogen from Stationary Gas Turbines”, South Coast Air Quality Management District, March 2019.

“Rule 4703 Stationary Gas Turbines”, San Joaquin Valley Air Pollution Control District, September 2007.

Appendix A

Gas Turbines in Service in 2019

Permitted NOx Limits and Proposed NOx Limits

Manufacturer	Model	MW	Fuel	Emissions Controls	Permitted NOx Emission Limit (ppm)	Actual Annual NOx Emissions (tpy)	Proposed NOx Limit (ppm)	Proposed NOx Emissions (tpy)	Proposed NOx Reductions (tpy)
N/A	N/A	143	Natural Gas	Shutdown	0	0.00	0	0.00	0.00
General Electric	LM-6000	49.9	Natural Gas	SCR & Oxidation catalyst	2.5	18.94	2.5	18.94	0.00
General Electric	LM-2500	22.7	Natural Gas	Water Injection	24	67.09	24	67.09	0.00*
General Electric	LM-2500	29	Natural Gas	Steam Injection & SCR	12	42.00	5	17.50	-24.50
General Electric	LM-6000	48	Natural Gas	SCR & steam injections	2	4.63	2	4.63	0.00
General Electric	LM-2500	21.5	Natural Gas	SCR with steam injection	9	18.69	9	18.69	0.00
Allison**	501-K	4	Natural Gas and Diesel	SCR with water injection	2.5/5***	1.80	2.5/5***	1.80	0.00
General Electric	Saturn	0.85	Natural Gas	SCR & Oxidation catalyst	9	0.00	2.5	0.00	0.00
General Electric	LM-6000	49.9	Natural Gas	SCR & Oxidation catalyst	2.5	1.98	2.5	1.98	0.00
Total						155.13	Total	130.63	-24.50*

\*Estimated reduction of up to 74.2 TPY based on funding other projects which reduce emissions in neighboring community as it becomes available

\*\*Three identical turbine units permitted for facility

\*\*\*Turbine permitted emission of 2.5 ppmv when operating >30% capacity, 5 ppmv when operating <30% capacity