

Staff Report

Rule 3.22: Stationary Internal Combustion Engines

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Feather River AQMD

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1.0 Executive Summary:

Feather River Air Quality Management District (District) is a Bi-County agency that administers local, state, and federal air quality management programs for Yuba and Sutter counties. Under the provisions of the California Clean Air Act (CCAA) of 1988, Yuba County and the northern portion of Sutter County have been designated as “nonattainment-transitional” for failing to meet the state ozone standard. The southern portion of Sutter County is designated as “severe” nonattainment for failing to meet the state ozone standard¹. The southern portion of Sutter County, is also designated as a moderate nonattainment area for the 2015 8-hour ozone national ambient air quality standard (NAAQS) effective August 3, 2018².

Ozone is formed when volatile organic compounds (VOCs) react with nitrogen oxides (NOx) in the presence of sunlight and is one component of smog. It is a strong irritant that attacks the respiratory system and leads to the damage of lung tissues. Exposure to ozone aggravate asthma, bronchitis and maintain the state ambient air quality standard ozone.

Assembly Bill 617 amends California Health and Safety Code (HSC) section 409020.6. The changes require each air district that is a nonattainment area for one or more air pollutants to adopt an expedited schedule for implementation of best available retrofit control technology (BARCT) by December 31, 2023 for industries subject to the GHG Cap-and-Trade requirements.

The proposed amendments to Rule 3.22 would lower the NOx emission limits effective December 31, 2023 for natural gas spark ignited ICE used as a prime power source. The proposed amendments include minor formatting and editing for clarity.

2.0 Background:

Stationary internal combustion engines are typically used as either primary or backup engines to generate electricity or power pumps and compressors. These engines may be fueled by diesel, natural gas, propane (LPG), refinery fuel gas, digester gas, or landfill gas. Some final products of combustion include nitrogen oxides (NOx), volatile organic compounds (VOCs), carbon monoxide (CO), and particulate matter (PM10 and PM2.5), which are all discharged into the atmosphere. NOx and VOCs are recognized as precursors to ground-level ozone formation, and reductions in NOx and VOCs are necessary to attain and maintain the federal and state ambient air quality standard for ozone. Ozone can result in reduced lung function, increased respiratory symptoms, increased airway hyperactivity, and increased airways inflammation. Emissions of VOCs also react in the atmosphere to form PM10 and PM2.5. Inhalation of PM10 and PM2.5 deep into lungs reduces human pulmonary function.

The District originally adopted Rule 3.22 in 2009 to achieve reasonable emission reductions from internal combustion engines to help attain the state and federal ambient air quality standard for ozone. The rule was consistent among the Northern Sacramento Valley Air Basin Districts, where emission standards are based on CARB’s document Determination of

¹ <https://ww2.arb.ca.gov/resources/california-ambient-air-quality-standards>

² Additional Air Quality Designations for the 2015 Ozone National Ambient Air Quality Standards, 83 FR 25776, June 4, 2018.

Reasonably Available Control Technology (RACT) and Best Available Retrofit Control Technology (BARCT) for Stationary Spark-Ignited Combustion Engines [November 2001].

Different emission limits were set for North and South FRAQMD based on their attainment statuses. South FRAQMD was given stricter emission limits due to the designation as a federal ozone nonattainment area with a severe classification for the 1997 and 2008 ozone NAAQS. The emission limits set for South FRAQMD are considered to meet BARCT requirements.

The District submitted Rule 3.22 to the SIP, and on March 1, 2012, the US EPA finalized a Limited Approval/Limited Disapproval for the rule. The US EPA could not fully approve the rule because one section allowed for alternate testing procedures for NO_x analyzers to be approved by the Air Pollution Control Officer (APCO). The US EPA noted that this section did not have sufficient Quality Assurance/Quality Control requirements. The rule was amended on October 6, 2014 and was approved by the US EPA in December 2014.

In 2018, the District published a Proposed Expedited BARCT Schedule for Industrial Facilities Subject to Cap and Trade. The report evaluated the requirements of AB 617 and proposed to amend rule 3.22 during the calendar year of 2020. The changes proposed lowering the acceptable emission limit of NO_x for spark ignited prime engines to BARCT requirements.

3.0 Legal Mandate:

Assembly Bill 617 (AB 617) was approved on July 26, 2017, and amends California Health and Safety Code section 409020.6. The changes require each air district that includes a nonattainment area for one or more air pollutants, to adopt an expedited schedule for implementation of best available retrofit control technology (BARCT) by December 31, 2023.

The requirement applies to each industrial source subject to a market-based compliance mechanism, as of January 1, 2017. The District has facilities subject to the California Greenhouse Gas (GHG) Cap-and-Trade requirements which is considered a market-based compliance mechanism. These facilities have natural gas spark ignited internal combustion engines (ICE) used as a prime power source for natural gas compressors and are subject to the expedited BARCT requirements of AB 617. In addition, the facilities include natural gas production equipment such as natural gas dehydrators, condensate tanks, injection wells, and associated equipment. This equipment is subject to the requirements of the Greenhouse Gas Emission Standard for Crude Oil and Natural Gas Facilities and is already implementing BARCT for LDAR requirements. Therefore, the District's requirements under AB 617 to implement BARCT apply to only the natural gas spark ignited ICE used as a prime power source.

Yuba County and the northern area of Sutter County are designated as "nonattainment-transitional" for the state ozone standard. HSC §40925.54 requires the District to adopt a control measure that will use RACT for all existing stationary sources in these areas.

HSC §40914 requires the District's demonstrate that the plan includes "every feasible measure" to control emissions. All feasible control measures are those which have the most effective regulatory emissions standards demonstrated in California's air districts.

4.0 Proposed Rule Requirements:

The proposed amendments will require BARCT for natural gas spark ignited ICE by lowering the NO_x emissions thresholds and make minor editing and formatting changes.

Table 1 – Summary of Proposed Amendments

SECTION NUMBER	PROPOSED LANGUAGE
Section C.6	Add definition for Natural Gas Powered Engine
Section D.1 Table 3	Add table with new emission limits for Natural Gas Powered Engines
Rule 3.22 – All	Minor formatting and editing

The BARCT emission limits were based on CARB’s Determination of Reasonably Available Control Technology (RACT) and Best Available Retrofit Control Technology (BARCT) for Stationary Spark-Ignited Combustion Engines [November 2001]. A table from the report is listed below with the emission limits for rich and lean burn engines. This is CARB’s current determination of BARCT for rich and lean burn engines.

Table II-2				
Summary of BARCT Standards for Stationary Spark-Ignited Internal Combustion Engines				
Spark-Ignited Engine Type	% Control of NO_x	ppmv at 15% O₂¹		
		NO_x	VOC	CO
Rich-Burn				
Waste Gas Fueled	90	50	250	4,500
Cyclically-loaded, Field Gas Fueled	--	300	250	4,500
All Other Engines	96	25	250	4,500
Lean-Burn				
Two Stroke, Gaseous Fueled, Less Than 100 Horsepower	--	200	750	4,500
All Other Engines	90	65	750	4,500

1. For NO_x, either the percent control or the parts per million by volume (ppmv) limit must be met by each engine where applicable. The percent control option applies only if a percentage is listed, and applies to engines using combustion modification or exhaust controls. All engines must meet the ppmv VOC and CO limits.

Table 2 contains the proposed BARCT emission limits that would be effective 12/31/2023 for all spark ignited ICE used as prime power in Yuba and Sutter counties.

Table 2: Proposed Natural Gas Powered Engine Emission Limits Effective 12/31/2023

	NOx (ppmv @ 15% O ₂)	VOC (ppmv @ 15% O ₂)	CO (ppmv @ 15% O ₂)
Spark Ignited Rich Burn	25	250	4,000
Spark Ignited Lean Burn	65	750	4,000

The Technical Support Document from the US EPA for the 2014 rule amendment recommended lowering the emission limits to be consistent with South Coast Air Quality Management District Rule 1110.2. The emission limits of the South Coast rule are shown in Table 3.

Table 3 – South Coast Air Quality Management District Rule 1110.2 Emission Limits

NOx (ppmvd)	VOC (ppmvd)	CO (ppmvd)
11	30	70

The District did not adopt the lower emission limit of the South Coast Air Quality Management District as this region is designated an “extreme” ozone nonattainment area whereas the south Sutter County region of the Feather River Air Quality Management District is a “severe” ozone nonattainment classification. The District is only required meet BARCT emissions as specified in AB 617. No revisions were required in the EPA’s Technical Support Document.

5.0 Socioeconomic Impact:

California Health and Safety Code §40728.5 requires, in part, that:

“Whenever a District intends to propose the adoption, amendment or repeal of a rule or regulation that will significantly affect air quality or emissions limitations, that agency shall, to the extent that data are available, perform an assessment of the socioeconomic impacts of the adoption, amendment, or repeal of the rule or regulation.”

However, districts with a population of less than 500,000 persons are exempt from the provisions of HSC §4072.5(a). The District’s population is estimated to be approximately 166,892³ which is below the 500,000 person threshold. Therefore, a socioeconomic analysis for this rulemaking is not required.

³ <https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-total.html>

6.0 Emission Impacts of Proposed Rule:

The proposed amendments to Rule 3.22 will result in a reduction of NOx emissions for the District. The emission reductions have been summarized in Table 4 below. While the rule will initially be implemented in 2020, emission reductions will not be met until after December 31, 2023, when BARCT controls become mandatory. NOx reductions were the only criteria pollutant evaluated since VOC and CO emission limits already meet BARCT requirements.

Table 4 – Emission Impacts from Rule 3.22 Amendments

Current NOx Emissions for Effected Sources (tons/year)	Total NOx Emissions after BARCT Implementation (tons/year)	Potential NOx Emission Reductions (tons/year)
37.98	19.67	18.31

7.0 Estimated Cost Impact:

California HSC §40703 requires the District, in the process of the adoption of any rule or regulation, to consider and make public its findings related to cost effectiveness of the rule.

The reduction of NOx emissions from process equipment, such as internal combustion engines, is mainly accomplished through pre-combustion modifications and/or post-combustions exhaust controls. The application of a specific technique will depend on the type of engine, the characteristic of its primary fuel and method of firing. Table 5 presents a summary of these technologies and other feasible options that includes affected engine type, approximate effectiveness over uncontrolled emissions, cost estimates, and a general description.

Table 5 - Summary of NO_x Emissions Control Technologies for Stationary IC Engines

Control Technology	Engine Types	Effectiveness	Capital Costs	Description
Non-Selective Catalytic Reduction (NSCR)	Rich Burn Engines	NOX: >98% CO: >97% HC: >80%	\$50-200/bhp	Exhaust Control: Post combustion oxidation of HC & CO by O ₂ and NO _x over a catalyst (Usually a noble metal like platinum, rhodium, or palladium). The HC & CO are converted to CO ₂ and water, while NO _x is reduced to N ₂ .
Selective Catalytic Reduction (SCR)	Lean Burn Engines	NOX: >95% CO: >97% HC: >80%	\$135-510/bhp	Exhaust Control: Ammonia or urea injected in the exhaust before a catalyst. The HC & CO are converted to CO ₂ and water, while the NO _x is reduced to N ₂ .
Post Combustion Oxidation & Selective Non-Catalytic Reduction	CI, Lean Burn, and Rich Burn Engines	NOX: >90% PM: >60% CO: <10 ppm	\$30-155/bhp	Exhaust Control: <ul style="list-style-type: none"> • Non-Catalytic Oxidation of HC, PM, CO • Urea injected to reduce NO_x • Ammonia Slip (2ppm)
Lean + Derating	Rich and Lean Burn Engines	NO _x : >80%	n/a	Combustion Control: Increase the air -to-fuel ratio toward lean and derate or decrease the cylinder pressures and temperatures which reduces the power output of an engine. The lower pressure and temperature reduces NO _x , but may increase HC & CO.
Pre-Stratified Charge	Rich and Lean Burn Engines	NO _x : >80%	\$1250-1825/bhp	Combustion Control: Small amounts of air are introduced to the intake manifold create sequential fuel-rich and fuel-lean zone and rapid flame cooling in the fuel-lean zone.
Low-Emissions Combustion	Rich and Lean Burn Engines	NO _x : >80%	\$285/bhp	Combustion Control: Lean Burn combined with: <ul style="list-style-type: none"> • Ignited system improvement, • Turbocharging, aftercooling • Air/fuel ratio controller
Engine Replacement	CI, Lean Burn, and Rich Burn Engines	60-100%	Variable	For replacement with an electric motor, emissions are reduced 100% at the IC engine location. For replacement with a newer engine, emissions will drop drastically.

8.0 Environmental Review and Compliance:

The amendments of Rule 3.22 are categorically exempt from the California Environmental Quality Act (CEQA) under Sections 15307 and 15308 of the State CEQA guidelines and no exceptions to these exemptions apply. This exemption is allowed when the rule will help improve air quality in Yuba and Sutter county. California Public Resources Code (Section 21159) requires an environmental analysis of the reasonably foreseeable methods of compliance. The District has concluded that no reasonably foreseeable adverse environmental impacts will be caused by adoption of the proposed rule.

9.0 Required Findings:

California Health and Safety Code §40727(a) requires that prior to adoption or amending a rule or regulation, an air district's board must make findings of necessity, authority, clarity, consistency, nonduplication and reference. The findings must be based on the following:

1. Information presented in the District's written analysis, prepared pursuant to HSC §40727.2;
2. Information contained in the rulemaking records pursuant to HSC §40728; and
3. Relevant information presented at the Board's hearing for the rule.

The table below describes each finding and the basis for making the finding:

Required Finding	Finding Determination
<p>Necessity: The District must find that the rulemaking demonstrates a need exists for the rule of for its amendment or repeal. [HSC §40727(b)(1)]</p>	<p>It is necessary for the District to adopt the proposed amendments in order to meet the requirements of HSC 40920.6 by AB 617.</p>
<p>Authority: The District must find that a provision of law or of a state or federal regulation permits or requires the District to adopt, amend, or repeal the rule. [HSC §40727(b)(3)]</p>	<p>The District is authorized to adopt rules and regulations by HSC §40001, 40702, 40919, 41010, and 42300.</p>
<p>Clarity: The District must find that the rule is written or displayed do that its meaning can be easily understood by the persons directly affected by it. [HSC §40727(b)(3)]</p>	<p>The District has reviewed the proposed amendments and determined that they can be easily understood by the affected industry. In addition, the record contains no evidence that the persons directly affected by the rule cannot understand the rule.</p>
<p>Consistency: The rule is in harmony with, and not in conflict with or contradictory to, existing statues, court decisions, or state or federal regulations. [HSC §40727(b)(4)]</p>	<p>The proposed rule does not conflict with and is not contradictory to existing statutes, court decisions, or state or federal regulations.</p>

<p>Non-Duplication: The District must find that either: 1) The rule does not impose the same requirements as an existing site or federal regulation; or 2) that the duplicative requirements are necessary or proper to execute the powers and duties granted to, and imposed upon the District. [HSC §40727(b)(5)]</p>	<p>The proposed rule does not impose requirements that duplicate existing laws or regulations.</p>
<p>Reference: The district must refer to any statute, court decision, or other provision of law that the District implements, interprets, or makes specific by adopting, amending or repealing the rule. [HSC §40727(b)(6)]</p>	<p>References to statutes are noted where applicable.</p>

10.0 Rule Analysis:

Health and Safety Code section 40727.2 requires a written analysis comparing the proposed rules with existing federal regulations, state regulations, and any other AQMD existing or proposed rules and regulations that apply to the same source type.

Comparison of Proposed Rule 3.22 and Feather River AQMD Rules and Regulations

District Rules and Regulations	Does the proposed rule conflict or contradict any provisions?
Regulation 1 – General Provisions	No
Regulation 2 – Open Burning	No
Regulation 3 – Prohibition – Stationary Emissions Sources	No
Regulation 4 – Stationary Emission Sources Permit System and Registration	No
Regulation 5 – Hearing Board Procedures	No
Regulation 6 – Variances	No
Regulation 7 – Fees	No
Regulation 8 – Penalties and Abatement	No
Regulation 9 – Enforcement Procedures	No
Regulation 10 – New Source Review	No
Regulation 11 – Air Toxic Control Measure	No

Comparison of Proposed Rules and other Federal and State Regulations

Federal Regulations for spark ignited (SI) engines fall under the Code of Federal Regulations (CFR), Title 40, Part 60, Subpart JJJJ. Stationary SI engines located at a major source of a HAP or area source of a HAP are subject to the rule. The emission limits for the federal requirements

have been summarized in Table 6 and 7 below. The NOx emission limits for the proposed amendments to Rule 3.22 are more stringent than the federal regulations.

Table 6 NSPS emissions standards for SI stationary NG and lean burn LPG engines (25-100 hp)

BHP	Date of Manufacture	HC+NOx (g/hp-hr)	CO (g/hp-hr)
25 < bhp < 100	July 2008	2.8	4.8

Table 7 NSPS emissions standards for NG and lean burn LPG engines > 100 hp

Engine Type	Bhp	Date of manufacture	NOx ppmvd @ 15% O2	CO ppmvd @ 15% O2	VOC ppmvd @ 15% O2
SI Natural Gas	100 ≤ hp < 500	July 2008	160	540	86
		January 2011	82	270	60
SI lean burn natural gas	500 ≤ hp < 1350	January 2011	160	540	86
		January 2011	82	270	60
SI natural gas	hp ≥ 500	July 2007	160	540	86
		July 2010	82	270	60

There are no state regulations for stationary SI natural gas engines. Stationary natural gas engines are the only category of engines subject to the Rule 3.22 amendments.