SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Preliminary Draft Staff Report
Proposed Amended Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities

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EXECUTIVE SUMMARY

South Coast Air Quality Management District (South Coast AQMD) Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (Rule 1135), is an industry-specific rule which applies to electric generating units (i.e. boilers, turbines, engines, etc.) at investor-owned electric utilities, publicly owned electric utilities, or have a generation capacity of at least 50 Megawatts of electrical power for distribution in the state or local electrical grid system.

During the 2022 amendment of Rule 1135, stakeholders urged staff to conduct a Best Available Retrofit Control Technology (BARCT) analysis of electric generating units located on Santa Catalina Island emphasizing zero-emission (ZE) technologies. In response to stakeholder comments, staff performed a BARCT analysis with a focus on ZE and near-zero emission technologies to repower Santa Catalina Island.

Proposed Amended Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (PAR 1135) will establish oxides of nitrogen (NOx) emission limits for electric generating units located on Santa Catalina Island to reflect current BARCT. PAR 1135 includes monitoring, reporting, and recordkeeping requirements for electric generating units located on Santa Catalina Island. The proposed rule will also extend the compliance deadline for boilers and gas turbines to comply with Rule 1135 emission limits. A total of 133 electric generating units at 32 electricity generating facilities are potentially affected by PAR 1135.

The proposed BARCT limit is estimated to reduce NOx emissions at the electricity generation facility located on Santa Catalina Island by 69.7 tons per year, or 0.19 tons per day. PAR 1135 will partially implement Control Measure for Large Combustion Sources, L-CMB-06: NOx Emission Reductions from Electricity Generating Facilities, of the 2022 Air Quality Management Plan (2022 AQMP).[1]

PAR 1135 was developed through a public process. Four Working Group meetings were held on May 5, 2022, August 4, 2022, November 3, 2022, and January 19, 2023. Staff also reported on the progress of the BARCT assessment to the South Coast Air Quality Management District Stationary Source Committee on August 19, 2022. In addition, a Public Workshop will be held on February 22, 2023. Staff also conducted multiple site visits as part of this rulemaking process and has met numerous times with facility operators, technology vendors, and interested stakeholders.

[1] South Coast AQMD, 2022 AQMP, http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/final-2022-aqmp.pdf?sfvrsn=16

CHAPTER 1: BACKGROUND

INTRODUCTION

BACKGROUND

REGULATORY BACKGROUND

AFFECTED FACILITIES

PUBLIC PROCESS

INTRODUCTION

Proposed Amended Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (PAR 1135) applies to electric generating units at electricity generating facilities that are investor-owned electric utilities, publicly owned electric utilities, or have a generation capacity of at least 50 Megawatts of electrical power for distribution in the state or local electrical grid system. PAR 1135 is needed to update oxides of nitrogen (NOx) emission limits for electricity generating facilities located on Santa Catalina Island to reflect Best Available Retrofit Control Technology (BARCT).

BACKGROUND

The 2022 amendment of South Coast Air Quality Management District (South Coast AQMD) Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (Rule 1135) included a revision to the averaging time for diesel internal combustion engines located on Santa Catalina Island to demonstrate compliance with emission limits. Stakeholders commented that an updated BARCT assessment was warranted due to the change in averaging time and that the BARCT assessment should emphasize zero-emission (ZE) technologies. The adopted resolution directed staff to re-initiate rule development in 2022 that included a revised BARCT assessment for the electric generating units located on Santa Catalina Island with a specific focus on non-diesel alternatives and ZE and near-zero emission (NZE) technologies.

In December 2022, the South Coast AQMD adopted the 2022 Air Quality Management Plan (2022 AQMP)[1] which includes a series of control measures to achieve the 2015 8-hour ozone National Ambient Air Quality Standard. Control Measure for Large Combustion Sources, L-CMB-06: NOx Emission Reductions from Electricity Generating Facilities, of the 2022 AQMP focuses on assessing low NOx and ZE technologies for power generation, and specifically mentions the replacement of existing diesel internal combustion engines with lower-emitting technologies.

REGULATORY BACKGROUND

Rule 1135 was adopted in 1989 and applied to electric power generating steam boiler systems, repowered units, and alternative electricity generating sources. A NOx system-wide average emission limit and a daily NOx emissions cap was established for each utility system. Additionally, Rule 1135 required Emission Control Plans and continuous emissions monitoring systems (CEMS).

Rule 1135 was amended in December 1990 to resolve implementation and enforceability issues raised by the California Air Resources Board (CARB). This amendment included accelerated retrofit dates for emission controls, unit-by-unit emission limits, modified compliance plan and monitoring requirements, computerized telemetering, and an amended definition of alternative resources. Rule 1135 was amended again July 1991 to address additional staff recommendations regarding system-wide emission rates, daily emission caps, annual emission caps, oil burning, and cogeneration, along with outstanding issues related to modeling and BARCT analysis. The United States Environmental Protection Agency (U.S. EPA) approved Rule 1135 into the State Implementation Plan on August 11, 1998.

[1] South Coast AQMD, 2022 Air Quality Management Plan, http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/final-2022-aqmp.pdf?sfvrsn=16

When the REgional Clean Air Incentives Market (RECLAIM) program was adopted in 1993, electricity generating facilities were included in NOx RECLAIM with the exception of electricity generating facilities that were owned and operated by the City of Burbank, City of Glendale, and the City of Pasadena that were allowed to opt-in to the program. The cities of Burbank and Pasadena opted in to RECLAIM, while the City of Glendale remained regulated by command-and-control rules. In response to an increased demand for power generation and delayed installation of controls by electricity generating facilities, in May 2001, the South Coast AQMD Governing Board adopted the South Coast AQMD Rule 2009 – Compliance Plan for Power Producing Facilities (Rule 2009),[2] which required installation of BARCT through compliance plans at electricity generating facilities. As a result, much of the equipment at electricity generating facilities was retrofitted or replaced to meet lower NOx emission limits. Diesel internal combustion engines providing power to Santa Catalina Island were not subject to Rule 2009 because the facility did not qualify as a Power Producing Facility because its capacity was less than 50 Megawatts.

In 2018, Rule 1135 was amended to establish BARCT NOx limits which are needed to transition electric generating facilities in the RECLAIM program to a command-and-control regulatory structure and to implement Control Measure CMB-05: Further NOx Reductions from RECLAIM Assessment of the 2016 Air Quality Management Plan (2016 AQMP)[3] and Assembly Bill 617. The 2018 amendment expanded Rule 1135 applicability to all electric generating units at RECLAIM NOx, former RECLAIM NOx, and non-RECLAIM NOx electricity generating facilities. The amendment updated emission limits to reflect current BARCT levels and to provide implementation timeframes for boilers, gas turbines, and internal combustion engines located on Santa Catalina Island. Additionally, the amendment established provisions for monitoring, reporting, and recordkeeping, and exemptions from specific provisions.

Rule 1135 was amended on January 7, 2022, to remove ammonia limits, update provisions for Continuous Emission Monitoring Systems, reference South Coast AQMD Rule 429.2 – Startup and Shutdown Exemption Provisions for Oxides of Nitrogen From Electricity Generating Facilities[4] for startup and shutdown requirements, and revise requirements for diesel internal combustion engines on Santa Catalina Island. Staff was directed to re-initiate rule development to include a revised BARCT assessment for the electric generating units located on Santa Catalina Island with a specific focus on non-diesel alternatives and ZE and NZE technologies.

AFFECTED FACILITIES AND EQUIPMENT

The proposed amendments to Rule 1135 primarily impacts one electricity generating facility located on Santa Catalina Island. However, PAR 1135 also includes a revision to the compliance deadline for boilers and gas turbines to comply with Rule 1135 emission limits, which affects the remaining Rule 1135 universe. There are 133 units at 32 electricity generating facilities that are potentially impacted by PAR 1135. **Table 1-1** contains the equipment affected by PAR 1135.

[2] South Coast AQMD, Rule 2009, http://www.aqmd.gov/docs/default-source/rule-book/reg-xx/rule-2009-compliance-plan-for-power-producing-facilities.pdf?sfvrsn=4

[3] South Coast AQMD, 2016 AQMP, www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/final2016aqmp.pdf?sfvrsn=15

[4] South Coast AQMD, Rule 429.2, http://www.aqmd.gov/docs/default-source/rule-book/rule-iv/rule-429-2.pdf?sfvrsn=9

Table 1-1: PAR 1135 Affected Equipment

Equipment Type	Number of Units
Boilers	17
Combined Cycle Gas Turbines	26
Combined Cycle Gas Turbine-Associated Duct Burners	11
Diesel Internal Combustion Engines	6
Simple Cycle Gas Turbines	73

PUBLIC PROCESS

Development of PAR 1135 was conducted through a public process. Four Working Group meetings were held on May 5, 2022, August 4, 2022, November 3, 2022, and January 19, 2023. The Working Group is composed of representatives from businesses, environmental groups, public agencies, and consultants. The purpose of the Working Group meetings is to discuss proposed concepts and work through the details of South Coast AQMD's proposal. Staff also reported on the progress of the BARCT assessment to the South Coast AQMD Stationary Source Committee on August 19, 2022. Additionally, a Public Workshop will be held on February 22, 2023. The purpose of the Public Workshop is to present the proposed rule language to the general public and stakeholders and to solicit comment. Staff also conducted multiple site visits as part of this rulemaking process and has met with individual facility operators, technology vendors, and interested stakeholders.

CHAPTER 2: BARCT ASSESSMENT

INTRODUCTION

BARCT ANALYSIS APPROACH

Assessment of South Coast AQMD Regulatory Requirements

Assessment of Emission Limits for Existing Units

Other Regulatory Requirements

Assessment of Pollution Control Technologies

Initial BARCT Emission Limit and Other Considerations

Cost-Effectiveness and Incremental Cost-Effectiveness Analyses

BARCT Emission Limit Recommendation

INTRODUCTION

South Coast Air Quality Management District (South Coast AQMD) conducted an assessment of Best Available Retrofit Control Technology (BARCT) for electric generating units located on Santa Catalina Island. Staff will reevaluate BARCT for the remaining electricity generating facilities in the future to fully implement Control Measure for Large Combustion Sources, L-CMB-06: NOx Emission Reductions from Electricity Generating Facilities, from the 2022 Air Quality Management Plan (2022 AQMP).[1]

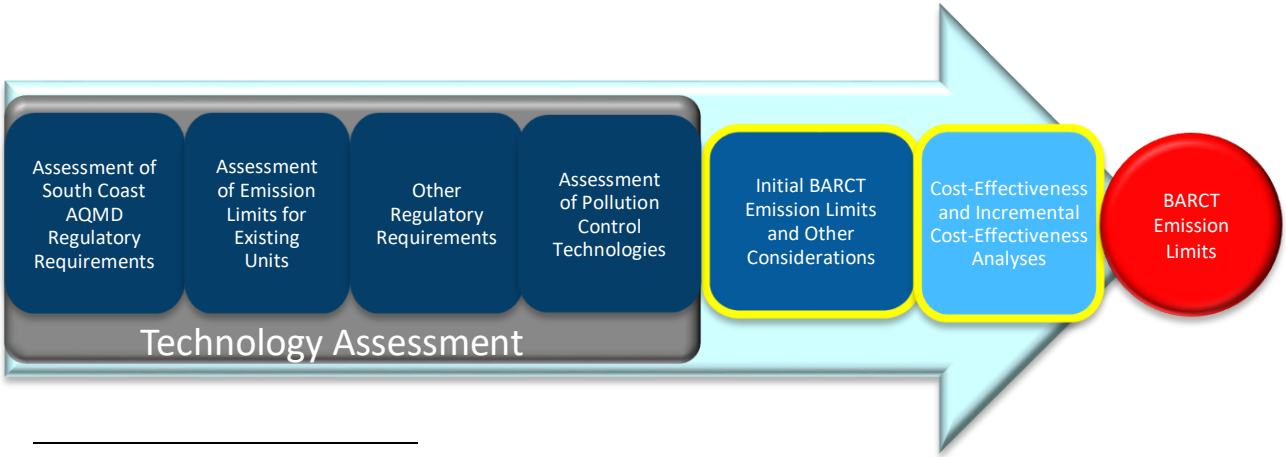
BARCT is defined in the Health & Safety Code Section 40406 as "an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source." Consistent with state law, BARCT emission limits take into consideration environmental impacts, energy impacts, and economic impacts. In addition to oxides of nitrogen (NOx) reductions sought in the proposed amended rule, staff identified potential environmental and energy effects of the proposed rule through the California Environmental Quality Act (CEQA) process. Economic impacts are assessed at the equipment category level by a review of cost-effectiveness and incremental cost-effectives contained in this report and at the macro level as part of the socio-economic assessment contained in a separate report.

BARCT ANALYSIS APPROACH

The BARCT analysis approach follows a series of steps conducted for each equipment category and fuel type. For Proposed Amended Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (PAR 1135), internal combustion engines, fuel cells, linear generators, and solar photovoltaic (PV) cells were analyzed.

The steps for BARCT analysis consist of:

- Assessment of South Coast AQMD Regulatory Requirements
- Assessment of Emissions Limits for Existing Units
- Other Regulatory Requirements
- Assessment of Pollution Control Technologies
- Initial BARCT Emission Limits and Other Considerations
- Cost-Effectiveness and Incremental Cost-Effectiveness Analyses
- BARCT Emission Limits



[1] South Coast AQMD, 2022 Air Quality Management Plan, http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/final-2022-aqmp.pdf?sfvrsn=16

Assessment of South Coast AQMD Regulatory Requirements

As part of the BARCT assessment, staff reviewed existing South Coast AQMD regulatory requirements that affect NOx emissions for electric generating units located on Santa Catalina Island. NOx emissions from electric generating units located on Santa Catalina Island are regulated under South Coast AQMD Rule 1135 – Emissions of Oxides of Nitrogen from Electric Power Generating Systems (Rule 1135) and Regulation XX – Regional Clean Air Incentives Market (RECLAIM) (Regulation XX).

The RECLAIM program limits NOx emissions from electricity generating facilities, but does not limit emissions or establish concentration limits by equipment category or fuel type. However, emissions limits are established at the time of permitting, and permits include concentration limits for NOx and emissions limits for non-RECLAIM pollutants such as particulate matter. A facility's NOx allocations are diminished over time, requiring facilities to lower emissions or to purchase credits from other facilities that have lowered emissions below their allocations.

Rule 1135 established interim NOx emission limits for the electricity generating facility located on Santa Catalina Island, which includes a 50 tons per year NOx limit by January 1, 2024 and 45 tons per year NOx limit by January 1, 2025 from all electric generating units. Rule 1135 established a final 13 ton per year NOx limit from all electric generating units located on Santa Catalina Island on and after January 1, 2026, with an option for a three-year extension. Rule 1135 also requires new diesel combustion engines located on Santa Catalina Island to meet a 45 parts per million by volume (ppmv) NOx limit at 15% oxygen on a dry basis.

Assessment of Emission Limits for Existing Units

Staff examined the current electric generating units located on Santa Catalina Island to assess emission limits. Permit limits for NOx were identified for all equipment to identify what is already being done in practice.

Six diesel internal combustion engines are located on Santa Catalina Island. Five of these engines were installed more than 38 years ago and one was installed 28 years ago. All units are controlled with selective catalytic reduction. In 2003, the higher emitting units were retrofitted, while the lowest emitting unit was a new installation in 1995. The lowest permitted NOx limit for a diesel engine used for electricity generation in South Coast AQMD is 51 ppmv at 15% oxygen on a dry basis. The details of the diesel internal combustion engines subject to PAR 1135 are listed below in **Table 2-1** below. The NOx permit limit of 6.5 pounds per Megawatt hour (lbs/MW-hr) for the diesel internal combustion engines located on Santa Catalina Island is roughly 100 times higher than the California Air Resources Board (CARB) distributed generation emission standard for NOx at 0.07 lbs/MW-hr required for newly installed electric generating units.[2] PAR 1135's definition of Santa Catalina Island near-zero emission (NZE) electric generating unit is based on CARB's distributed generation emission standard for NOx, which is equivalent to approximately 2.5 ppmv NOx at 15% oxygen on a dry basis.

[2] CARB, Final Regulation Order – Establish a Distributed Generation Certification Program, https://ww2.arb.ca.gov/sites/default/files/barcu/regact/dg01/finreg.pdf?_ga=2.89974301.708521970.1675193247-969541522.1644423250

Table 2-1: Prime Diesel Internal Combustion Engines at the Electricity Generating Facility Located on Santa Catalina Island

Unit	Size (HP)	Output (MW)	Install Year	Retrofit Date	Control[^]	NOx Permit Limit[+]
ICE1	1575	1.125	1968	2003	SCR	6.5 lbs/Megawatt-hour (MW-hr)[~]
ICE3	1950	1.4	1985	2003	SCR	6.5 lbs/MW-hr[~]
ICE6	2150	1.5	1964	2003	SCR	6.5 lbs/MW-hr[~]
ICE5	1500	1	1967	2003	SCR	6.5 lbs/MW-hr[~]
ICE2	2200	1.5	1976	2003	SCR	6.5 lbs/MW-hr[~]
ICE4	3900	2.8	1995	None	SCR	51 ppmv at 15% oxygen, dry; 6.5 lbs/MW-hr[~]

[+] Actual NOx concentrations emitted are generally lower than the NOx permit limits
[~] Averaged over one calendar year, limit is based on total mass NOx emitted from Units 1 – 6 and microturbines
[^] SCR: Selective Catalytic Reduction

Other Regulatory Requirements

As part of the BARCT assessment, staff examined NOx limits for diesel internal combustion engines promulgated by Bay Area Air Quality Management District (BAAQMD), Sacramento Metropolitan Air Quality Management District (SMAQMD), and San Joaquin Valley Air Pollution Control District (SJVAPCD). **Table 2-2** below notes the NOx limits in the three air districts. The applicable equipment sizes differ by regulation.

Table 2-2: Other Air District Emission Standards for Diesel Internal Combustion Engines

Air District	Rule Number	Rule Adoption Date	NOx Limit
BAAQMD	Regulation 9, Rule 8	July 25, 2007	110 ppmv at 15% oxygen
SMAQMD	Rule 412	June 1, 1995	80 ppmv at 15% oxygen
SJVAPCD	Rule 4702	August 18, 2021	U.S. EPA Tier 4[+] or meet certified compression-ignition engine standard[~]

[+] Applies to non-certified compression-ignited engines installed on or before January 1, 2015 (greater than 750 brake horsepower and less than 1,000 annual operating hours) and United States Environmental Protection Agency (U.S. EPA)-certified Tier 1 or Tier 2 compression-ignited engines
[~] Applies to U.S. EPA-certified Tier 3 or Tier 4 compression ignition engines

Assessment of Pollution Control Technologies

As part of the BARCT assessment, staff conducted a technology assessment to evaluate NOx pollution control technologies for electric generating units located on Santa Catalina Island. Staff reviewed scientific literature, vendor information, and strategies utilized in practice. The technologies are presented below and the applicability for use with various electric generating units is noted.

Fuel Cells

A fuel cell is a device capable of producing electrical energy from chemical reactions through the conversion of a fuel, such as hydrogen or propane, and an oxidizing agent, such as oxygen, into electricity. A fuel cell works similarly to a battery and is comprised of two electrodes, an anode and a cathode, surrounding an electrolyte membrane (**Figure 2-1**). A fuel such as hydrogen or propane is supplied to the anode and oxygen enters the cathode. The porous electrolyte membrane only allows positively charged protons to pass through to the cathode. Negatively charged electrons that cannot pass through the electrolyte membrane flow through an external circuit to generate an electric current. Oxygen, protons, and unused electrons combine in the catalytic cathode to produce water and heat as a byproduct of waste.

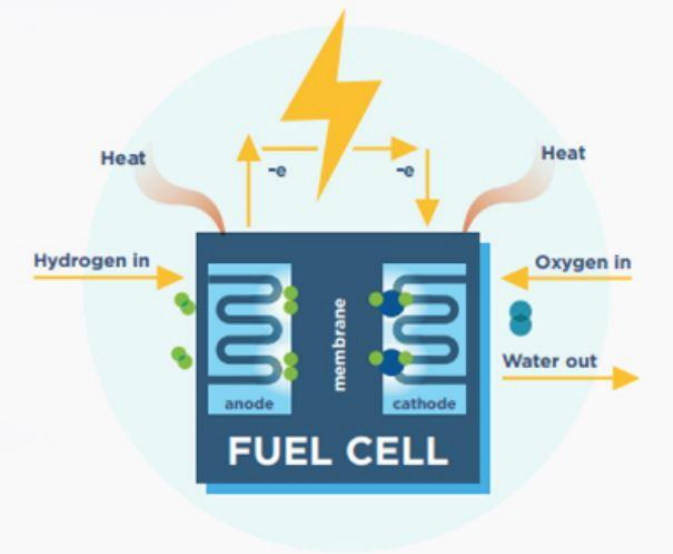


Figure 2-1: Typical Components of a Hydrogen Fuel Cell[3]

Fuel cells are two to three times more efficient than internal combustion engines and provide the flexibility to operate utilizing a variety of fuels such as hydrogen, propane, and biogas. A hydrogen fuel cell generates virtually no NOx emissions. Alternately, propane fuel cells are expected to produce less than 2.5 ppmv of NOx emissions.[4] Fuel cells can also be combined to form a fuel cell stack in series to yield a higher voltage or in parallel for a higher current and are complementary to other energy technologies such as batteries, solar panels, and wind turbines.

Internal Combustion Engines

Internal combustion engines work by a chemical process releasing energy through the combustion of a fuel and air mixture. Gasoline or diesel are most commonly used but renewable fuels such as natural gas, propane, or biodiesel may also be utilized. An internal combustion engine consists of two components working together, a fixed cylinder and a piston. Expanding combustion gases within the engine pushes the piston, which in turn rotates the crankshaft. This high-speed motion generates an electric current.

[3] Fuel Cell & Hydrogen Energy Association, Fuel Cell Basics, https://www.fchea.org/fuelcells

[4] Combined Heath and Power Partnership, Catalog of CHP Technologies, Section 6. Technology Characterization – Fuel Cells, https://www.epa.gov/sites/default/files/2015-07/documents/catalog_of_chp_technologies_section_6._technology_characterization_-_fuel_cells.pdf

Non-road diesel internal combustion engines contribute considerably to air pollution. To improve air quality, the U.S. EPA developed Tier 4 emission standards for nonroad diesel internal combustion engines to reduce harmful emissions. Replacement with a U.S. EPA Tier 4 Final diesel engine is expected to produce less than 45 ppmv NOx. Replacement with a propane internal combustion engine is expected to produce less than 11 ppmv NOx. Staff also discussed with stakeholders the possibility of propane internal combustion engines meeting a 2.5 ppmv NOx limit with add-on control equipment. However, staff has not received further information regarding this control option.

Linear Generators

A linear generator works to directly convert linear motion into electricity by compressing a mixture of fuel and air in a center reaction zone. The compression of fuel and air creates a chemical combustion reaction that drives magnets through copper coils in a linear motion. Energy is created from the magnets attached to oscillators, which interact with the copper coils during linear motion to generate electricity (**Figure 2-2)**.

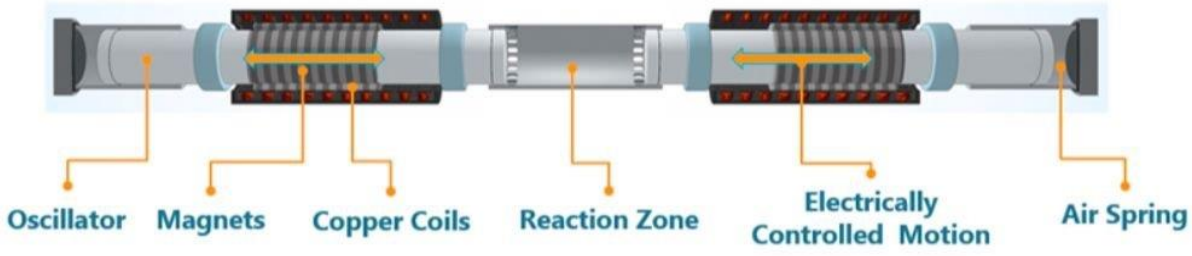


Figure 2-2: Components of a Linear Generator[5]

Linear generators maintain reaction temperatures below levels at which NOx forms, resulting in NZE. Further, linear generators do not require add-on control technologies such as selective catalytic reduction to control NOx emissions and have lower start-up emissions since it is not dependent on a catalyst to reach a destruction temperature. In addition, linear generators utilize a parametric monitoring system to maintain proper combustion to meet energy demands. The parametric monitoring system works by monitoring air and fuel flow to ensure proper air-to-fuel ratio is achieved, which also ensures emissions are under control. Lastly, linear generators also provide the flexibility to operate utilizing various fuels including hydrogen and propane.

Solar Photovoltaic Cells

Solar PV cells generate zero-emission (ZE) electricity by absorbing sunlight and utilizing light energy to create an electrical current. Light consists of photons vibrating at a range of wavelengths, and the wavelengths can be captured by a solar PV cell. Solar PV cells are made of a semiconductor material, typically silicon, that is treated in a way that allows it to interact with photons from sunlight. Sunlight energy absorbed by solar PV cells causes electrons to flow through two layers of silicon to create an electric field (**Figure 2-3**). The electric field forces loosened electrons to flow through in one direction, generating an electric current. Metals plates on each sides of the solar PV cell collect those electrons and transfer them to wires where electrons then flow as

[5] Greentech Media, "Mainspring Energy Lands $150M Deal to Deploy its Linear Generators with NextEra," https://www.greentechmedia.com/articles/read/mainspring-energys-linear-generators-to-roll-out-through-150m-deal-with-nextera

electricity. Solar PV cells are wired together and installed on top of a substrate such as metal or glass to create solar panels, which are then installed collectively as a group to form a solar power system.

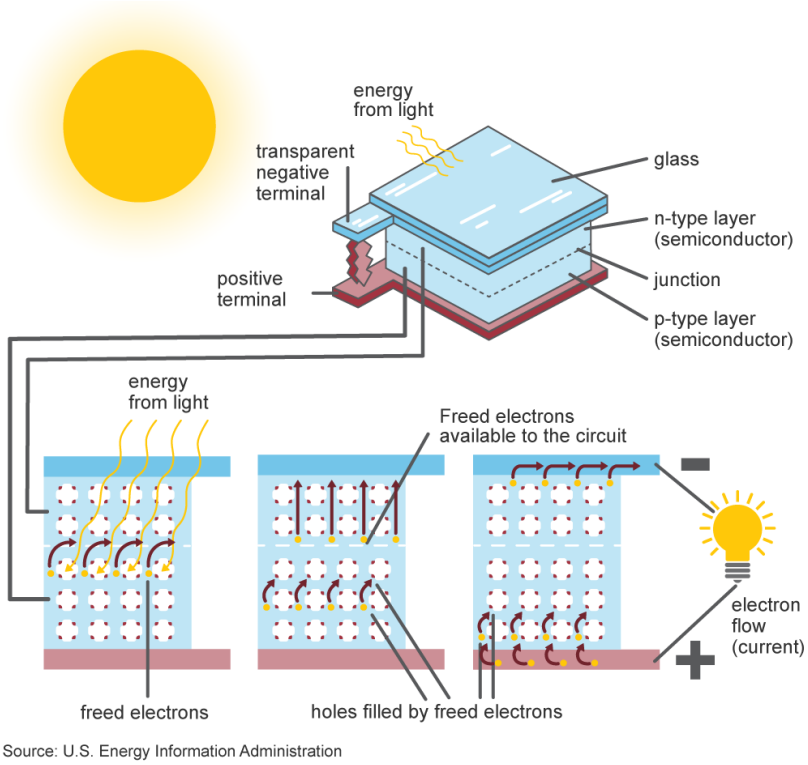


Figure 2-3: Inside a Solar PV Cell[6]

Solar PV cells can supply power through different systems. Through an on-grid system, excess power is produced by solar panels fed to the local utility grid, which can supply power that solar panels are not producing (e.g. at night). Off-grid systems contain solar panels that charge batteries, where electricity is drawn. A hybrid system consists of solar panels connected to the grid and a battery backup to store excess power.

Other Technologies

Staff also screened other technologies including wind turbines and undersea cables. While staff found technological limitations in this particular case, it is possible in the future that technological advances could overcome hurdles staff identified.

Initial BARCT Emission Limit and Other Considerations

Staff considered specific repower parameters for the electricity generating facility on Santa Catalina Island throughout the technology assessment process, including electricity demand, space limitations, and fuel storage. Furthermore, challenges for the deployment of ZE and/or NZE

[6] United States Energy Information Administration, Photovoltaics and Electricity, https://www.eia.gov/energyexplained/solar/photovoltaics-and-electricity.php#:~:text=The%20U.S.%20Energy%20Information%20Administration%20%28EIA%29%20estimates%20that,2020%2C%20up%20from%2011%20billion%20kWh%20in%202014

technologies were taken into consideration when establishing the BARCT NOx mass emission limit.

Electricity Demand

The electricity generating facility on Santa Catalina Island historically produces approximately 29,000 MW-hr per year of power. In September 2022, the electricity generating facility located on Santa Catalina Island reached a new peak load of 6.3 Megawatts (MW) during a heat wave. The historical annual power generation and new peak load was used to determine feasible repower scenarios to establish BARCT.

Space Limitations

A significant challenge for installing ZE and/or NZE technologies at the electricity generating facility located on Santa Catalina Island is limited space (**Figure 2-4**). The estimated available onsite space for ZE and/or NZE technologies is less than 10,000 square feet. The electricity generating facility on Santa Catalina Island also provides water and gas service, which limits the equipment that could be removed and replaced with ZE and/or NZE equipment on the existing facility footprint. The BARCT analysis assumed that three of the six existing diesel engines that will not be replaced with Tier 4 Final diesel engines and all existing microturbines could be removed to install ZE and/or NZE technologies for power generation (see areas marked in red in **Figure 2-4)**.

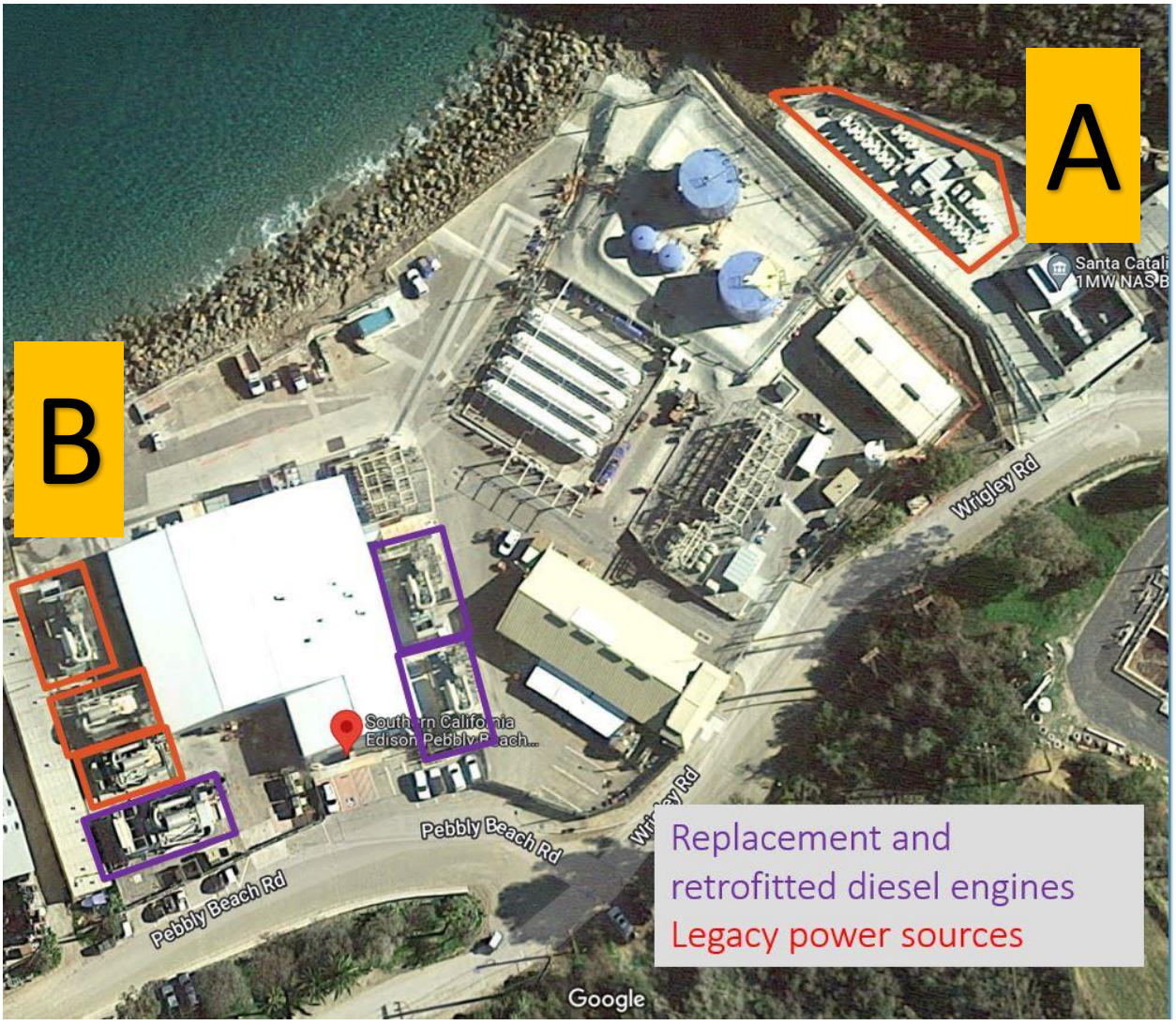


Figure 2-4: Land Availability at the Electricity Generating Facility Located on Santa Catalina Island

A – Microturbine platform
B – Diesel internal combustion engines

Staff also evaluated the possibility of land acquisition outside of the existing facility footprint to install ZE and/or NZE technologies. Additional land procurement would be necessary for solar PV cells to provide a significant contribution of power generation to Santa Catalina Island. However, land availability on Santa Catalina Island for solar PV cells is limited, as most open land on the island is mountainous and solar energy production is optimal on flat pieces of land. A potential site on Santa Catalina for the installation of solar PV cells, or other ZE and/or NZE technologies, is Middle Ranch (**Figure 2-5**). Middle Ranch is approximately 15 acres, which can accommodate solar PV installations that could provide approximately 30% of historical power generation needed for Santa Catalina Island. Complications in the permitting process and land use plans with external agencies may generate substantial obstacles for the acquisition of additional land. The current land use plan restricts energy facilities from being established on most areas of Santa Catalina Island,

including the Middle Ranch site. Modifications to the Santa Catalina Island land use plan would require the revision of existing regulations with external agencies, which could take multiple years.

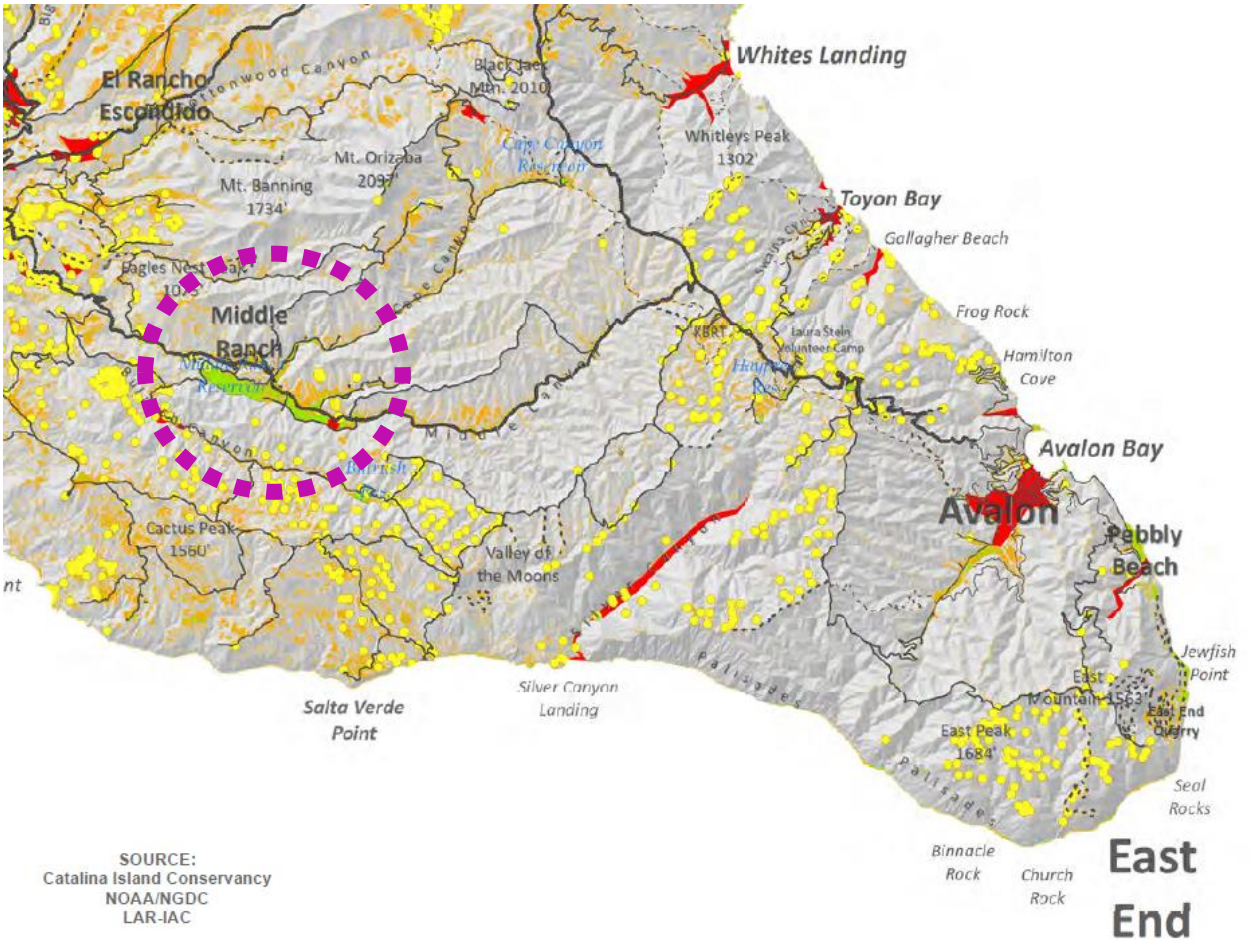


Figure 2-5: Middle Ranch area of Santa Catalina Island[7]

Fuel Storage

Santa Catalina Island does not have fueling infrastructure on the island; all fuel must be barged in. All repower scenarios for the electricity generating facility located on Santa Catalina Island include three diesel internal combustion engines for redundancy because the site already has 30-days of diesel fuel storage. The repower scenarios assume at least 5% power generation (MW-hr per year) from diesel engines in the event that the barge is not running, and fuel cannot be delivered. Staff analyzed fuel deliveries from 2017 to 2021 to Santa Catalina Island and found that the longest time lapse between fuel deliveries was five days and that the barge did not run for a maximum of 14 days in a calendar year (approximately 4% of a calendar year). Staff assumed at least 5% power generation (MW-hr per year) from diesel engines to be conservative. The BARCT analysis assumes that two of the existing diesel engines would be replaced with U.S. EPA Tier 4 Final diesel engines and that the newest and cleanest diesel engine would be retained. The newest and cleanest diesel engine was retrofitted with a catalyst block in an attempt to comply with requirements for particulate matter (PM) emissions pursuant to South Coast AQMD Rule 1470 –

[7] Catalina Island Conservancy, GIS Work for Large Solar Project on Island, Accessed: July 21, 2022

Requirements for Stationary Diesel-Fueled Internal Combustion and Other Compression Engines.[8] Multiple tests demonstrated that the catalyst block was insufficient in meeting the PM requirements contained in Rule 1470. The electricity generating facility located on Santa Catalina Island plans to pursue this engine's replacement with a Tier 4 Final diesel engine. If the newest diesel engine is replaced with a Tier 4 Final diesel engine, then the emissions associated with the repower scenarios would remain conservative.

Constructing additional fuel storage beyond the existing 30-day supply for diesel and propane storage tanks is limited on the existing facility footprint. Currently, there are four[9] 30,000-gallon propane storage tanks located at the electricity generating facility on Santa Catalina Island. If ZE technologies fueled by hydrogen were to be utilized, the electricity generating facility would most likely need to expand its existing footprint to accommodate ancillary fuel storage facilities. Staff assumes that a five-day fuel reserve is necessary for ZE and/or NZE technologies while diesel engines are operational at the electricity generating facility on Santa Catalina Island.

Initial BARCT Emission Limit

Staff projected the number of barge trips necessary for ZE and NZE technologies fueled by hydrogen and propane, respectively. **Table 2-3** provides projections of fuel usage and associated barge trips based on repower scenarios for the electricity generating facility on Santa Catalina Island. Staff assumed a maximum capacity of 9,100-gallons (gal) of propane and 1,250-kilograms (kg) of hydrogen per barge.

Table 2-3: Hydrogen and Propane Barge Trips Estimated for Santa Catalina Island

	Hydrogen Estimated for 95% ZE Scenario	Hydrogen Estimated for a 65% ZE Scenario	Propane Estimated for 95% NZE Scenario[+]	Propane Estimated for 65% NZE Scenario[+]
Annual Fuel Requirements	3,502,175 kg	2,396,255 kg	4,767,812 gal	3,262,187 gal
Annual Number of Barge Trips	2801	1917	524	358
Monthly Number of Barge Trips	233	160	44	30

[+] According to the electric generating facility located on Santa Catalina Island, propane storage may not be able to be filled to the 90,000-gallon capacity due to weather conditions

Staff determined a 95% ZE scenario to be technologically infeasible due to the number of barge trips required for hydrogen fueled ZE technologies. Staff is only aware of two barges that deliver fuel to Santa Catalina Island. Therefore, repower scenarios with fuel requirements that exceed approximately 60 barge trips per month were considered to be technologically infeasible. Staff estimates approximately 233 barge trips per month would be required for a 95% ZE scenario using hydrogen fueled technologies. Further, a 95% ZE scenario with a combination of both solar PV cells and hydrogen fueled equipment was determined to be technologically infeasible. Due to

[8] South Coast AQMD, Rule 1470, http://www.aqmd.gov/docs/default-source/rule-book/reg-xiv/rule-1470.pdf?sfvrsn=8

[9] One of the propane storage tanks is currently not used due to fire suppression requirements

limited land availability suitable for solar PV cell installation, staff estimates that a maximum of 30% of power generation for Santa Catalina Island could be provided by solar PV cells. The remaining 65% of ZE hydrogen fueled equipment needed for a 95% ZE scenario is estimated to result in 160 barge trips per month.

Currently, the electricity generating facility located at Santa Catalina Island has approximately 300 barge deliveries per year[10] to fuel the diesel internal combustion engines and propane microturbines used for power generation. The repower scenario comprised of 30% ZE, 65% NZE, and 5% diesel internal combustion engines is estimated to result in approximately 373 barge trips per year.

The recommendation for the initial BARCT NOx emission limit is based on the technology assessment. A cost-effectiveness analysis, which includes an incremental cost-effectiveness analysis, is then made with cost information provided by stakeholders to further refine the determination for the final BARCT NOx emission limit. Staff proposed an initial BARCT emission limit of 1.6 tons per year NOx for electric generating units located on Santa Catalina Island. The initial BARCT limit is based on a combination of technologies comprising of 30% ZE, 65% NZE, and 5% diesel internal combustion engines for power generation (MW-hr per year) on Santa Catalina Island.

Cost-Effectiveness and Incremental Cost-Effectiveness Analyses

A complete discussion of cost-effectiveness is provided in Chapter 4: Impact Assessment of this report. The findings are summarized here as part of the BARCT assessment process.

Staff conducted a cost-effectiveness analysis of several repower scenarios utilizing ZE and/or NZE technologies to repower the electricity generating facility on Santa Catalina Island (**Table 2-4**). Staff evaluated the following repower scenarios based on annual power generation (MW-hr per year): all Tier 4 Final diesel engines; 50% NZE, 50% diesel engines; 50% ZE, 50% diesel internal combustion engines; 30% ZE, 50% NZE, 20% diesel internal combustion engines; 95% NZE, 5% diesel internal combustion engines; 30% NZE, 65% NZE, 5% diesel internal combustion engines; and 95% ZE, 5% diesel internal combustion engines.

[10] Only includes fuel deliveries made for electric generating units and does not include fuel deliveries made for propane gas service

Table 2-4: Cost-Effectiveness Analysis for Santa Catalina Island Repower Scenarios

	All Tier 4 Final Diesel Engines	50% NZE, 50% Diesel Engines	50% ZE,[+,~] 50% Diesel Engines	30% ZE,[+] 50% NZE, 20% Diesel Engines	95% NZE, 5% Diesel Engines	30% ZE,[+] 65% NZE, 5% Diesel Engines	95% ZE,[+,~] 5% Diesel Engines
Net Annual Costs (includes annualized capital and O&M costs)	$2,296,000	$3,166,000	$9,274,000	$(637,000)	$3,678,000	$(859,000)	$6,183,000
NOx Emission Reductions (Tons/Year)	54.66	62.70	63.21	67.39	69.48	69.78	70.45
Cost-Effectiveness ($/Ton of NOx Reduced)	$42,000	$51,000	$147,000	$(9,000)	$53,000	$(12,000)	$88,000

[+] Repower scenario requires the acquisition of land outside of the existing facility footprint
[~] Repower scenario does not include costs associated with new hydrogen fuel storage, except land lease costs

The initial BARCT limit of 1.6 tons per year NOx for the electricity generating facility on Santa Catalina Island was determined to be cost-effective at less than the 2022 AQMP cost-effectiveness threshold of $325,000 per ton of NOx reduced.

Staff proceeded to conduct incremental cost-effectiveness analyses between each progressively more stringent repower scenario repower scenarios analyzed (**Table 2-5**) and against an all Tier 4 Final diesel engine scenario (**Table 2-6**). Incremental cost-effectiveness is the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option.

Table 2-5: Incremental Cost-Effectiveness of Progressively More Stringent Repower Scenarios

	All Tier 4 Final Diesel Engines versus 50% NZE	50% NZE versus 50% ZE	50% ZE versus 30% ZE, 50% NZE	30% ZE, 50% NZE versus 95% NZE	95% NZE versus 30% ZE, 65% NZE	30% ZE, 65% NZE versus 95% ZE
Incremental Cost-Effectiveness	$108,000	$11,977,000	$(2,371,000)	$2,065,000	$(15,126,000)	$10,511,000

Table 2-6: Incremental Cost-Effectiveness of ZE and/or NZE Scenarios Compared to an All Tier 4 Final Diesel Engine Repower Scenario

	All Tier 4 Final Diesel Engines versus 50% NZE	50% NZE versus 50% ZE	50% ZE versus 30% ZE, 50% NZE	30% ZE, 50% NZE versus 95% NZE	95% NZE versus 30% ZE, 65% NZE	30% ZE, 65% NZE versus 95% ZE
Incremental Cost-Effectiveness	$108,000	$14,183,000	$(2,640,000)	$1,974,000	$(14,492,000)	$10,511,000

The initial BARCT limit of 1.6 tons per year NOx for the electricity generating facility on Santa Catalina Island was determined to be incrementally cost-effective at less than $325,000 per ton of NOx reduced.

BARCT Emission Limit Recommendation

The repower scenario consisting of 30% ZE technology, 65% NZE technology, and 5% diesel internal combustion engines was determined to be the scenario producing the most NOx emission reductions, while being technologically feasible, cost-effective, and incrementally cost-effective. Therefore, the recommended BARCT NOx emission limit for the electricity generating facility on Santa Catalina Island is based on the 30% ZE, 65% NZE, and 5% diesel internal combustion engine scenario.

The BARCT NOx emission limit for the electricity generating facility located on Santa Catalina Island is listed below in **Table 2-7**.

Table 2-7: Recommended BARCT Emission Limit

BARCT NOx Emission Limit	NOx (tons per year)
Recommended BARCT NOx mass emission limit	1.6

CHAPTER 3: SUMMARY OF PROPOSALS

INTRODUCTION

DEFINITIONS (Subdivision (c))

EMISSIONS LIMITS (Subdivision (d))

MONITORING, RECORDKEEPING, AND REPORTING (Subdivision (e))

INTRODUCTION

Proposed Amended Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (PAR 1135) establishes a Best Available Retrofit Control Technology (BARCT) oxides of nitrogen (NOx) mass emission limit for electric generating units located on Santa Catalina Island. Additionally, PAR 1135 establishes provisions for monitoring, reporting, and recordkeeping for near-zero-emission (NZE) electric generating units and electric generating units without continuous emissions monitoring systems (CEMS) located on Santa Catalina Island. PAR 1135 also extends the compliance deadline for boilers and gas turbines to comply with emission limits.

DEFINITIONS (Subdivision (c))

PAR 1135 adds and modifies definition to clarify and explain key concepts and removes obsolete definitions. Please refer to PAR 1135 for each definition.

Proposed Modified Definitions:	Backup Unit Electric Generating Unit Electricity Generating Facility
Proposed Added Definitions:	Annual NOx Mass Emissions Santa Catalina Island Near-Zero-Emission Electric Generating Unit Santa Catalina Island Zero-Emission Electric Generating Unit

EMISSIONS LIMITS (Subdivision (d))

Paragraph (d)(1) extends the deadline to comply with emission limits for boilers and gas turbines from January 1, 2024 to April 1, 2024 at the request of stakeholders. An extension for one quarter (or three months) is proposed to provide additional time for electricity generating facilities to finalize the installation of controls. Staff is aware of only two units that need the additional time because of supply chain issues.

Current South Coast Air Quality Management District (South Coast AQMD) Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (Rule 1135) subparagraph (d)(2)(A) was deleted to remove the first interim annual oxides of nitrogen (NOx) mass emission limit of 50 tons of NOx by January 1, 2024. The first interim limit was deleted due to permitting delays associated with existing applications for Tier 4 Final diesel engines. It is expected that the electricity generating facility located on Santa Catalina Island can meet the interim limit of 45 tons of NOx by January 1, 2025 by replacing two older diesel engines with Tier 4 Final diesel engines.

Clause (d)(2)(A)(i) extends the deadline prohibiting the installation of any new diesel internal combustion engine from January 1, 2024 to July 1, 2025. Staff updated this provision due to the failure of the cleanest existing diesel engine's new catalyst block to meet particulate matter emission standards as specified by South Coast AQMD Rule 1470 – Requirements for Stationary Diesel-Fueled Internal Combustion and Other Compression Ignition Engines.[1] Staff's proposed BARCT limit assumes that three lower emitting diesel engines (one engine with a permit limit of 51 ppmv NOx and two new Tier 4 Final engines) will be used in the event zero-emission (ZE)

[1] South Coast AQMD, Rule 1470, http://www.aqmd.gov/docs/default-source/rule-book/reg-xiv/rule-1470.pdf?sfvrsn=8

and/or NZE technologies cannot be operated (e.g. the barges cannot deliver fuel) up to approximately five percent of the time (approximately 440 hours per year). Therefore, staff is proposing to extend the deadline prohibiting the installation of any new diesel engines in the likely event that the cleanest existing diesel engine will be replaced.

Clause (d)(2)(A)(ii) will prohibit the installation of any equipment that does not meet the definition of a "Santa Catalina Island Near-Zero-Emission (NZE) Electric Generating Unit" or a "Santa Catalina Island Zero-Emission (ZE) Electric Generating Unit" after July 1, 2025. This provision was added to require the installation of cleaner power generation technologies that were demonstrated to be technologically feasible and cost-effective during the BARCT assessment.

Clause (d)(2)(A)(iv) will establish a new BARCT emission limit of 1.6 tons per year NOx for the electricity generating facility located on Santa Catalina Island. The emission limit of 1.6 tons per year NOx includes emissions from startups, shutdowns, and missing data substitutions. The BARCT emission limit of 1.6 tons per year was established based on a repower scenario of 30% ZE, 65% NZE, and 5% diesel internal combustion engines.

MONITORING, RECORDKEEPING, AND REPORTING (Subdivision (e))

Subparagraphs (e)(1)(A) and (e)(2)(A) clarify that Santa Catalina Island NZE electric generating units less than or equal to 0.4 Megawatts (MW) and Santa Catalina Island ZE electric generating units do not require installation of continuous emission monitoring systems (CEMS).

Subparagraph (e)(3)(A) establishes a method to calculate NOx emissions from Santa Catalina Island NZE electric generating units less than or equal to 0.4 MW located on Santa Catalina Island, as those units will not be required to install CEMS. The NOx emissions calculated from Santa Catalina Island NZE electric generating units less than or equal to 0.4 MW are required to be added to the total annual NOx emissions from electricity generating units that have CEMS to demonstrate compliance with emission limits specified in paragraph (d)(2).

Subparagraph (e)(3)(B) requires records of all data used to calculate the annual NOx emissions from Santa Catalina Island NZE electric generating units less than or equal to 0.4 MW for compliance verification purposes. The data is required to be maintained onsite for a minimum of five years and be made available to the Executive Officer upon request.

Paragraph (e)(4) requires an electric generating unit located on Santa Catalina Island which exceeds 0.4 MW, except for Santa Catalina Island ZE electric generating units, to utilize NOx CEMS and comply with South Coast AQMD Rule 218 – Continuous Emission Monitoring,[2] South Coast AQMD Rule 218.1 – Continuous Emission Monitoring Performance Specifications,[3] South Coast AQMD Rule 218.2 – Continuous Emission Monitoring System: General Provisions,[4] South Coast AQMD Rule 218.3 – Continuous Emission Monitoring System: Performance Specifications,[5] and Title 40 of the Code of Federal Regulations (CFR) Part 75.[6]

[2] South Coast AQMD, Rule 218, http://www.aqmd.gov/docs/default-source/rule-book/reg-ii/rule-218.pdf?sfvrsn=4

[3] South Coast AQMD, Rule 218.1, http://www.aqmd.gov/docs/default-source/rule-book/reg-ii/rule-218-1.pdf?sfvrsn=4

[4] South Coast AQMD, Rule 218.2, http://www.aqmd.gov/docs/default-source/rule-book/reg-ii/r218-2.pdf?sfvrsn=20

[5] South Coast AQMD, Rule 218.3, http://www.aqmd.gov/docs/default-source/rule-book/reg-ii/r218-3.pdf?sfvrsn=20

[6] CFR, Title 40, Part 75, https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-75

CHAPTER 4: IMPACT ASSESSMENTS

INTRODUCTION
POTENTIALLY IMPACTED FACILITIES
EMISSION INVENTORY AND EMISSION REDUCTIONS
COST-EFFECTIVENESS
INCREMENTAL COST-EFFECTIVENESS
RULE ADOPTION RELATIVE TO COST-EFFECTIVENESS
SOCIOECONOMIC ASSESSMENT
CALIFORNIA ENVIRONMENTAL QUALITY ACT
DRAFT FINDINGS UNDER HEALTH & SAFETY CODE SECTION 40727
COMPARATIVE ANALYSIS

INTRODUCTION

Impact assessments were conducted during the Proposed Amended Rule 1135 – Emissions of Oxides of Nitrogen From Electricity Generating Facilities (PAR 1135) development to assess environmental and socioeconomic implications. Health & Safety Code (H&SC) requirements for cost-effectiveness analysis and incremental cost-effectiveness analysis were evaluated during rule development of PAR 1135. Draft findings and comparative analyses were prepared pursuant to H&SC Sections 40727 and 40727.2, respectively. Staff is currently reviewing PAR 1135 to determine if it will result in any potential adverse environmental impacts. Appropriate California Environmental Quality Act (CEQA) documentation will be prepared based on this analysis.

POTENTIALLY IMPACTED FACILITIES

There are 32 electricity generating facilities that are potentially impacted by PAR 1135. The proposed amendments to Rule 1135 primarily impacts one electricity generating facility located on Santa Catalina Island. However, PAR 1135 also includes a revision to the compliance deadline for boilers and gas turbines to comply with South Coast Air Quality Management District (South Coast AQMD) Rule 1135 – Emissions of Oxides of Nitrogen from Electricity Generating Facilities (Rule 1135) emission limits, which affects the remaining Rule 1135 universe. There are 133 units at 32 electricity generating facilities that are potentially impacted by PAR 1135. Staff is only aware of two electric generating units that need additional time to meet the compliance deadline for boilers and gas turbines because of supply chain issues. **Table 4-1** contains the equipment affected by PAR 1135.

Table 4-1: PAR 1135 Affected Equipment

Equipment Type	Number of Units
Boilers	17
Combined Cycle Gas Turbines	26
Combined Cycle Gas Turbine-Associated Duct Burners	11
Diesel Internal Combustion Engines	6
Simple Cycle Gas Turbines	73

EMISSION INVENTORY AND EMISSION REDUCTIONS

PAR 1135 will result in emission reductions from the electricity generating facility located on Santa Catalina Island by removing three diesel engines and 23 microturbines and replacing them with near-zero- (NZE) and/or zero-emission (ZE) technologies. Furthermore, the proposed Best Available Retrofit Control Technology (BARCT) emission limit includes the replacement of two diesel engines with Tier 4 Final diesel internal combustion engines (Tier 4 Final diesel engines). NZE and ZE technologies would provide Santa Catalina Island with 95% of its power generation along with three diesel internal combustion engines, which would act in a backup capacity for redundancy and reliability in the event barge trips for fuel deliveries cannot occur.

Staff established baseline emissions for the electricity generating facility located on Santa Catalina Island by determining the average of emissions from prime power diesel internal combustion engines listed in the Annual Emission Reports (AERs)[1] for the reporting years of 2017, 2019, and 2021. The baseline emissions from the electricity generating facility located at Santa Catalina Island were determined to be 71.3 tons of oxides of nitrogen (NOx) per year. Emissions data from the 2018 AER reporting year was not included, as emissions data for each diesel internal combustion engine was initially not available. The AER emission data from 2020 was also not included, as emissions were not representative of typical operations due to the COVID-19 pandemic. The electricity generating facility located on Santa Catalina Island later provided the 2018 AER report. However, staff decided to maintain the initial method of calculating baseline emissions, as they are considered representative of typical operations.

The proposed BARCT limit is based on a combination of technologies comprised of 30% ZE, 65% NZE, and 5% diesel internal combustion engines. The proposed BARCT limit is estimated to reduce NOx emissions at the electricity generation facility located on Santa Catalina Island by 69.7 tons per year, or 0.19 tons per day. Estimated emission reductions were calculated by taking the difference between the baseline emissions from the electricity generating facility located on Santa Catalina Island and the estimated NOx emissions from the repower scenario. Estimated emission reductions for the repower scenario was determined by assigning an estimated percentage of power generation output to each equipment type. Power generation was then calculated (Megawatt hour per year (MW-hr per year)) based on an estimated percentage of equipment output. This power generation was then multiplied by an emissions factor of 0.07 pounds per MW-hr based on the California Air Resources Board (CARB) distributed generation emission standard for NOx.[2] Lastly, the estimated NOx emissions from each equipment type were added to calculate the total estimated NOx emissions for the repower scenario.

COST-EFFECTIVENESS

The H&SC Section 40920.6 requires a cost-effectiveness analysis when establishing BARCT requirements. The cost-effectiveness of a technology is measured in terms of the cost in dollars per ton of air pollutant reduced. To determine the cost-effectiveness of each assessed repower scenario for Santa Catalina Island, the following calculation was used:

$$\text{Cost-Effectiveness} = \frac{(Annualized\ Capital\ Cost + Annual\ O\&M) - Existing\ Annual\ O\&M}{Estimated\ Annual\ Emissions\ Reductions}$$

The annualized capital cost in the formula above incorporates a Capital Recovery Factor (CRF) of 4% over the life of the equipment. The CRF method calculates the present value of the control costs over the life of the equipment by adding the capital cost to the present value of all annual costs and other periodic costs over the life of the equipment. A 20-year equipment life was assumed for fuel cells, linear generators, and repower scenarios with a mix to technologies. A 25-year equipment life was assumed for diesel internal combustion engines and solar photovoltaic

[1] South Coast AQMD, Annual Emissions Reporting, http://www.aqmd.gov/home/rules-compliance/compliance/annual-emission-reporting

[2] CARB, Final Regulation Order, Article 3. Distributed Generation Certification Program, https://ww2.arb.ca.gov/sites/default/files/barcu/regact/dg01/finreg.pdf?_ga=2.253027983.708521970.1675193247-969541522.1644423250

(PV) cells. Existing annual operation and maintenance (O&M) costs are then subtracted from the cost of the repower scenario. The difference is divided by the estimated annual emissions reductions for the repower scenario, resulting in the cost-effectiveness amount in dollars.

The cost-effectiveness amount for each assessed repower scenario was measured against the 2022 Air Quality Management Plan (AQMP)[3] cost-effectiveness threshold of $325,000 per ton of NOx. Therefore, if the cost per ton of emissions reduced is less than the cost-effectiveness threshold of $325,000 per ton of NOx, then the control method is considered to be cost-effective.

Costs were provided by technology vendors and the electricity generating facility located on Santa Catalina Island. Capital costs include one-time costs associated with the purchase of equipment, installation, demolition, engineering assessments, labor, and commissioning and testing. Annual operating costs included maintenance and parts, emissions and performance testing, employee and service costs, insurance and permitting, fuel costs (including shipping), hazardous materials handling or treatment, and land lease cost. Values are reported in 2022 dollars. Further, no stranded asset costs were incorporated as the newest diesel internal combustion engine on an electricity generating facility located on Santa Catalina Island is over 25-years old and the existing microturbines were provided by South Coast AQMD.

The cost-effectiveness analysis of each repower scenario evaluated for the electricity generating facility on Santa Catalina Island is listed below in **Table 4-2**. Although the replacement of five diesel internal combustion engines were below the cost-effectiveness threshold of $325,000 per ton of NOx reduced, it produced the least amount of NOx emission reductions in comparison to the other repower scenarios evaluated. Furthermore, repower scenarios with a mix of technologies (ZE, NZE, and diesel internal combustion engines) were determined to be more cost-effective than the Tier 4 Final diesel engine repower scenario. In fact, the repower scenarios with a mix of technologies were determined to be cost-saving over the life of the equipment when compared to current operations.

[3] South Coast AQMD, 2022 Air Quality Management Plan, http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/final-2022-aqmp/final-2022-aqmp.pdf?sfvrsn=16

Table 4-2: Cost-Effectiveness Analysis of Repower Scenarios on Santa Catalina Island

	All Tier 4 Final Diesel Engines	50% NZE, 50% Diesel Engines	50% ZE, 50% Diesel Engines	30% ZE, 50% NZE, 20% Diesel Engines	95% NZE, 5% Diesel Engines	30% ZE, 65% NZE, 5% Diesel Engines	95% ZE, 5% Diesel Engines
Net Annual Costs (includes annualized capital and O&M costs)	$2,296,000	$3,166,000	$9,274,000	$(637,000)	$3,678,000	$(859,000)	$6,183,000
NOx Emission Reductions (Tons/Year)	54.66	62.70	63.21	67.39	69.48	69.78	70.45
Cost-Effectiveness ($/Ton of NOx Reduced)	$42,000	$51,000	$147,000	$(9,000)	$53,000	$(12,000)	$88,000

Therefore, the proposed BARCT emission limit is based on a repower scenario that was determined generate the most emission reductions, while being technologically feasible, cost-effective, and incrementally cost-effective. This repower scenario consists of a mix of technologies including 30% ZE, 65% NZE, and 5% diesel internal combustion engines and is the most cost-effective repower scenario of those evaluated.

INCREMENTAL COST-EFFECTIVENESS

Health & Safety Code Section 40920.6 requires an incremental cost-effectiveness analysis for BARCT rules or emission reduction strategies when there is more than one control option which would achieve the emission reduction objective of the proposed amendments. Incremental cost-effectiveness is the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option.

Incremental cost-effectiveness is calculated as follows:

$$\text{Incremental cost-effectiveness} = \frac{Calt - Cproposed}{Ealt - Eproposed}$$

Where:

$C_{proposed}$ is the present worth value of the proposed control option;
$E_{proposed}$ are the emission reductions of the proposed control option;
C_{alt} is the present worth value of the alternative control option; and
E_{alt} are the emission reductions of the alternative control option

The incremental cost effectiveness measured against each progressively more stringent repower scenario is presented below in **Table 4-3** and the incremental cost-effectiveness for each repower scenario measured against the all Tier 4 Final diesel engines scenario is presented below in **Table 4-4**. Both analyses demonstrate that the proposed BARCT NOx emission limit based on a mixed technology repower scenario (30% ZE, 65% NZE, and 5% diesel internal combustion engines) is the most incrementally cost-effective.

Table 4-3: Incremental Cost-Effectiveness of Progressively More Stringent Repower Scenarios

	All Tier 4 Final Diesel Engines versus 50% NZE	50% NZE versus 50% ZE	50% ZE versus 30% ZE, 50% NZE	30% ZE, 50% NZE versus 95% NZE	95% NZE versus 30% ZE, 65% NZE	30% ZE, 65% NZE versus 95% ZE
Incremental Cost-Effectiveness	$108,000	$11,977,000	$(2,371,000)	$2,065,000	$(15,126,000)	$10,511,000

Table 4-4: Incremental Cost-Effectiveness of ZE and/or NZE Scenarios Compared to an All Tier 4 Final Diesel Engine Repower Scenario

	All Tier 4 Final Diesel Engines versus 50% NZE	50% NZE versus 50% ZE	50% ZE versus 30% ZE, 50% NZE	30% ZE, 50% NZE versus 95% NZE	95% NZE versus 30% ZE, 65% NZE	30% ZE, 65% NZE versus 95% ZE
Incremental Cost-Effectiveness	$108,000	$14,183,000	$(2,640,000)	$1,974,000	$(14,492,000)	$10,511,000

RULE ADOPTION RELATIVE TO COST-EFFECTIVENESS

On October 14, 1994, the South Coast AQMD Governing Board adopted a resolution that requires staff to address whether rules being proposed for amendment are considered in the order of cost-effectiveness. The 2022 AQMP ranked, in the order of cost-effectiveness, all of the control measures for which costs were quantified. It is generally recommended that the most cost-effective actions be taken first. Proposed Amended Rule 1135 partially implements Control Measure for Large Combustion Sources, L-CMB-06: NOx Emission Reductions from Electricity Generating Facilities (L-CMB-06). The 2022 AQMP ranked Control Measure L-CMB-06 seventeenth in cost-effectiveness for stationary source control measures for ozone.

SOCIOECONOMIC ASSESSMENT

A socioeconomic impact assessment will be prepared and released for public review and comment at least 30 days prior to the South Coast AQMD Governing Board Hearing of Proposed Amended Rule 1135, which is scheduled for May 5, 2023 (subject to change).

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

Pursuant to CEQA and South Coast AQMD's certified regulatory program (Public Resources Code Section 21080.5, CEQA Guidelines Section 15251(l), and South Coast AQMD Rule 110), the South Coast AQMD, as lead agency for the proposed project, will be reviewing Proposed Amended Rule 1135 to determine if any potential adverse environmental impacts will occur. Appropriate CEQA documentation will be prepared based on the analysis.

DRAFT FINDINGS UNDER HEALTH & SAFETY CODE SECTION 40727

Requirements to Make Findings

H&SC Section 40727 requires that prior to adopting, amending or repealing a rule or regulation, the South Coast AQMD Governing Board shall make findings of necessity, authority, clarity, consistency, non-duplication, and reference based on relevant information presented at the public hearing, and in the staff report.

Necessity

Proposed Amended Rule 1135 is needed to establish BARCT emission limits at the electricity generating facility located at Santa Catalina Island and to extend the deadline to comply with emission limits for boilers and gas turbines at electricity generating facilities.

Authority

The South Coast AQMD Governing Board has authority to adopt amendments to Proposed Amended Rule 1135 pursuant to the H&SC Sections 39002, 40000, 40001, 40440, 40702, 40725 through 40728, 41508, and 41508.

Clarity

Proposed Amended Rule 1135 is written or displayed so that its meaning can be easily understood by the persons directly affected by it.

Consistency

Proposed Amended Rule 1135 is in harmony with and not in conflict with or contradictory to, existing statutes, court decisions, or state or federal regulations.

Non-Duplication

Proposed Amended Rule 1135 will not impose the same requirements as any existing state or federal regulations. The proposed amended rule is necessary and proper to execute the powers and duties granted to, and imposed upon, the South Coast AQMD.

Reference

In amending Rule 1135, the following statutes which the South Coast AQMD hereby implements, interprets or makes specific are referenced: H&SC Sections 39002, 40000, 40001, 40702, 40440(a), and 40725 through 40728.5.

COMPARATIVE ANALYSIS

H&SC Section 40727.2 requires a comparative analysis of the proposed amended rule with any Federal or District rules and regulations applicable to the same source. A comparative analysis is presented below in **Table 4-5**.

Table 4-5: PAR 1135 Comparative Analysis

Rule Element	PAR 1135	Rule 1110.2	Rule 2009	RECLAIM	40 CFR Part 60 Da	40 CFR Part 60 GG	40 CFR Part 60 KKKK	40 CFR Part 72
Applicability	Boilers, internal combustion engines, and turbines located at investor-owned electric utilities, publicly owned electric utilities, facilities with combined generation capacity of ≥ 50 MW	Gaseous and liquid fueled engine over 50 rated brake horsepower	Facility generating ≥ 50MW and owned or operated by Southern California Edison, Los Angeles Dept. of Water and Power, City of Burbank, City of Glendale, City of Pasadena, or any their successors	Facilities regulated under the NOx RECLAIM program (South Coast AQMD Reg. XX)	Electric utility steam generating units at a facility generating > 73 MW and constructed or modified after 9/18/78	Gas turbines with heat input of ≥ 10 MMBtu/hr constructed or modified before 2/18/2005	Gas turbines with heat input of ≥ 10 MMBtu/hr constructed or modified after 2/18/2005	Facilities regulated under the national sulfur dioxide and nitrogen dioxide air pollution control and emission reductions program
Requirements	Emission limits: • Boiler: NOx 5 ppmv @ 3% O2; Ammonia 5 ppmv @ 3% O2 • Combined Cycle Gas Turbine and Associated Duct Burner: NOx 2 ppmv @ 15% O2; Ammonia 5 ppmv @ 15% O2 • Simple Cycle Gas Turbine: NOx 2.5 ppmv @ 15% O2; Ammonia 5 ppmv @ 15% O2 Internal Combustion Engine: NOx 45 ppmv @ 15% O2; Ammonia 5 ppmv @ 15% O2; CO 250 ppmv @ 15% O2; VOC 30 ppmv @ 15% O2; PM 0.0076 lbs/MMBtu @ 15% O2	Existing Internal Combustion Engine: NOx 11 ppmv @ 15% O2; CO 250 ppmv @ 15% O2; VOC 30 ppmv @ 15% O2;	Submit Compliance Plan to demonstrate BARCT by 2003/2004	As determined by Rule 2009	NOx limit: 0.15 lb/MMBtu	NOx limit @ 15% O2: 0.0075*(14.4/Y) +F where Y = manufacture's rated heat input and F = NOx emission allowance for fuel-bound nitrogen	NOx limit for electric generating units (@ 15% O2): • ≤ 50 MMBtu/hr – 42 ppm when firing natural gas • 50 MMBtu/hr and ≤ 850 MMBtu/hr – 15 ppm when firing natural gas • >850 MBtu/hr – 15 ppm when firing natural gas • ≤ 50 MMBtu/hr – 96 ppm when firing other fuel • 50 MMBtu/hr and ≤ 850 MMBtu/hr – 74 ppm when firing other fuel • >850 MBtu/hr – 42 ppm when firing natural gas	NOx limits for boilers = 0.40 lb/MMBtu
Reporting	Annual reporting of NOx emissions	Breakdowns, monthly portable engine logs,	None	• Daily electronic reporting for major sources • Quarterly Certification of Emissions Report and Annual Permit Emissions	Daily written reports or quarterly electronic reports	Excess emissions and CEMS downtime within 30 days	Excess emissions and CEMS downtime within 30 days; annual performance testing within 60 days	40 CFR 75 requirements for quarterly reports of information and hourly data from CEMS monitors, and calibration

Rule Element	PAR 1135	Rule 1110.2	Rule 2009	RECLAIM	40 CFR Part 60 Da	40 CFR Part 60 GG	40 CFR Part 60 KKKK	40 CFR Part 72
				Program for all units				
Monitoring	• A continuous in-stack NOx monitor	A continuous in-stack NOx monitor for engines ≥ 1,000 bhp and operating more than two million bhp-hr per calendar year	None	A continuous in-stack NOx monitor for major sources	A continuous in-stack NOx monitor	A continuous in-stack NOx monitor	A continuous in-stack NOx monitor	A continuous in-stack NOx monitor
Recordkeeping	Performance testing; emission rates; monitoring data; CEMS audits and checks maintained for five years	Source testing or Relative accuracy tests per 40 CFR 70 at least once every two years	None	• < 15-min. data = min. 48 hours; • ≥ 15-min. data = 3 years (5 years if Title V) • Maintenance & emission records, source test reports, RATA reports, audit reports and fuel meter calibration records for Annual Permit Emissions Program = 3 years (5 years if Title V)	Performance testing; emission rates; monitoring data; CEMS audits and checks	Performance testing; emission rates; monitoring data; CEMS audits and checks	Performance testing; emission rates; monitoring data; CEMS audits and checks	Performance testing; emission rates; monitoring data; CEMS audits and checks maintained for three years
Fuel Restrictions	Liquid petroleum fuel limited to Force Majeure natural gas curtailment, readiness testing, and source testing	None	None	None	None	None	None	None