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, at publicly owned electric utilities, or which 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. PAR 1135 includes monitoring, reporting, and recordkeeping requirements for electric generating units located on Santa Catalina Island. A total of 29 electric generating units at one electricity generating facility is affected by PAR 1135.

The proposed final NOx emission limit is estimated to reduce NOx emissions at the electricity generation facility located on Santa Catalina Island by 65.3 tons per year, or 0.18 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. Six Working Group meetings were held on May 5, 2022, August 4, 2022, November 8, 2022, January 19, 2023, March 27, 2024, and June 13, 2024. 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 was held on February 22, 2023, and an additional one will be held on July 31, 2024. 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

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, at publicly owned electric utilities, or which have a generation capacity of at least 50 Megawatts (MW) 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

After a series of NOx rules for utility boilers were adopted in the 1970s, South Coast AQMD Rule 1135.1 – Controlling Emissions of Oxides of Nitrogen from Electric Power Generating Equipment[2] (Rule 1135.1) was adopted in 1980. Rule 1135.1applied to electric utilities with generating system capacity over 500 MW and required the use of least NOx dispatch to minimize NOx emissions. In 1982, the California Superior Court entered a judgment vacating Rule 1135.1, as the result of a lawsuit seeking to rescind Rule 1135.1. The judgement specified a decreasing annual NOx emissions cap until 1990 when a final NOx emissions cap was established.

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

[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

[2] South Coast AQMD, Rule 1135.1, http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1135-1.pdf?sfvrsn=4

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 in 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.

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 South Coast AQMD Rule 2009 – Compliance Plan for Power Producing Facilities (Rule 2009),[3] 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 MW.

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)[4] 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[5] 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.

[3] 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

[4] 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

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

AFFECTED FACILITIES AND EQUIPMENT

The proposed amendments to Rule 1135 impacts one electricity generating facility located on Santa Catalina Island. The electricity generating facility on Santa Catalina Island currently operates six diesel internal combustion engines and 23 microturbines to generate power. Over 90 percent of the power generated at the electricity generating facility on Santa Catalina Island is from diesel internal combustion engines. The diesel internal combustion engines on Santa Catalina Island produce approximately 10 to 70 times more NOx than other electric generating units subject to Rule 1135. The electricity generating facility on Santa Catalina Island produces more than 10 percent of the NOx emissions from all electricity generating facilities in South Coast AQMD while providing less than 0.06% of the power[6]. **Table 1-1** contains the equipment affected by PAR 1135.

Table 1-1: PAR 1135 Affected Equipment

Equipment Type	Rating (MW)	Construction Year	NOx Emissions[7]
Diesel Engine Unit 7	1	1958	97 ppmv (15% O_2, dry)
Diesel Engine Unit 8	1.5	1964	97 ppmv (15% O_2, dry)
Diesel Engine Unit 10	1.125	1968	140 ppmv (15% O_2, dry)
Diesel Engine Unit 12	1.5	1976	82 ppmv (15% O_2, dry)
Diesel Engine Unit 14	1.4	1985	103 ppmv (15% O_2, dry)
Diesel Engine Unit 15	2.8	1995	51 ppmv (15% O_2, dry)
Microturbines (23 units)	1.49	2011	0.07 lb/MW-hr

PUBLIC PROCESS

Development of PAR 1135 was conducted through a public process. Six Working Group meetings were held on May 5, 2022, August 4, 2022, November 8, 2022, January 19, 2023, March 27, 2024, and June 13, 2024. 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 was held on February 22, 2023 and another one will be held on July 31, 2024. 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.

[6] Based on the Final Staff Report for the 2018 amendment to Rule 1135 (9 MWh/15,904 MWh and 0.2 tpd/1.9 tpd)

[7] NOx emissions for diesel engines calculated by using the uncontrolled NOx emissions and control efficiency specified in Southern California Edison's Best Available Control Technology and Alternative Analysis for Pebbly Beach Generating Station (Version 00; Revised April 30, 2021) and NOx emissions for microturbines reflect the emission standard in the California Air Resources Board Distributed Generation Certification Regulation

CHAPTER 2: BARCT ASSESSMENT

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]

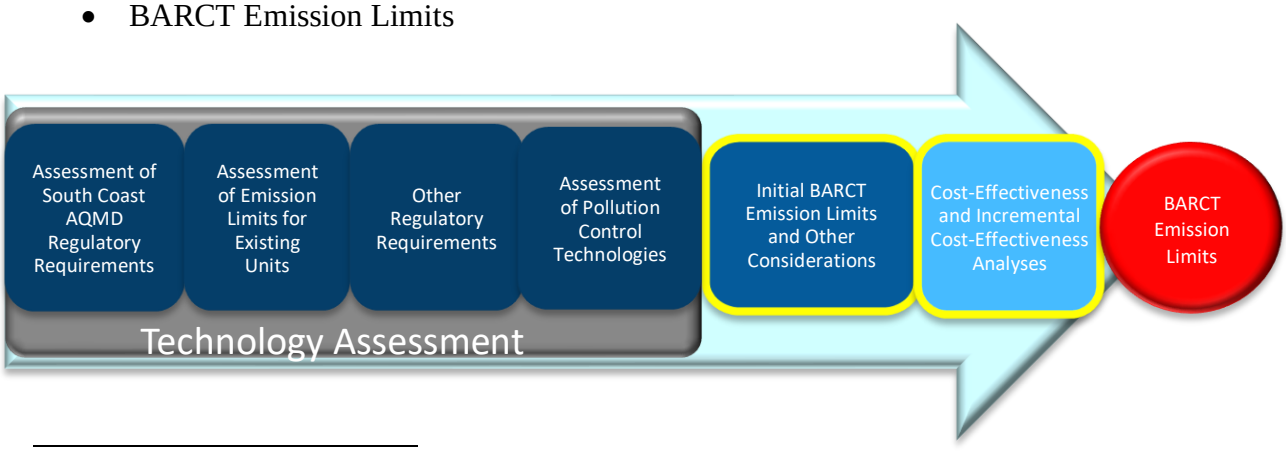
BARCT is defined in the Health & Safety Code Section 40406 as "an emission limitation that is based on the maximum degree of reduction achievable, taking into account environmental, energy, and economic impacts by each class or category of source." Consistent with state law, BARCT emission limits take 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, solar photovoltaic (PV) cells, and tidal and current energy harvesting systems 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 may 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 13 ton per year final 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 prime power diesel internal combustion engines are located on Santa Catalina Island. Five of these engines were installed more than 39 years ago and one was installed 29 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 proposed 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.

The electricity generating facility located on Santa Catalina Island also operates 23 propane fired microturbines to supplement the six prime power diesel internal combustion engines. The

[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

microturbines have registrations pursuant to Rule 222 – Filing Requirements for Specific Emission Sources Not Requiring a Written Permit Pursuant to Regulation II. The microturbine registration operating parameters specify that each gas turbine shall be certified with the State of California at the date of manufacture. The California Air Resources Board Distributed Generation Certification Regulation specifies a NOx emission limit of 0.07 lb/MW-hr.

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+
10	1575	1.125	1968	2003	SCR	6.5 lbs/Megawatt-hour (MW-hr)~
14	1950	1.4	1985	2003	SCR	6.5 lbs/MW-hr~
8	2150	1.5	1964	2003	SCR	6.5 lbs/MW-hr~
7	1500	1	1958	2003	SCR	6.5 lbs/MW-hr~
12	2200	1.5	1976	2003	SCR	6.5 lbs/MW-hr~
15	3900	2.8	1995	None	SCR	51 ppmv at 15% O_2, 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

The baseline emissions from the six prime power diesel internal combustion engines located on Santa Catalina Island were determined to be 71.3 tons of NOx per year based on Annual Emission Report (AER) data.[3] Emissions from microturbines located on Santa Catalina were not included in the baseline emissions calculation because the current definition of electric generating unit in Rule 1135 does not include microturbines.

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.

[3] 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 AERs for the reporting years of 2017, 2019, and 2021. The AER data for the 2018 reporting year was not available and the AER data or 2020 was not representative due to the COVID-19 pandemic, and therefore were not included.

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.

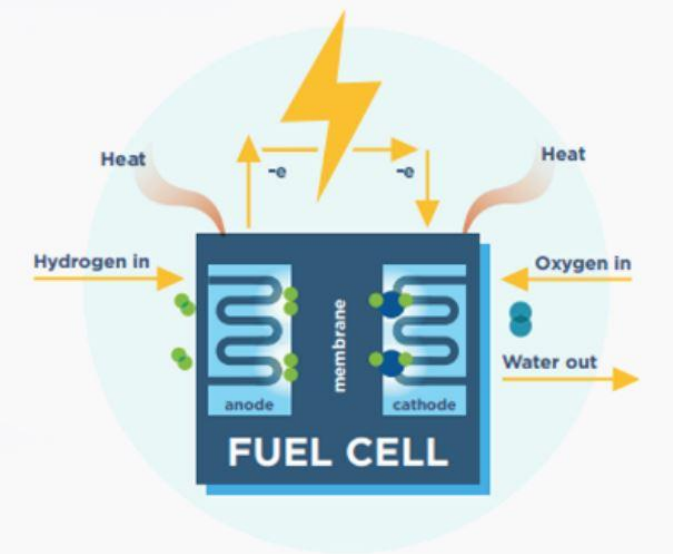


Figure 2-1: Typical Components of a Hydrogen Fuel Cell[4]

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. The products of a hydrogen fuel cell are electricity, water, and heat. Alternately, propane fuel cells are expected to produce less than 2.5 ppmv of NOx emissions.[5] 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 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.

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.

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

[5] 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

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 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)**.

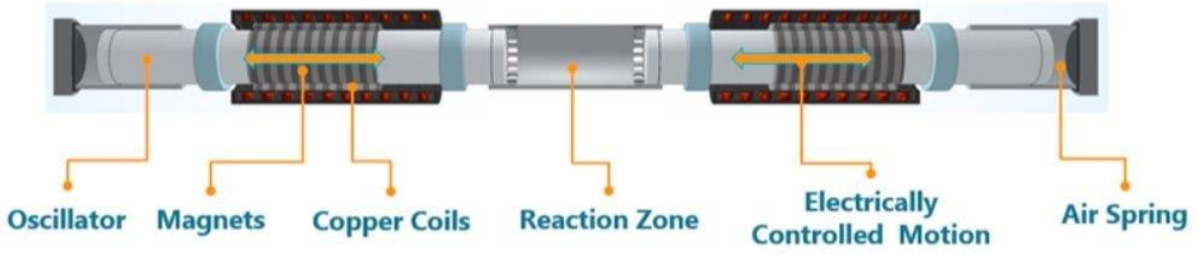


Figure 2-2: Components of a Linear Generator[6]

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. Metal plates on each side of the solar PV cell collect those electrons and transfer them to wires where electrons then flow as 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.

[6] 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

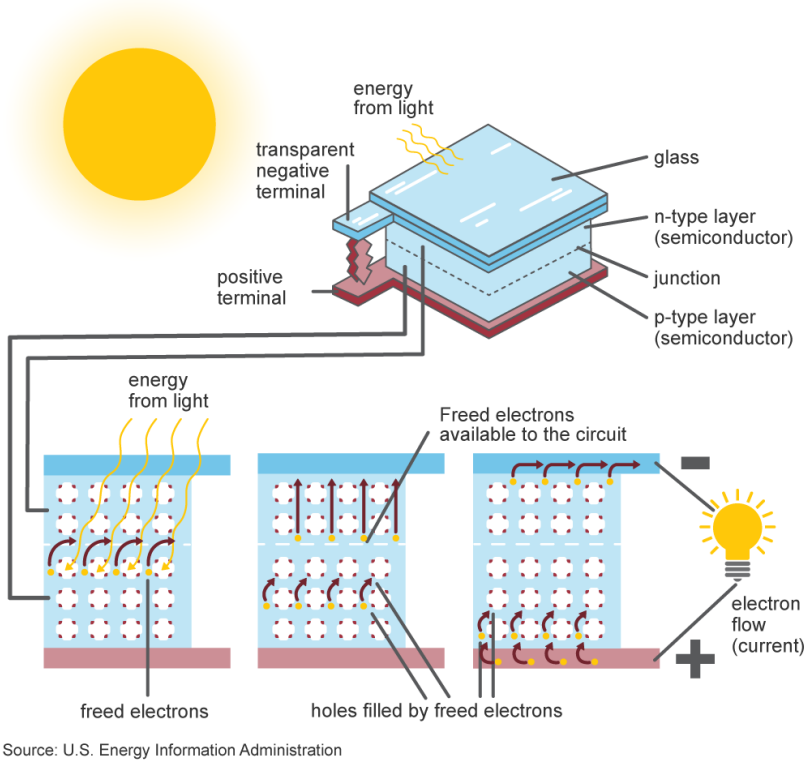


Figure 2-3: Inside a Solar PV Cell[7]

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.

Tidal and Current Energy Harvesting Systems

Tidal and current energy harvesting systems are a renewable ZE technology that generate electricity from tidal streams and ocean currents (**Figure 2-4**). Tidal and current energy harvesting systems generate power by the wing utilizing the hydrodynamic lift force created by the underwater current and the turbine being pulled through the water at a water flow higher than the stream speed. The turbine shaft turns the generator which outputs electricity to the grid via a power cable.

[7] 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

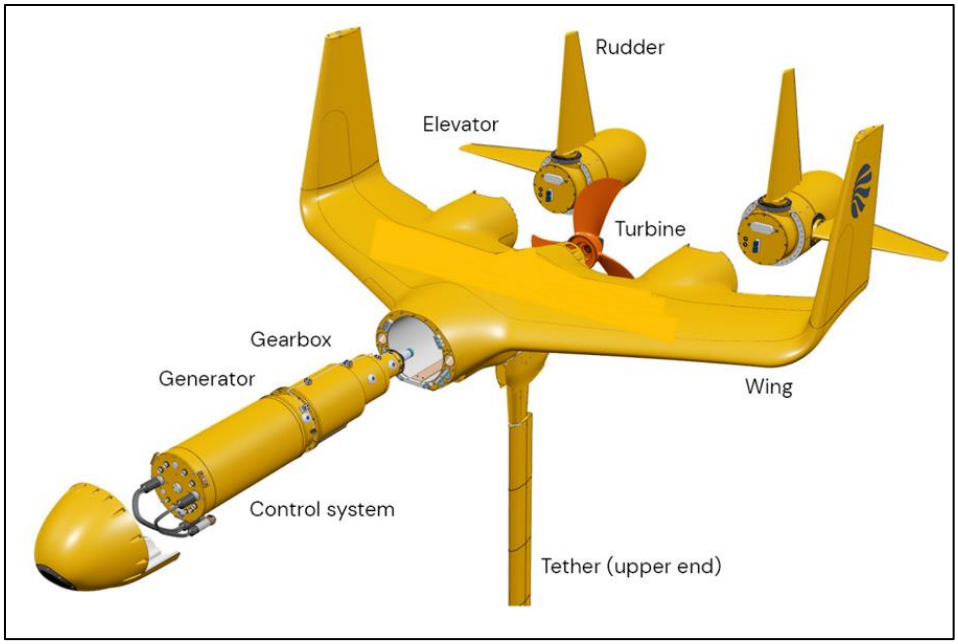


Figure 2-4: Tidal and Current Energy Harvesting System

Senate Bill (SB) 605 (Padilla, Chapter 405, Statutes of 2023) requires the California Energy Commission, in consultation with other state agencies, to evaluate the technological and economic feasibility of deploying wave and tidal energy[8]. Other requirements of SB 605 include identifying suitable sea space for wave and tidal energy projects and identifying monitoring strategies to evaluate impacts to marine and tidal ecosystems.

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 the 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 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. The average hourly load is approximately 3.3 Megawatts (MW). In September 2022, the electricity generating facility located on Santa Catalina Island reached a new peak load of 6.3 MW during a heat wave. The historical annual power generation and new peak load was used to determine feasible repower scenarios to establish BARCT.

[8] https://legiscan.com/CA/text/SB605/id/2844364

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 2-5**). The estimated available onsite space for ZE and/or NZE technologies is less than 5,000 square feet. The electricity generating facility located 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 2-5)**.

Figure 2-5: Land Availability at the Electricity Generating Facility Located on Santa Catalina Island

A – Microturbine platform
B – Diesel internal combustion engines

Staff analyzed the number of ZE and NZE units that could fit in the existing facility footprint (**Table 2-3**)[9]. Initially, staff anticipated that eight linear generators could fit on the microturbine pad. However, the electricity generating facility on Santa Catalina Island stated that the microturbine pad (location A in Figure 2-5) could likely only accommodate five linear generators due to required ancillary equipment. Staff repeatedly requested information from the electric generating facility located on Santa Catalina Island regarding the number of NZE units that could fit in location B in Figure 2-5, when considering ancillary equipment needed. The electricity generating facility located on Santa Catalina Island stated that they had not analyzed how many NZE units could fit at location B because six diesel engines are necessary to meet electricity demand. Therefore, the estimated number of ZE or NZE units in Table 2-3 does not account for potential ancillary equipment needed, except for linear generators located on the microturbine pad. The electric generating facility located on Santa Catalina Island has since stated plans to install NZE units at location B.

Table 2-3: Estimated Number of ZE or NZE Units Possible in Available Onsite Space

ZE or NZE Technology	Number of Units in Available Onsite Space	Electric Power Output (MW)
Propane Linear Generators	11	2.75
Hydrogen Linear Generators	11	2.75
Propane Fuel Cells	13	5.7
Hydrogen Fuel Cells	4	4

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 2-6**). 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.

[9] Staff's analysis assumed that ZE and/or NZE technologies were not stacked, however, some vendors stated that their technology has the capability of being stacked.

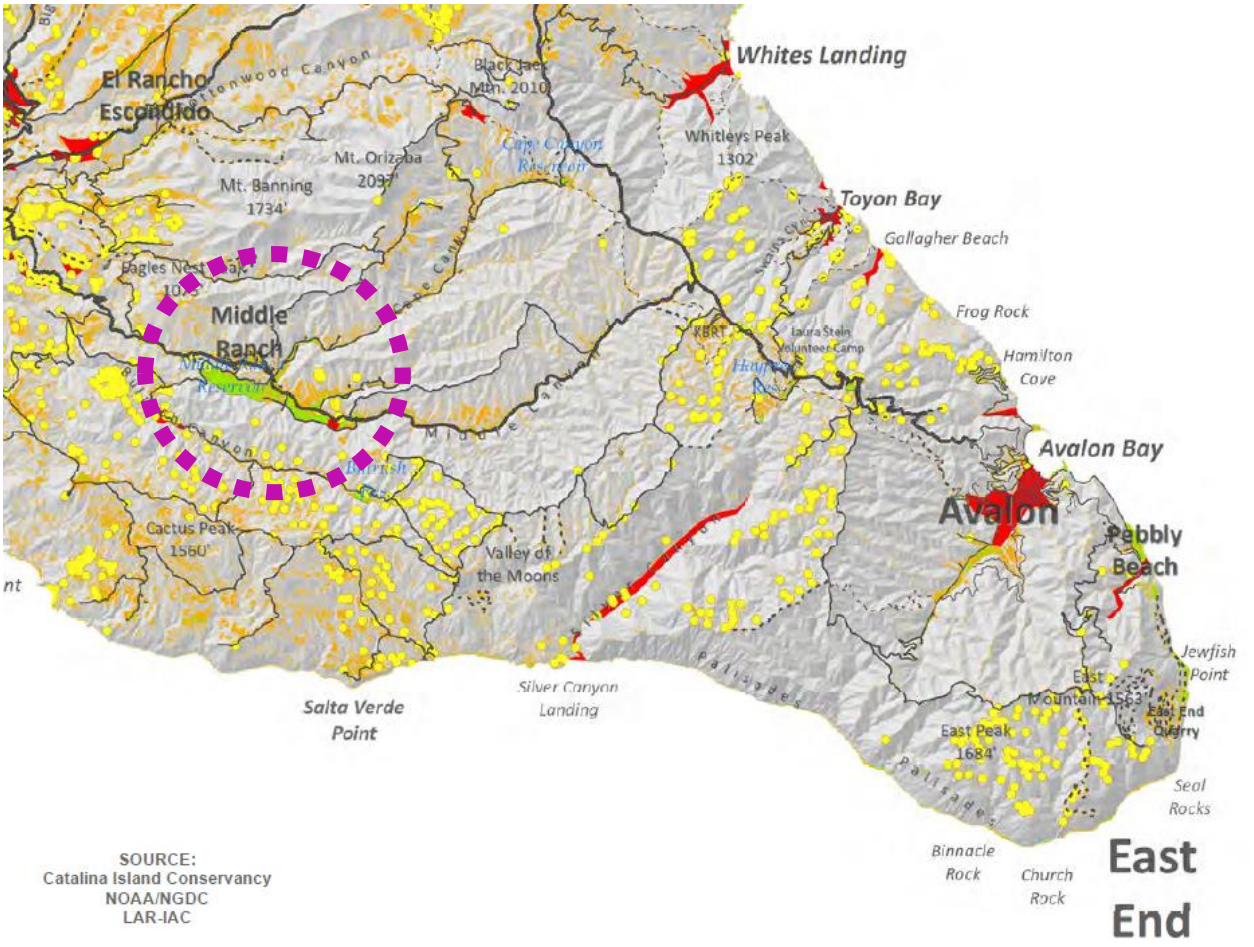


Figure 2-6: Middle Ranch area of Santa Catalina Island[10]

Fuel Storage

Santa Catalina Island does not have fueling infrastructure on the island; all fuel must be brought in by barges. 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 three of the existing diesel engines would be replaced with U.S. EPA Tier 4 Final diesel engines.

Constructing additional fuel storage beyond the existing 30-day supply for diesel and propane storage tanks is limited on the existing facility footprint. If ZE technologies fueled by hydrogen were to be utilized, the electricity generating facility located on Santa Catalina Island would most likely need to expand its existing footprint to accommodate ancillary fuel storage facilities.

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

Potential land for additional fuel storage was identified at a location adjacent to the electricity generating facility, but outside of the existing facility footprint. After an initial discussion with the landowning company, several unsuccessful attempts for further discussions led staff to determine that acquisition of the land could not be relied upon for the purposes of establishing a BARCT limit.

There are four 30,000-gallon propane storage tanks located at the electricity generating facility located on Santa Catalina Island. However, only three of the propane storage tanks are currently in service due to fire suppression requirements needed to bring the fourth propane storage tank online. Additional water storage for fire suppression is needed to operate the fourth propane storage tank.

Storage tank capacity can fluctuate throughout the year based on seasonal utility demand and gas expansion as temperature rises. Staff requested information from the electricity generating facility located on Santa Catalina Island regarding ambient temperature and daily propane tank percent fill from 2019 to 2023. Based on the data provided, staff found that there was no correlation between temperature and propane tank fill ($R^2 < 0.009$).

The electric generating facility located on Santa Catalina Island stated that a minimum fuel reserve of 25 percent storage tank capacity is required at all times[11]. The average capacity of the propane tanks is 67 percent, but the propane tanks can be filled up to a maximum aggregate capacity of 83 percent. Staff calculated a 2.9 day fuel reserve at average capacity[12]. Since the proposed BARCT limit incorporates 5% diesel engines and 30% ZE technology based on annual power generation (MW-hr per year), existing propane fuel storage was determined to be sufficient. In a scenario where 95% of power is generated using propane, staff calculates a fuel reserve average capacity just below 2 days.

Initial BARCT Emission Limit

Staff projected the number of fuel tanks necessary for ZE and NZE technologies fueled by hydrogen and propane, respectively. **Table 2-4** provides projections of fuel usage and associated fuel tanks delivered based on repower scenarios for the electricity generating facility located on Santa Catalina Island. Staff assumed a maximum capacity of 9,100-gallons (gal) of propane, 1,250-kilograms (kg), or 7,450 gallons of diesel per fuel tank[13]. The electricity generating facility located on Santa Catalina Island utilizes approximately 2 million gallons of diesel and 190,000 gallons of propane annually for power generation, which equates to approximately 300 fuel tanks. The electric generating facility located on Santa Catalina Island also utilizes approximately 650,000 gallons of propane annually for utility service, which equates to approximately 70 fuel tanks.

[11] Between 2019 to 2023, there were 7 days in which the propane tank capacity was below 25 percent

[12] Staff calculated days of propane storage based on three propane storage tanks, a 10-day utility fuel reserve, a 25% fuel reserve minimum, and fuel needed for 65% NZE technology for the proposed BARCT limit

[13] Fuel tank capacity for barge deliveries is included in the Southern California Edison Pebbly Beach Alternatives Study, Revised Final Action Plan (July 14, 2022)

Table 2-4: Hydrogen and Propane Fuel Tanks Estimated for Various Repower Scenarios

	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	2,146,200 kg	1,395,030 kg	2,860,690 gal	1,859,449 gal
Annual Number of Fuel Tanks	1,717	1,116	309	205

Staff determined a 95% ZE scenario to be technologically infeasible due to the number of fuel tanks required for hydrogen fueled ZE technologies. Staff is only aware of one barge that delivers fuel to Santa Catalina Island; the barge makes deliveries Monday through Friday. Based on historical fuel usage at the electricity generating facility on Santa Catalina Island, it is possible to deliver at least two tanks of fuel each day that the barge is operating. Staff assumed that the maximum amount of fuel that could be delivered to the electricity generating facility on Santa Catalina Island is two fuel tanks for 260 days out of the year. Therefore, repower scenarios that required over 448 fuel tanks annually were considered to be technologically infeasible[14]. Staff estimates approximately 1,730 fuel tanks would be required annually for a 95% ZE repower scenario using hydrogen fueled technologies. Additionally, a 95% ZE scenario with a combination of both solar PV cells and hydrogen fueled equipment was determined to be technologically infeasible. Due to 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 approximately 1,130 fuel tanks annually.

Furthermore, a 95% ZE scenario including hydrogen fueled technologies would likely require ancillary fuel storage facilities outside of the existing facility footprint. After several unsuccessful attempts with the landowning company of a potential fuel storage site, staff determined that acquisition of the land could not be relied upon for the purposes of establishing a BARCT limit. Moreover, even if land for additional fuel storage could be acquired, the hydrogen fuel source would eventually be depleted as there are currently not enough barges to replenish the hydrogen fuel reserves.

The repower scenario comprised of 95% propane fueled NZE and 5% diesel internal combustion is estimated to result in 309 fuel tanks being delivered annually. This is approximately three percent more fuel tanks being delivered for power generation than current operations.

The repower scenario comprised of 30% ZE, 65% NZE, and 5% diesel internal combustion engines is estimated to result in approximately 220 fuel tanks being delivered annually. The quantity of fuel tanks that would be delivered as a result of a repower scenario comprised of 30% ZE, 65% NZE, and 5% diesel internal combustion engines results in approximately 80 fewer fuel tanks being delivered for power generation than current operations.

[14] Staff's calculations account for the propane tanks that are delivered for utility service

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.

Staff later revised the initial BARCT limit to 1.8 tpy NOx after updating the emission factors used to calculate the final BARCT limit. The emission factors were updated to reflect the U.S. EPA standard for Tier 4 Final engines used in generator sets rated greater than 1200 hp (1.48 lbs/MWhr) and emission standard for Santa Catalina Island Zero-Emission Electric Generating Units defined in PAR 1135 (<0.01 lb/MWhr). The updated emission factors used are conservative, as Tier 4 Final engines can achieve more than 20 percent lower emissions depending on load. Furthermore, Santa Catalina Island Zero-Emission Electric Generating Units are not counted towards emission calculations, as specified in paragraph (e)(4) of PAR 1135.

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 located on Santa Catalina Island (**Table 2-5**). Staff evaluated the following technologically feasible repower scenarios based on annual power generation (MW-hr per year): all Tier 4 Final diesel engines; 50% NZE, 50% diesel internal combustion engines; 30% ZE, 50% NZE, 20% diesel internal combustion engines; 95% NZE, 5% diesel internal combustion engines; and 30% NZE, 65% NZE, 5% diesel internal combustion engines.

Table 2-5: Cost-Effectiveness Analysis for Santa Catalina Island Repower Scenarios

	All Tier 4 Final Diesel Engines	50% NZE, 50% Diesel Engines	30% ZE,+ 50% NZE, 20% Diesel Engines	95% NZE, 5% Diesel Engines	30% ZE,+ 65% NZE, 5% Diesel Engines
Net Annual Costs (includes annualized capital and O&M costs)	$2,296,000	$663,000	$2,076,000	$3,060,000	$1,924,000
NOx Emission Reductions (Tons/Year)	49.57	59.92	65.3	69.24	69.5
Cost-Effectiveness ($/Ton of NOx Reduced)	$46,000	$11,000	$32,000	$44,000	$28,000

+ Repower scenario requires the acquisition of land outside of the existing facility footprint

The initial BARCT limit of 1.8 tons per year NOx for the electricity generating facility located 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 2-6**) and against an all Tier 4 Final diesel engine scenario (**Table 2-7**). 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 2-6: Incremental Cost-Effectiveness of Progressively More Stringent Repower Scenarios

	All Tier 4 Final Diesel Engines versus 50% NZE, 50% Diesel Engines	50% NZE, 50% Diesel Engines versus 30% ZE, 50% NZE, 20% Diesel Engines	30% ZE, 50% NZE, 20% Diesel Engines versus 95% NZE, 5% Diesel Engines	95% NZE, 5% Diesel Engines versus 30% ZE, 65% NZE, 5% Diesel Engines
Incremental Cost-Effectiveness	$(158,000)	$263,000	$250,000	$(4,372,000)

The initial BARCT limit of 1.8 tons per year NOx for the electricity generating facility located 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 located 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 2-8**.

Table 2-8: Recommended BARCT Emission Limit

BARCT NOx Emission Limit	NOx (tons per year)
Recommended BARCT NOx mass emission limit	1.8

CHAPTER 3: SUMMARY OF PROPOSALS

INTRODUCTION

DEFINITIONS (Subdivision (c))

EMISSION 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 nitrogen (NOx) mass emission limits for electric generating units located on Santa Catalina Island, requirements to install Santa Catalina Island NZE electric generating units and/or Santa Catalina Island ZE electric generating units, and requirements to remove existing prime power diesel internal combustion engines from service. Additionally, PAR 1135 establishes provisions for monitoring, reporting, and recordkeeping for Santa Catalina Island near-zero-emission (NZE) electric generating units and electric generating units not required to install continuous emissions monitoring systems (CEMS) located on Santa Catalina Island. PAR 1135 also includes updates to remove outdated rule provisions, correct rule references, and other editorial changes.

DEFINITIONS (Subdivision (c))

PAR 1135 adds and modifies definitions to provide clarification New or modified definitions added to PAR 1135 include:

- *ANNUAL NOx MASS EMISSIONS means actual emissions of NOx produced from all electric generating units at an electricity generating facility between January 1st through December 31st.*

  This proposed definition provides clarity that NOx mass emission limits are calculated on a fixed basis per calendar year, rather than on a rolling basis.

- *ELECTRIC GENERATING UNIT means a boiler that generates electric power, a gas turbine that generates electric power with the exception of cogeneration turbines, or equipment that generates electric power and is located on Santa Catalina Island. An electric generating unit does not include emergency internal combustion engines and portable engines registered under the California Air Resources Board Statewide Portable Equipment Registration Program (PERP).*

  The definition was modified to broaden the definition of electric generating units located on Santa Catalina Island. The proposed definition includes all prime power electric generating equipment located on Santa Catalina Island.

- *SANTA CATALINA ISLAND NEAR-ZERO EMISSION (NZE) ELECTRIC GENERATING UNIT means any electric generating unit located on Santa Catalina Island that produces NOx emissions greater than 0.01 pounds per Megawatt-hour (lb/MW- hr) but less than or equal to 0.07 lb/MW-hr as demonstrated by a South Coast AQMD permit condition or other method determined to be equivalent by the Executive Officer.*

  This proposed definition provides clarity on the rate of emissions considered to be near-zero emission on Santa Catalina Island. Through the permitting process, staff will determine if equipment meets the emission requirements from a manufacturer guarantee, source test, or other approved method.

- *SANTA CATALINA ISLAND ZERO-EMISSION (ZE) ELECTRIC GENERATING UNIT means any electric generating unit located on Santa Catalina Island that produces NOx emissions less than 0.01 lb/MW-hr as demonstrated by a South Coast AQMD permit condition or other method determined to be equivalent by the Executive Officer.*

This proposed definition provides clarity on the rate of emissions considered to be zero-emission on Santa Catalina Island. The emissions requirement of less than 0.01 lb/MW-hr NOx for Santa Catalina Island ZE electric generating units is intended to address any potential emissions. However, Santa Catalina Island ZE electric generating units should have emissions of 0 lb/MW-hr NOx, as any equipment that may cause the issuance of air contaminants or may control air contaminants is required to have a permit, except for equipment specified in Rule 219 – Equipment Not Requiring a Written Permit Pursuant to Regulation II.

EMISSION LIMITS (Subdivision (d))

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, as the compliance deadline has passed. It is expected that the electricity generating facility located on Santa Catalina Island can meet the first interim limit of 45 tons per year of NOx by January 1, 2027 by replacing two older diesel engines with Tier 4 Final diesel engines.

Subparagraph (d)(2)(A) prohibits the electricity generating facility located on Santa Catalina Island from installing more than three new diesel internal combustion engines. Furthermore, new diesel internal combustion engines installed cannot exceed a maximum cumulative rating of 5.5 MW. The maximum cumulative rating is the sum of the name plate rating of each new diesel internal combustion engine. The new Tier 4 Final diesel engines proposed to be installed are rated at 1.825 Megawatts (MW) each. Staff rounded the maximum cumulative rating for the proposed three Tier 4 final diesel engines to 5.5 MW for simplicity.

Subparagraph (d)(2)(B) extends the deadline prohibiting the installation of any new diesel internal combustion engine from January 1, 2024 to January 1, 2028. Installation of any new diesel internal combustion must be completed by January 1, 2028. 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]. It is expected that the electricity generating facility located on Santa Catalina Island can meet the second interim limit of 30 tons per year of NOx by January 1, 2028 by replacing three older diesel engines with Tier 4 Final diesel engines. Due to the existing capacities of fuel storage and limitations to expand fuel storage outside of existing facility footprint, the extension of the prohibition deadline will provide reliability and redundancy in the event barge trips for propane fuel deliveries cannot occur.

Subparagraph (d)(2)(C) 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 January 1, 2028. 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.

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

Subparagraph (d)(2)(D) was also added to ensure that a minimum amount of Santa Catalina Island NZE electric generating units and/or Santa Catalina Island ZE electric generating units are installed. Santa Catalina Island NZE electric generating units and/or Santa Catalina Island ZE electric generating units will need to provide approximately 75 percent of the power at the electricity generating facility located on Santa Catalina Island to meet the final proposed NOx limit of 6 tons per year (tpy). Throughout the rule development process, the electricity generating facility located on Santa Catalina Island expressed that three Tier 4 final diesel engines are necessary to provide redundancy during maintenance and unplanned outages. Similarly, backup Santa Catalina Island NZE electric generating units and/or Santa Catalina Island ZE electric generating units are necessary to provide sufficient power during maintenance and unplanned outages to meet the final proposed NOx limit as well as minimize the use of diesel engines. Subparagraph (d)(2)(D) requires by January 1, 2030, installation of Santa Catalina Island NZE electric generating units and/or Santa Catalina Island ZE electric generating units with a minimum cumulative rating of 1.8 MW. The minimum cumulative rating is the sum of the name plate rating of each Santa Catalina Island NZE electric generating unit and Santa Catalina Island ZE electric generating unit installed, excluding the highest rated Santa Catalina Island NZE electric generating unit and/or Santa Catalina Island ZE electric generating unit, solar photovoltaic cells, and battery storage. Compliance with subparagraph (d)(2)(D) can be achieved in many ways. For example, installation of three propane engines rated 1.5 MW each would comply with subparagraph (d)(2)(D) because the cumulative rating when subtracting the highest rated Santa Catalina Island NZE electric generating unit is 3.0 MW[2]. However, installation of two propane engines rated 1.5 MW each would not comply with subparagraph (d)(2)(D) because the cumulative rating when subtracting the highest rated Santa Catalina Island NZE electric generating unit is 1.5 MW.

Subparagraph (d)(2)(E) will establish progressively more stringent NOx mass emission limits for the electricity generating facility located on Santa Catalina Island. The final proposed NOx emission limit is 6 tpy. The NOx mass emission limits include emissions from startups, shutdowns, and missing data substitutions.

Subparagraph (d)(2)(F) requires all prime power diesel internal combustion engines for which installation was completed earlier than *[Date of Adoption]* to be removed from service by January 1, 2030. If extensions are granted pursuant to subparagraphs (d)(3)(C) and (d)(5)(C), the compliance date will become six months after the any time extension granted. Therefore, all six existing prime power diesel internal combustion engines will be required to be removed from service by January 1, 2030 or six months after time extensions. Removing from service means physically removing the equipment from the facility or altering the equipment in such a way that it cannot be used without new construction activities. The January 1, 2030, compliance deadline in subparagraph (d)(2)(F) aligns with the implementation date of the 13 tpy NOx limit.

Subparagraph (d)(3)(A) requires that by January 1, 2028, the owner or operator conduct a feasibility analysis to determine if the proposed emission limits in clause (d)(2)(E)(iii) can be met by the compliance date. The analysis should identify the electric generating units under consideration, the progress in procuring and installing the electric generating units, a description

[2] Staff assumed that propane engines can meet the proposed Santa Catalina Island NZE Electric Generating Unit standard of 0.07 lb/MW-hr NOx for the subparagraph (d)(2)(D) compliance examples

of how those units would achieve the emission limits, and, if applicable, the length of time of up to three years for an extension to the implementation date.

Subparagraph (d)(3)(B) establishes a requirement that a request for a time extension shall be made available for public review no less than 30 days prior to approval.

Subparagraph (d)(3)(C) provides the criteria for which the Executive Officer will evaluate any extension request for approval.

Similarly, paragraphs (d)(3)(D) through (d)(3)(F) requires that by January 1, 2033, the owner or operator conduct a feasibility analysis to determine if the proposed emission limits in clause (d)(2)(E)(iv) can be met by the compliance date. The same requirements for public review and approval criteria apply.

Subparagraph (d)(5)(A) updates the time extension provision for the electricity generating facility on Santa Catalina Island. PAR 1135 allows the electricity generating facility located on Santa Catalina Island to request up to two time extensions; one time extension for the 13 tpy NOx limit and one time extension for the 6 tpy NOx limit. Each time extension can be approved for up to three years.

Subparagraph (d)(5)(B) establishes a requirement that a request for a time extension shall be made available for public review no less than 30 days prior to approval.

Clause (d)(5)(C)(ii) was updated to specify that the extenuating circumstances that demonstrate the need for a time extension are limited to unforeseen construction interruptions and/or supply chain disruptions.

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

Paragraphs (e)(1) to (e)(3) clarify that Santa Catalina Island NZE electric generating units rated less than or equal to 0.5 Megawatts (MW) and Santa Catalina Island ZE electric generating units do not require installation of continuous emission monitoring systems (CEMS).

Paragraph (e)(4) establishes a method to calculate NOx emissions from Santa Catalina Island NZE electric generating units rated less than or equal to 0.5 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 rated less than or equal to 0.5 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).

Paragraph (e)(5) requires records of all data used to calculate the annual NOx emissions from Santa Catalina Island NZE electric generating units rated less than or equal to 0.5 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)(6) requires the installation of a non-resettable device to continuously record the megawatt-hours hours for each Santa Catalina Island NZE electric generating unit rated less than or equal to 0.5 MW.

CHAPTER 4: IMPACT ASSESSMENTS

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 is one electricity generating facility located on Santa Catalina Island impacted by PAR 1135. The electricity generating facility on Santa Catalina Island currently operates six diesel internal combustion engines and 23 microturbines to generate power. Table 1-1 in Chapter 1 of the staff report contains more detailed information on the equipment affected by PAR 1135.

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 Tier 4 final diesel engines, Santa Catalina Island NZE electric generating units, and Santa Catalina Island ZE electric generating units.

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 on 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 and similar to the emission baseline used in the 2018 amendment to Rule 1135[2].

The proposed final NOx limit of 6 tpy can be achieved using a combination of Tier 4 final diesel engines, Santa Catalina Island NZE electric generating units, and Santa Catalina Island ZE electric generating units. Staff assumed a combination of 30% ZE, 50% NZE, and 20% diesel internal combustion engines for the purposes of the cost-effectiveness analysis. The proposed limit is estimated to reduce NOx emissions at the electricity generation facility located on Santa Catalina Island by 65.3 tons per year, or 0.18 tons per day. Estimated emission reductions were calculated by taking the difference between the baseline emissions from the electricity generating facility

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

[2] 2018 amendment to Rule 1135 used an emission baseline of 69 tpy NOx for the electricity generating facility located on Santa Catalina Island

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. Annual power generation for each equipment type was then multiplied by various emission factors: 1.48 lbs/MW-hr for Tier 4 final diesel engines, 0.07 lb/MW-hr for Santa Catalina Island NZE electric generating units, and 0.01lb/MW-hr for Santa Catalina Island ZE electric generating units. 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. Although the final NOx limit of 6 tpy proposed in PAR 1135 does not represent BARCT, staff still conducted a cost-effectiveness analysis. 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. Equipment life accounts for the monetary payoff of the equipment, not the operational life expectancy. A 20-year equipment life was assumed for repower scenarios with a mix to technologies. A 25-year equipment life was assumed for the all Tier 4 final diesel internal combustion engine repower scenario. 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 emission 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 facilities, including 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

[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

internal combustion engine on an electricity generating facility located on Santa Catalina Island is over 29-years old and the existing microturbines were provided by South Coast AQMD.

The cost-effectiveness analysis of each technologically feasible repower scenario evaluated for the electricity generating facility located on Santa Catalina Island is listed below in Table 4-1. Several variables impacted the cost-effectiveness of each repower scenario, however, the cost of fuel was the primary factor impacting cost-effectiveness. 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.

Table 4-1: Cost-Effectiveness Analysis of Repower Scenarios on Santa Catalina Island

	All Tier 4 Final Diesel Engines	50% NZE, 50% Diesel Engines	30% ZE, 50% NZE, 20% Diesel Engines	95% NZE, 5% Diesel Engines	30% ZE, 65% NZE, 5% Diesel Engines
Net Annual Costs (includes annualized capital and O&M costs)	$2,296,000	$663,000	$2,076,000	$3,060,000	$1,924,000
NOx Emission Reductions (Tons/Year)	49.57	59.92	65.3	69.34	69.5
Cost-Effectiveness ($/Ton of NOx Reduced)	$46,000	$11,000	$32,000	$44,000	$28,000)

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. Although the final NOx limit of 6 tpy proposed in PAR 1135 does not represent BARCT, staff still conducted an incremental cost-effectiveness analysis. 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 technologically feasible repower scenario is presented below in Table 4-2 and the incremental cost-effectiveness for each repower scenario measured against the all Tier 4 Final diesel engines scenario is presented below in Table 4-3.

Table 4-2: Incremental Cost-Effectiveness of Progressively More Stringent Repower Scenarios

	All Tier 4 Final Diesel Engines versus 50% NZE, 50% Diesel Engines	50% NZE, 50% Diesel Engines versus 30% ZE, 50% NZE, 20% Diesel Engines	30% ZE, 50% NZE, 20% Diesel Engines versus 95% NZE, 5% Diesel Engines	95% NZE, 5% Diesel Engines versus 30% ZE, 65% NZE, 5% Diesel Engines
Incremental Cost-Effectiveness	$(158,000)	$263,000	$250,000	$(4,372,000)

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 October 4, 2024 (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 reduce NOx emission limits at the electricity generating facility located on Santa Catalina Island.

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 4-3.

Table 4-3: 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	Concentration limits: • Boiler: NOx 5 ppmv @ 3% O2 • Combined Cycle Gas Turbine and Associated Duct Burner: NOx 2 ppmv @ 15% O2 • Simple Cycle Gas Turbine: NOx 2.5 ppmv @ 15% O2 Internal Combustion • Engine: NOx 45 ppmv @ 15% O2; CO 250 ppmv @ 15% O2; VOC 30 ppmv @ 15% O2; PM 0.0076 lbs/MMBtu @ 15% O2 NOx mass emission limits for the electricity generating facility located on Santa Catalina Island : • 45 tpy by January 1, 2027 • 30 tpy by January 1, 2028 •13 tpy by January 1, 2030 •6 tpy by January 1, 2035	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

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
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 Program for all units	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
Monitoring	A continuous in-stack NOx monitor for electric generating units that are not zero emission or near-zero emission and rated ≤0.5 MW	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