Proposed Amended Rule 1135
Emissions of Oxides of Nitrogen from Electricity Generating Facilities

Working Group Meeting #1

May 5, 2022

Join Zoom Webinar Meeting: https://scaqmd.zoom.us/j/95052088081

Webinar ID: 950 5208 8081

Teleconference Dial-In: 1-669-900-6833

Agenda

- Rule 1135 Background and Applicability
- 2022 Amendment – Santa Catalina Island Requirements
- Updated BARCT Assessment
- Next Steps

Background

Rule 1135 – Background and Applicability

Adopted in 1989 and amended in 2018 to implement Best Available Retrofit Control Technology (BARCT)

- Established NOx BARCT limits for all combustion units at RECLAIM and non-RECLAIM electricity generating facilities

Applies to electric generating units at electricity generating facilities

- Units include boilers, gas turbines, and Santa Catalina Island diesel internal combustion engines
- Excludes units located at landfills, petroleum refineries, and publicly owned treatment works

Most recently amended on January 7, 2022

- Addressed ammonia limits, startup and shutdown provisions, and monitoring, reporting, and recordkeeping
- Revised requirements for Santa Catalina Island engines
- Adopted resolution to revisit revised Santa Catalina Island requirements

Re-initiated rule development in February 2022 to assess Santa Catalina Island requirements

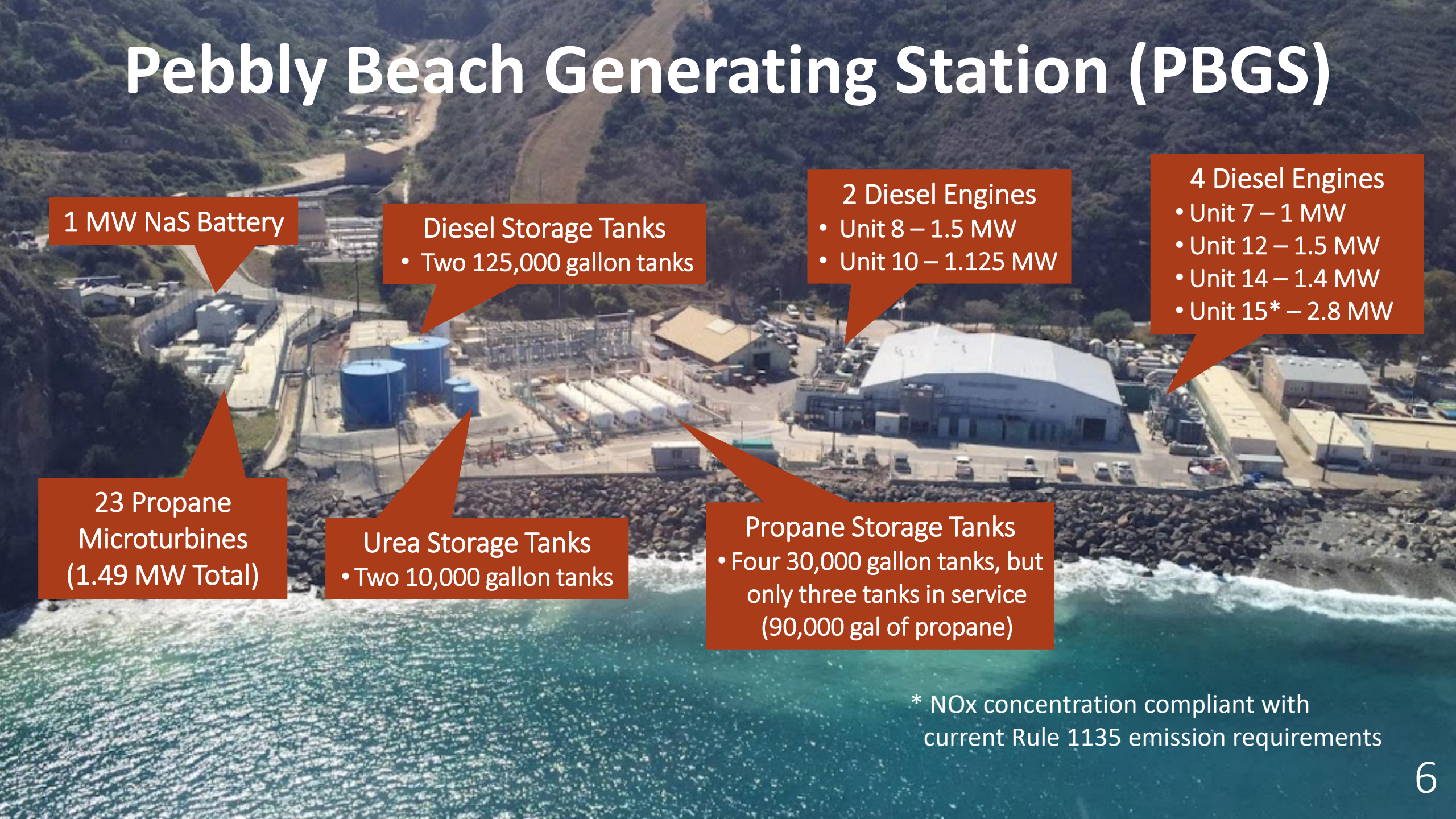
- Conduct more detailed technology assessment with focus on zero- and near-zero emission technologies (e.g. fuel cell, linear generator, solar)

Santa Catalina Island Engine Replacement Project

- Southern California Edison (SCE) currently provides electric generation for Catalina Island using six diesel internal combustion engines
- Rule 1135 (2018) required engines meet:
  - **Option 1:** NOx limit that represents replacing engines with U.S. EPA Tier IV diesel engines by 2024; or
  - **Option 2:** NOx emission cap of 13 tons per year by 2026 with combination of zero or near-zero emission technologies and Tier IV diesel engines
- SCE conducted a feasibility study* that concluded Option 1 to be most cost-effective
- During last rulemaking, concerns raised about Option 1 to allow diesel engine replacements
  - New developments in fuel cell technologies
  - Concerns for diesel engine replacements – toxic air contaminants and maximizing NOx emissions

* "Santa Catalina Island Repower Feasibility Study," authored by consulting group NV5 in partnership with the National Renewable Energy Laboratory and U.S. Environmental Protection Agency. https://www.sce.com/about-us/reliability/upgrading-transmission/catalina-repower

Pebbly Beach Generating Station (PBGS)



* NOx concentration compliant with current Rule 1135 emission requirements

2022 Amendments to Santa Catalina Island Requirements and Adoption Resolution

Emission Requirements

- Removed Option 1 allowing full diesel engine replacement
- Established 13-ton annual NOx emission cap by 2026
  - Option for three-year time extension retained
- Added interim NOx emission caps*:
  - 50 tons per year in 2024
  - 45 tons per year in 2025
- Added prohibition on new diesel engines after January 1, 2024

* Represents replacement of two or three diesel engines

Diesel Engine BARCT Limits

- Meet 45 ppmv for new engine installations
- Revised NOx averaging period from 60 minutes to 3 hours for new diesel engines

2022 Adoption Resolution and Engine Replacement Status

- At their January 7, 2022 meeting, Governing Board adopted resolution to re-initiate rulemaking in first quarter of 2022 to further assess the 2026 NOx emission cap of 13 tons per year
- Since then, staff is conducting an updated BARCT assessment and evaluating zero-emission and near-zero emission technologies
  - Updated BARCT assessment will inform if amendments to the Catalina Island requirements are needed
- SCE has submitted permit applications for replacement of up to three engines to meet 2024 and 2025 NOx emission caps
  - Units 8 and 10 (highest emitting engines) to be replaced with two new Tier 4 diesel engines
  - SCE evaluating modification or replacement of Unit 15 to bring unit into compliance with Rule 1470[1]
    - Unit currently under Abatement Order for being out of compliance with Rule 1470 particulate emission requirements
    - Unit 15 relied on heavily due to being lowest emitting and largest engine

[1] Rule 1470 – Requirements for Stationary Diesel-Fueled Internal Combustion and Other Compression Ignition Engines
https://www.aqmd.gov/docs/default-source/rule-book/reg-xiv/rule-1470.pdf?sfvrsn=8

Updated BARCT Assessment

Scope of Updated BARCT Assessment

- Updated BARCT assessment will include:
  - Detailed technology assessment focused on near-zero and zero emission technologies that can replace some or all existing diesel internal combustion engines on Santa Catalina Island
  - Evaluate Cost-effectiveness and incremental cost-effectiveness analyses
    - Current threshold is $50,000 per ton NOx reduced
- Technology assessment will evaluate technologies that are commercially available and able to be implemented for 2026 compliance deadline of 13-ton cap
- Goals are to:
  - Evaluate best approach to maximize NOx emission reductions from power generation for Catalina Island
  - Minimize use of diesel internal combustion engines

Approach to Technology Assessment

Determine project parameters for repowering Santa Catalina Island

Meet with vendors of zero and near-zero emission technologies and gather information on:

- Unit specifications (e.g. kW/MW capacity, size dimensions, fuel consumption rate)
- Fuel specifications (e.g. fuel type, footprint for storage, infrastructure and logistical requirements)
- Additional operation requirements (e.g. water usage, fire safety measures)
- Preliminary designs for unit siting and fuel storage

Seek input from SCE about vendor information and refine initial design proposals to address site-specific conditions or concerns

Gather cost information and proceed with cost-effectiveness and incremental cost-effectiveness analyses

- Costs include capital, installation, operation and maintenance, permitting, etc.
- Evaluate cost over NOx emissions reduced from technology and relative to alternative control options for the life of the equipment

Technology Assessment will be a collaborative process

- Staff seeking input on technologies to explore, findings, and feasibility of technology

PBGS Repower Parameters

Electrical Capacity:
5.5 MW

- Based on PBGS's historical hourly electrical load profile[1]
- By January 1, 2024, two or three new 1.83 MW (2,655 bhp) Tier 4 diesel engines would be installed to provide 3.66 to 5.49 MW of power
  - If repower with near-zero/zero emission technology, new engines would be converted to backup duty or planned maintenance

Available Onsite Space:
~8,750 – 10,300 sq. ft.

- Includes space from removal of three or four diesel engines, all 23 microturbines, and one diesel storage tank
- Purchasing land for additional space may be challenging
  - 88% of land on Catalina is owned by the Catalina Island Conservancy

Fuel Storage:
30 days

- Fuel for existing units must be barged in; island has no natural gas infrastructure
- Historically, site maintains a 30-day fuel reserve to ensure continuity of operations if fuel deliveries are interrupted

[1] 2015-2017 (Source: https://www.nrel.gov/docs/fy21osti/76779.pdf)

Electrical Capacity

- Average hourly load approximately 3.3 MW with a recorded peak load of 5.5 MW
- PBGS can meet peak load with four diesel engines running
- Microturbines and NaS battery used for peak load coverage and as intermediate step between dispatch of diesel engines
  - All 23 microturbines nearing end of equipment life and plan to be removed
  - Battery operational until 2031

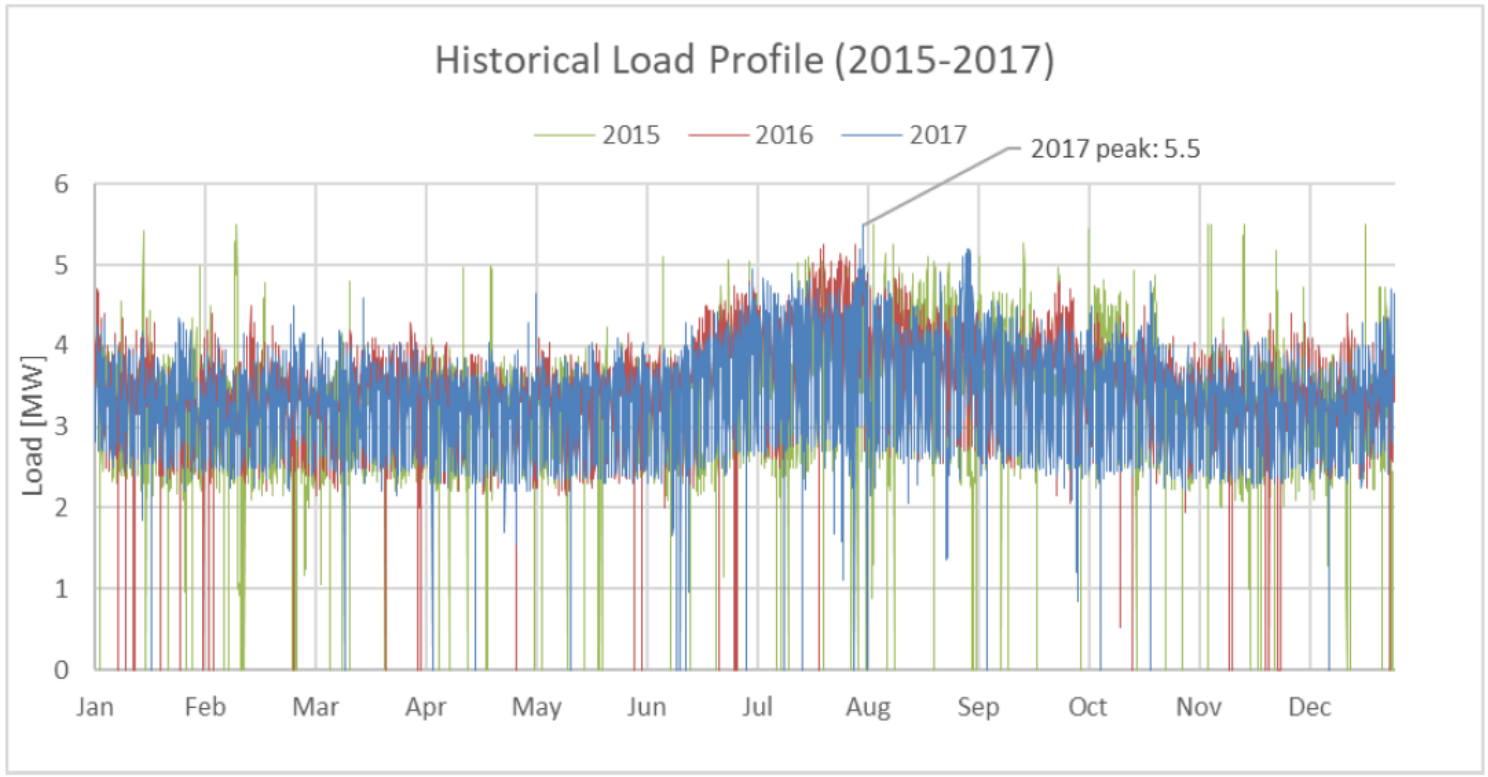


Figure 2. Historical hourly electrical load profile, 2015–2017

Source: SCE (2020)

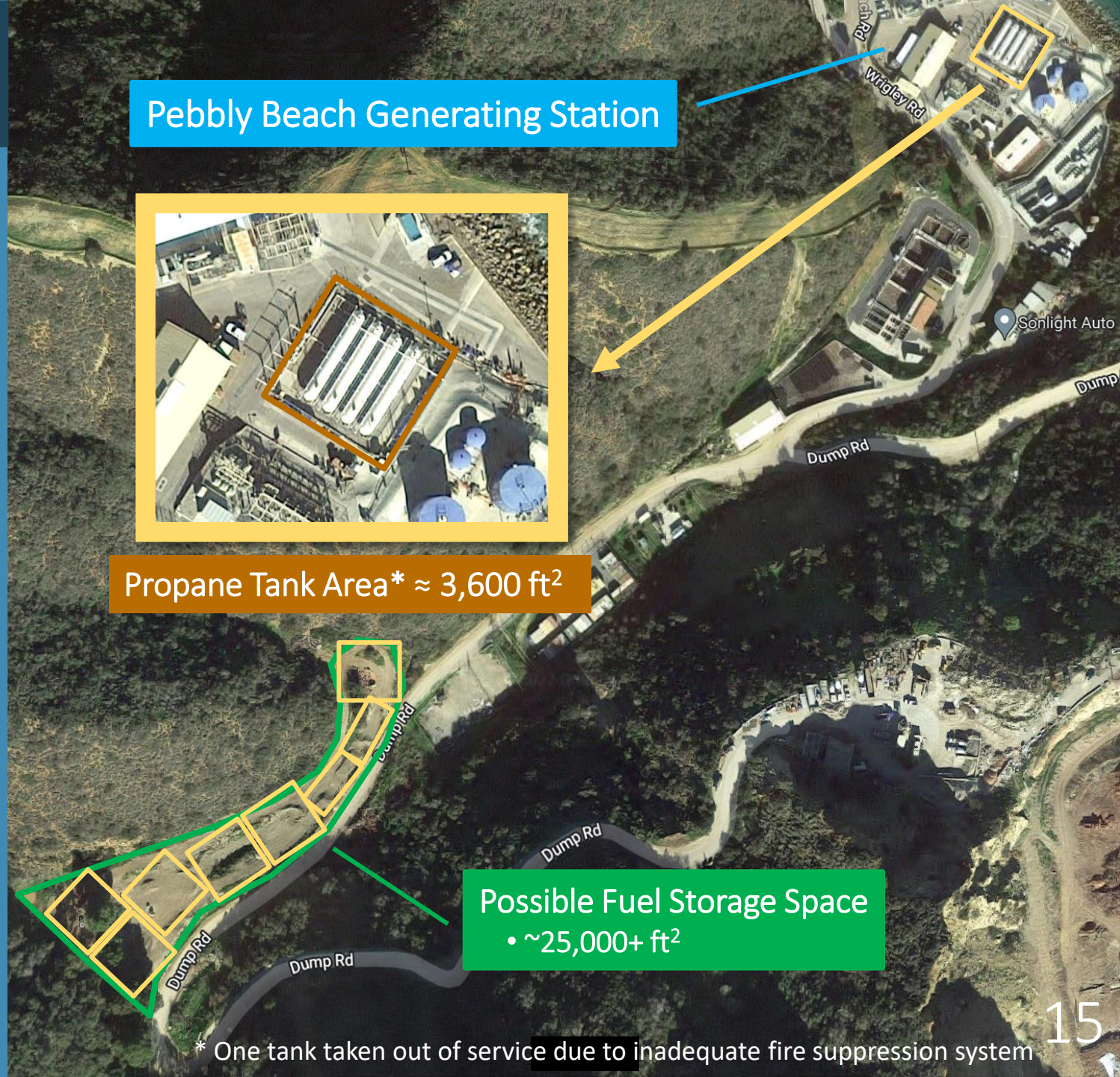
Available Onsite Space

1. Diesel Engines (4) ≈ 3,656 ft²
   - a. Unit 15 ≈ 1,579 ft² (52.2 x 30.3)
   - b. Unit 12 ≈ 738 ft² (37.2 x 19.8)
   - c. Unit 7 ≈ 441 ft² (36.8 x 12.0)
   - d. Unit 14 ≈ 898 ft² (44.2 x 20.3)
2. Diesel Tank Area ≈ 4,065 ft²
3. Microturbine Platform ≈ 2,610 ft²

- Estimated available space limited to existing footprints of equipment or structures due to:
  - Groundwater monitoring wells located throughout site
  - Clearance requirements

Fuel Storage

- PBGS has 30-day fuel storage onsite for diesel and propane
- Propane gas plant supplies fuel for microturbines and utility gas for island
  - Average monthly propane consumed: 54,000 gal (can be ~2x more in winter months)
  - 59 – 95% of propane volume used for utilities
- Repower project must ensure continuous fuel supply for electric generating units and retain propane storage for gas services
- Long-term fuel reserve on island may be needed to address potential interruptions in fuel deliveries (e.g. Barges run less in winter due to high seas)
- SCE Feasibility Study identified potential space for additional fuel storage
  - Land owned by Catalina Island Company



* One tank taken out of service due to inadequate fire suppression system

Potential Fuel Storage Space

- Proposed siting of additional fuel storage (e.g. propane) at potential off-site space by SCE Feasibility Study

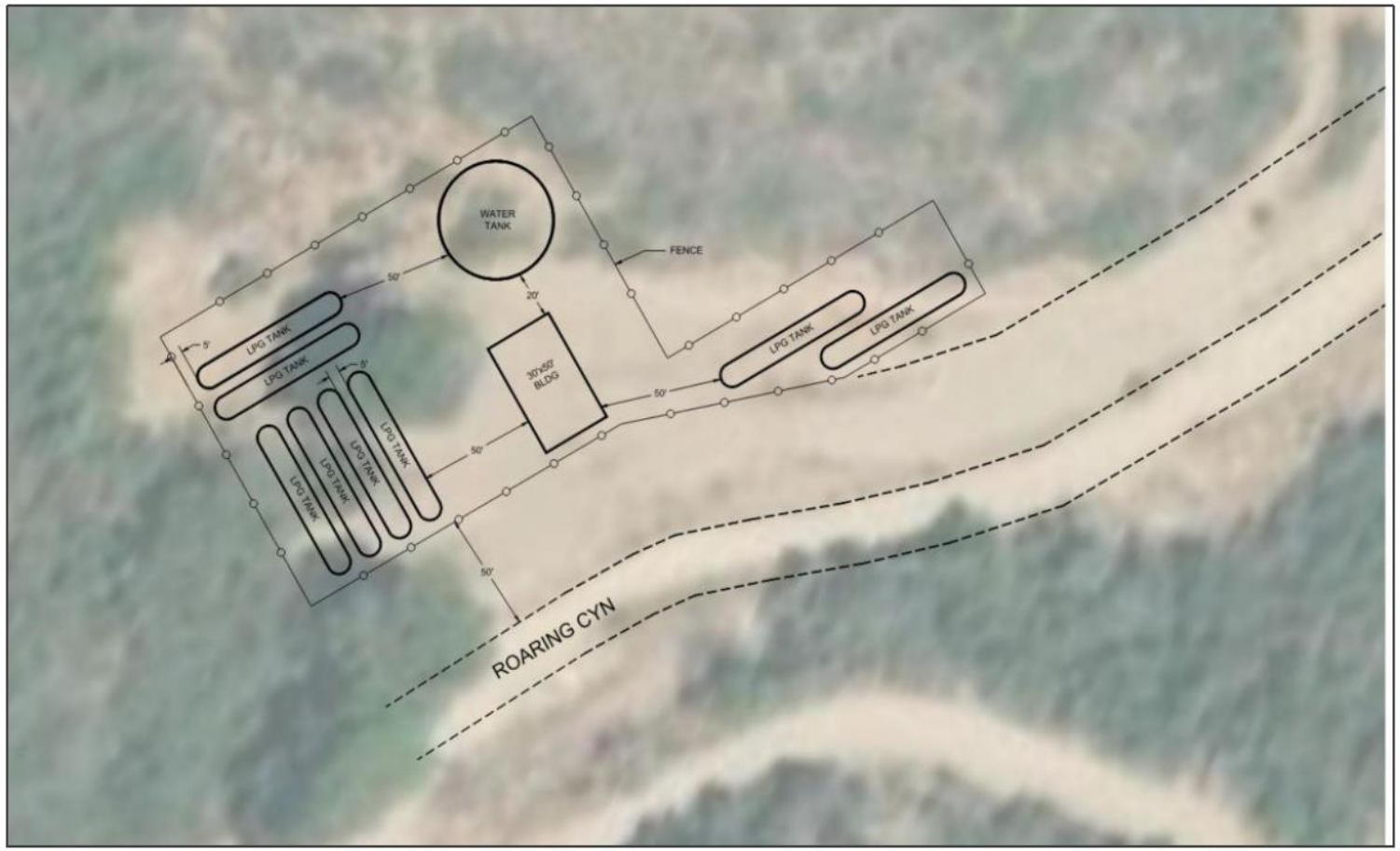


Figure 3-4 - Propane Storage for 100% Propane Generator Fleet

Technologies to be Assessed

- Near-Zero Emission
  - Electric generating units meeting the NOx emission standards in the California Air Resources Board's Distributed Generation (DG) Certification Regulation

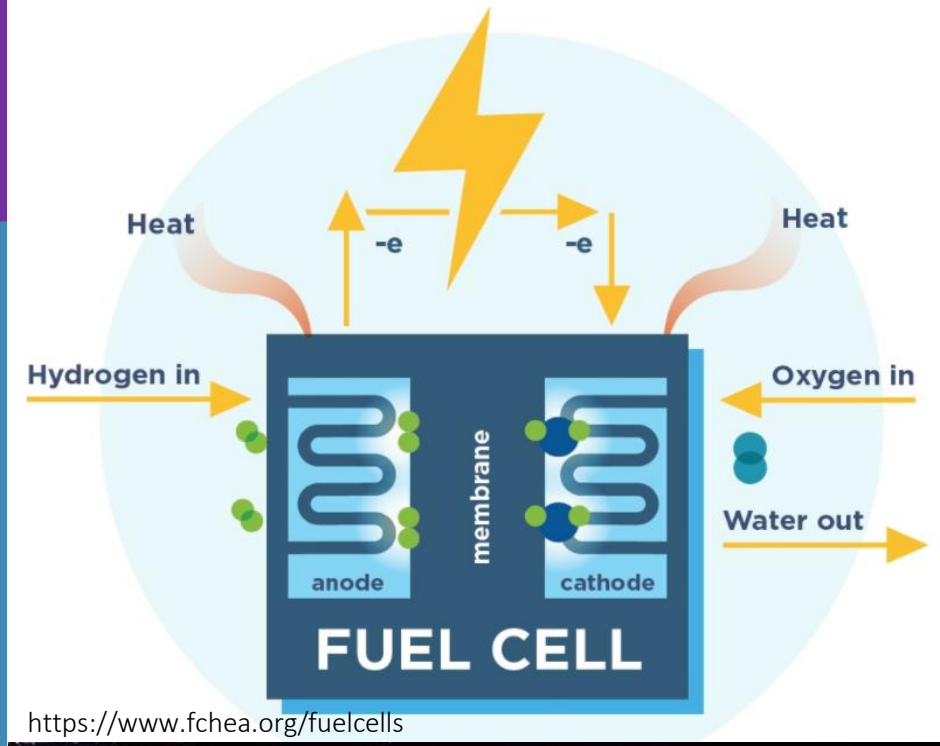
DG Unit Fuel	NOx Emission Standard (lb/MW-hr)	NOx Concentration[1] (ppmvd)
Fossil Fuel (2007)	0.07	2.5
Waste Gas (2013)	0.07	2.5

[1] Calculated using a 40% thermal efficiency

  - Includes fossil fuel-operated fuel cells, linear generators
- Zero Emission
  - Electric generating units that do not emit any NOx emissions
  - Includes hydrogen fuel cells, renewables (solar)
- Staff has been in contact with multiple vendors for each technology

Fuel Cells

- Hydrogen is fed into a fuel cell and combined with oxygen from air in an electrochemical reaction to generate electricity, heat, and water:
  - Anode separates hydrogen atoms into protons and electrons
  - Electrolyte (center) allows only protons to pass through to the cathode
  - Electrons that cannot pass through electrolyte flow through an external circuit, which creates electricity
  - Cathode helps oxygen, protons, and unused electrons combine to produce water and heat
- Individual fuel cells are grouped together to form a fuel cell stack to increase power output
- Zero-emission fuel cell systems are directly fueled by pure hydrogen
- Near-zero emission fuel cell systems extract hydrogen from hydrocarbon fuel to feed the fuel cell
  - Five fuel cell models currently certified to CARB's DG Certification Regulation



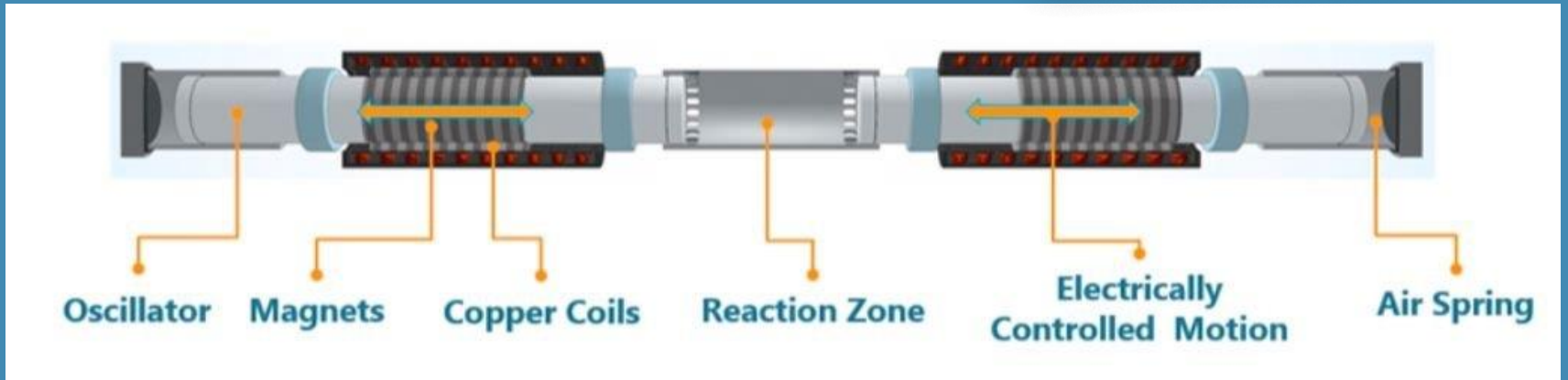
https://www.fchea.org/fuelcells

https://www.powermag.com/new-fuel-cell-power-plants-deployed-in-south-korea-and-california/

Linear Generators

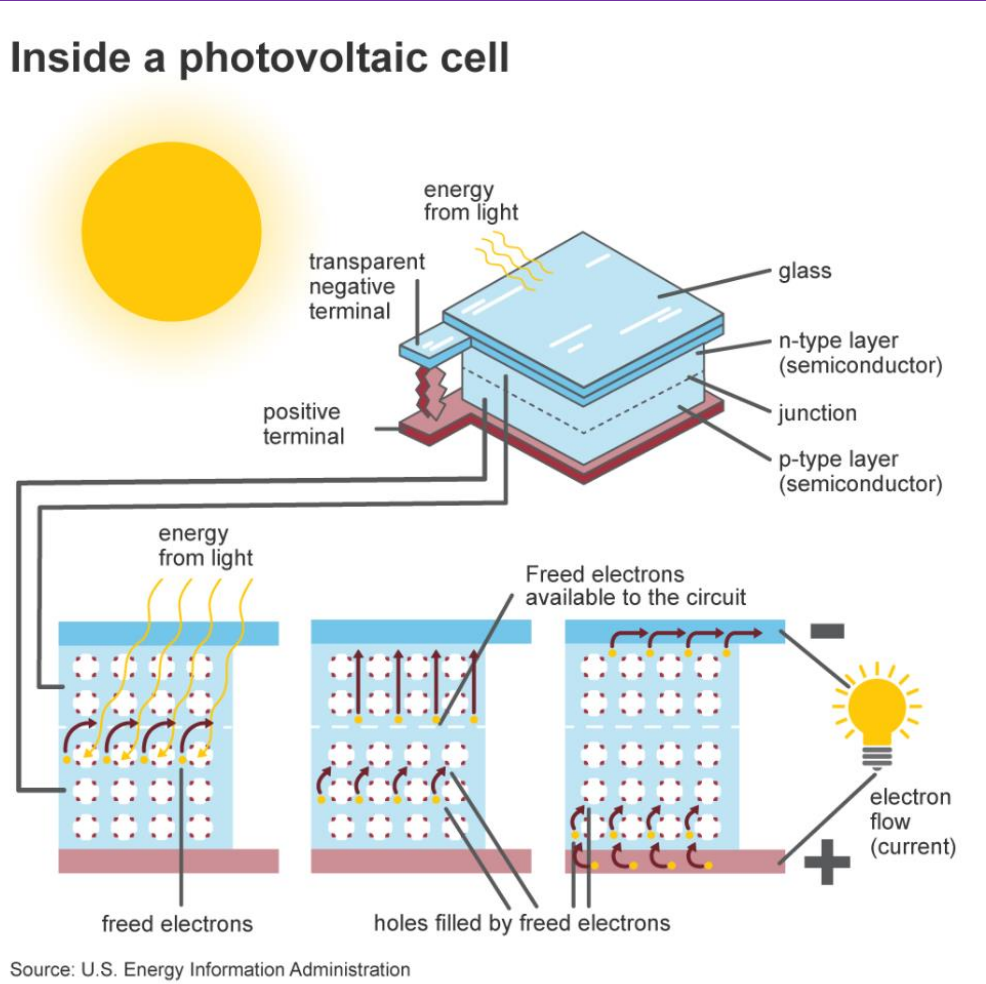
- A linear generator directly converts linear motion into electricity:
  - Compresses a fuel and air mixture in a center reaction zone until a uniform reaction occurs without a flame or burning
  - Energy created from the reaction drives linear motion of oscillators
  - Attached to oscillators are magnets, which interact with copper coils during linear motion to create electricity
- Linear generator maintains reaction temperatures below levels at which NOx forms, resulting in near-zero NOx emissions


https://www.mainspringenergy.com/



Solar Photovoltaic (PV) Cells

- A PV cell generates electricity when exposed to sunlight:
  - Semiconductor material absorbs sunlight and transfers the energy to electrons
  - Electrons are freed from the semiconductor material and flow to the top of the cell as an electrical current
  - Electrical current is captured by conductive metal contacts and flows as electricity
- PV cells are chained together to form modules or panels to increase power output
- PV cells can supply power through different systems:
  - On-Grid: Excess power produced by solar panels is fed to the local utility grid, which can supply power that solar panels are not producing (e.g. at night)
  - Off-Grid: Solar panels charge batteries, where electricity is drawn
  - Hybrid: Solar panels are connected to the grid and a battery backup to store excess power



Specifications of Technologies to be Assessed

Technology	Fuel Options	Range of Power Output per Unit	Range of Footprint (Sq. Ft.) per Unit	Range of Fuel Rate Consumption for 5.5 MW (gal/day)
Fuel Cells	• Hydrogen • Natural Gas • Propane • Biogas	100 kW – 2.8 MW	68 – 928	9,700 – 27,900
Linear Generators	• Hydrogen • Natural Gas • Propane • Biogas	230 – 250 kW	175	10,600 – 33,500

Technology	Installation Options	Panel Power Output	Power Output per Sq. Ft. of Panels
Solar (PV)	• Ground • Rooftop • Carport • Floating	250 – 400 W	8 – 22 W

Summary of Re-initiated Rule 1135 Rulemaking

- Staff is conducting an updated BARCT assessment to re-evaluate the Rule 1135 Santa Catalina Island emission requirements and maximize NOx reductions from power generation on island
- Technology assessment will focus on zero- and near-zero emission technologies (e.g. fuel cells, linear generators, solar) to provide up to 5.5 MW electrical load
- Parameters for repowering include:
  - On-site space available from removal of four diesel engines, microturbines, and one diesel storage tank with possible additional off-site space
  - Fuel reserve or supply (up to 30 days) to ensure continuous operations
- Staff is in contact with multiple technology vendors and seeking input for more zero- or near-zero emission technologies to consider




Next Steps

Next Steps

- Continue discussions with technology vendors and SCE
- Hold Working Group Meeting #2 in June/July 2022 to present evaluations of technologies assessed
- Present results of technology assessment to the Stationary Source Committee in August 2022
- Public Hearing tentatively scheduled for November 2022

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