



Challenge Statement

Energy Division

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Presentation Outline

Why Replace Diesel?	10:15 – 10:20 am
The Technical Problem	10:20 – 10:25 am
The Logistical Problem	10:25 – 10:30 pm
Cost, Timing and Uncertainty	10:30 – 10:35 pm
Overview of the Challenge Statement	10:35 – 10:40 pm



Why Replace Diesel?



Climate Effects of Diesel Generation

Scale:

- If all the safe-to-energize load during every 2019 PSPS event were powered using diesel, it would be equivalent to:
 - About 0.009 percent of California's total yearly emissions.
 - About 0.06 percent of California's yearly emissions from the electricity sector.

Or adding about 9000 new cars to the road during that year.



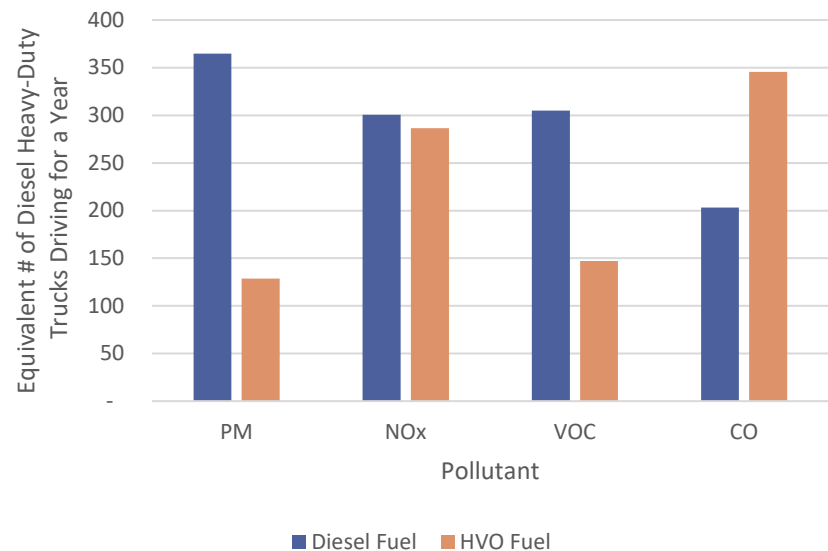


Air Quality Effects of Diesel Generation

Scale:

- If all the safe-to-energize load during every 2019 PSPS event were powered using diesel, it would be equivalent to:
 - About 300 Heavy Duty Diesel Trucks driving over the course of a year.*
 - About 6000 additional Heavy Duty Diesel Trucks driving on an average 2019 PSPS day.**

Air Pollution Effects if Diesel had been used to Power All Safe-to-Energize Substations During 2019 PSPS



* 100,000 mi per truck per year ** 270 mi per truck per day



The Impacts of Losing Power

- Expectation to keep the lights on.
- Access and Functional Needs Populations may depend on power.
- Critical Facilities depend on power.
- Loss of power can have economic and other widespread impacts.

The screenshot shows a CNBC news article. The top navigation bar includes 'MARKETS', 'BUSINESS', 'INVESTING', 'TECH', 'POLITICS', and 'CNBC TV'. The article title is 'PG&E power outage could cost the California economy more than \$2 billion'. The author is Pippa Stevens (@PIPPASTEVEN13). The article is categorized under 'MARKETS'. The publication date is 'PUBLISHED THU, OCT 10 2019-12:56 PM EDT' and the update date is 'UPDATED THU, OCT 10 2019-8:28 PM EDT'. There are social media share icons for Facebook, Twitter, LinkedIn, and Email. A 'KEY POINTS' section lists two bullet points: 'In an unprecedented move, PG&E enacted large-scale power cuts in Northern and central California as a preventative measure aimed at curbing wildfires.' and 'In January, PG&E filed for bankruptcy protection, saying it's facing more than \$30 billion in liabilities after it was determined that its power lines sparked last year's devastating Camp Fire.' To the right, there is a 'TRENDING' section with a small image of a man in a suit.

CNBC SIGN IN PRO WATCHLIST MARKETS

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MARKETS

PG&E power outage could cost the California economy more than \$2 billion

PUBLISHED THU, OCT 10 2019-12:56 PM EDT | UPDATED THU, OCT 10 2019-8:28 PM EDT

Pippa Stevens
@PIPPASTEVEN13

SHARE

KEY POINTS

- In an unprecedented move, PG&E enacted large-scale power cuts in Northern and central California as a preventative measure aimed at curbing wildfires.
- In January, PG&E filed for bankruptcy protection, saying it's facing more than \$30 billion in liabilities after it was determined that its power lines sparked last year's devastating Camp Fire.

TRENDING

1

2



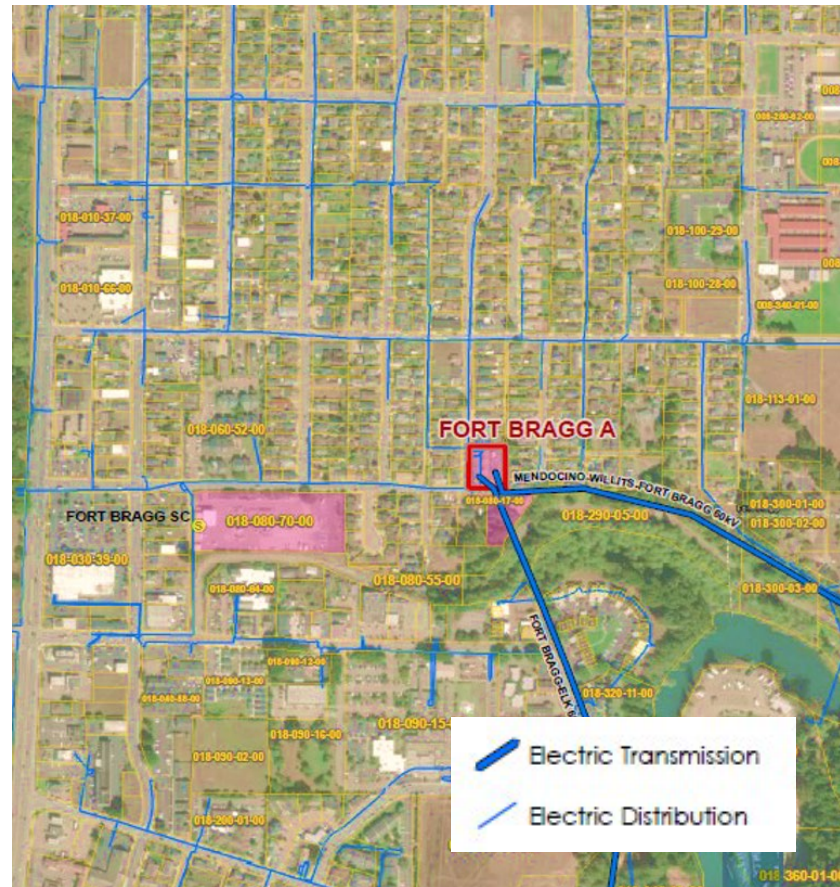
The Technical Problem



Not Just Backup Generation...



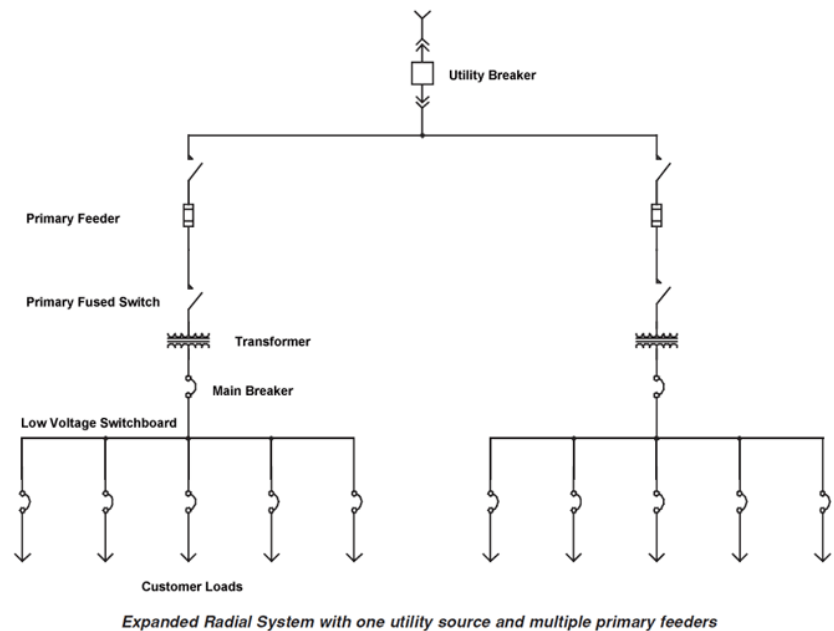
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Network and Protection Requirements

- Existing protection equipment detects faults through the large bursts of current.
- Protection near the substation needs longer periods of high current to trip.
- Many modern inverter-based technologies are limited in how much current they can supply, even for short periods.
- Protection systems could be upgraded to work with these new technologies, but it's costly.





Cold Load Pickup Requirements

- In the case of partial outages, substation generation may need to provide power to a distribution line that has gone “cold”
- In this case, the cold load generally takes more power and current to start up than it does to run continuously.
- Not all generation sources can provide the needed bursts in power and current while maintaining voltage and frequency requirements.





Power Quality Requirements

Requirement	Related Rules	Description
Load Acceptance (e.g. Block load pickup)	ISO 8528-1	Industry-adopted ratings for generator performance standards.
Frequency	Electric Rule 2	Supply alternating current service at approximately 60Hertz.
Voltage	Electric Rule 2, Rule 21, and IEEE 1453	Supply power at a voltage within a defined operating range.
Short Circuit Current and Short Circuit Interrupting Capacity	Electric Rule 2, Rule 21, Distribution Interconnection Handbook	Supply enough current to trip protection devices.
Blackstart	Specific to temporary generation	Ability to start when islanded from the grid.
Cold Load Pickup	Specific to islanded generation	Supply high current and power when energizing distribution lines.
Ground grids	Interconnection Handbook; IEEE Std. 80, Guide for Safety in AC Substation Grounding”	Worker safety. Address step, touch, and ground potential.



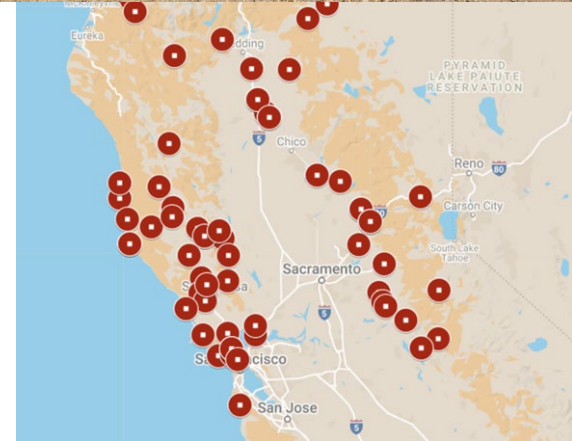
The Logistical Problem



Not Just Backup Generation...



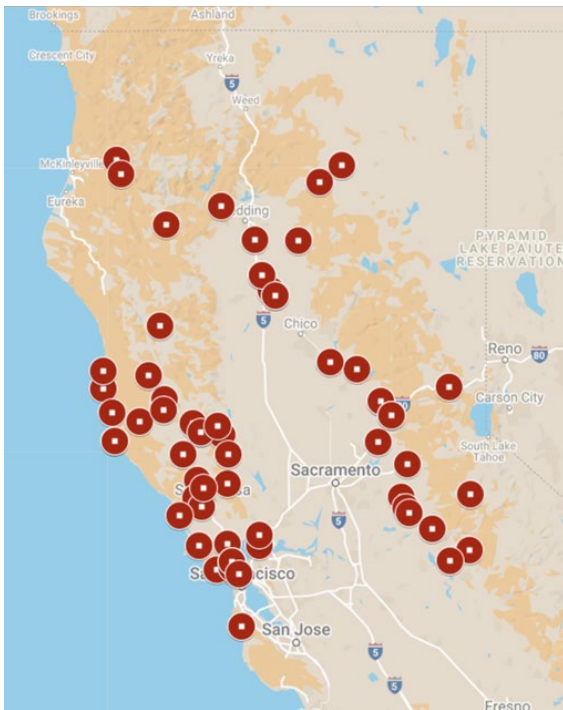
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Within 48 Hours: Deployment to Substation

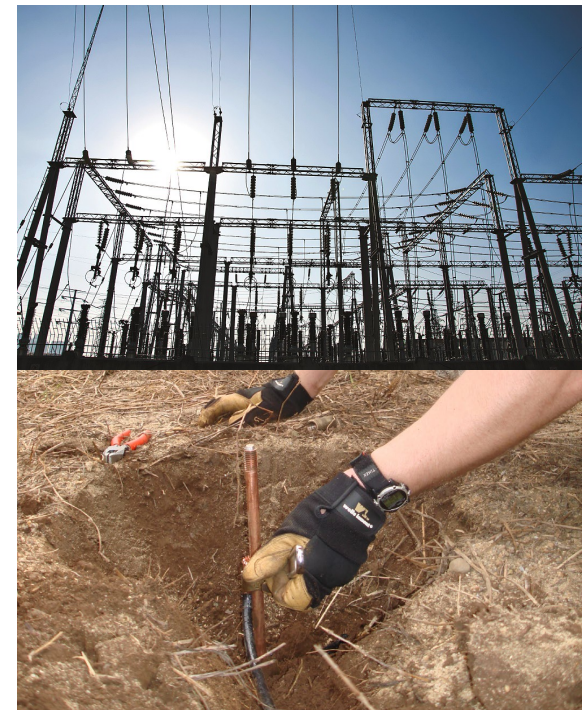
Statewide Deployment



Delivery to Substation



Interconnection





During the Event: Fueling and Control

- Fuel must be provided over the course of the event. Many substations do not have direct access to natural gas pipelines.
- It's dangerous to bring flammable, gaseous fuels into substations.
- If any equipment needs troubleshooting or maintenance, experts must be available to conduct it.
- Equipment controls must coordinate with the larger utility control of the grid.

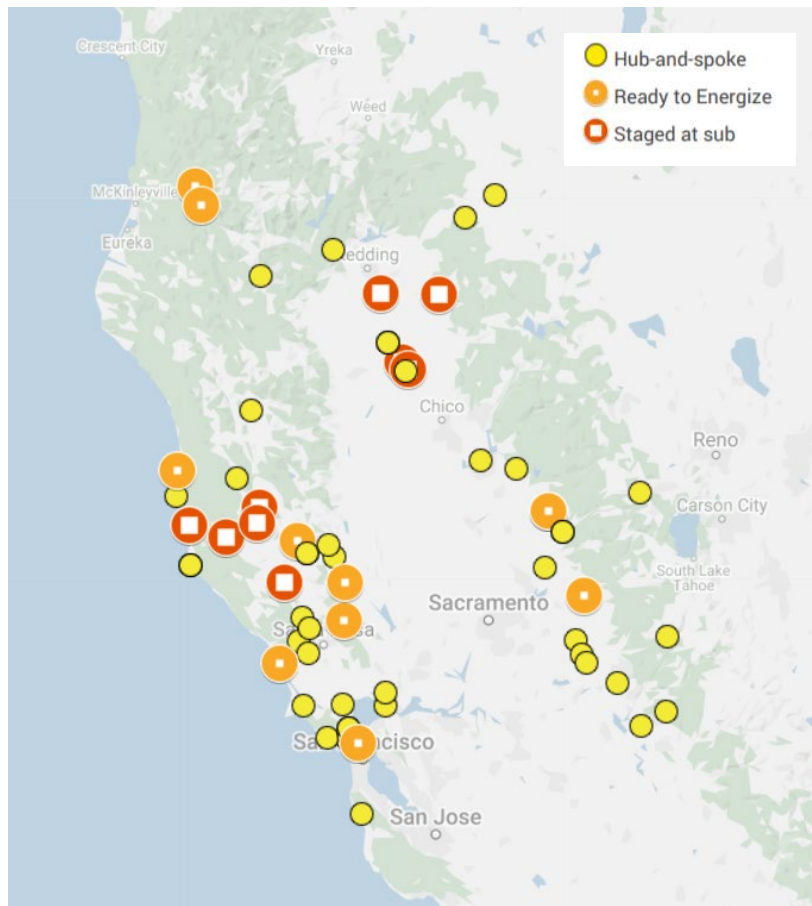




Cost, Timing and Uncertainty



Permanent vs Portable



Not fully up-to-date information, for illustration purposes.

- About 350 MW of portable diesel engines are being used to cover a potential 900 MW of load.
- Where and when this generation will be needed is uncertain, since it depends on the weather.
- Permanent installations at substations avoid the difficulties of deployment, but also can't cover many substations at once.
- Most cost figures used this afternoon reflect a direct MW-for-MW replacement of diesel, but in many cases reserved diesel generation covers multiple substations.



The Extent and Timeline for PSPS is Uncertain

The extent and location of PSPS, and thus the amount and location of needed generation, may vary with:

- Improved modeling: meteorology, fire spread, transmission operability
- Infrastructure hardening: pole replacement, covered conductors, undergrounding
- Segmentation of transmission and distribution system
- Enhanced management of power flow
- Advanced sensors and protection equipment

These longer-term uncertainties raise the possibility of stranded costs for any longer-term investment.



Estimated Diesel Cost for 2020

Total Cost for Fire Season	\$210,000 – \$500,000	per MW
Reservation Cost for Generation and Necessary Equipment	\$26	per kW-Month
Estimated Operational Cost (with multiple PSPS events)	\$270	per kW
Reservation Cost for Generation Only	\$19	per kW-Month

Note: Some proponents used diesel cost assumptions about 1.5x higher than our high estimates.



Overview of Challenge Statement



Overview

- Energy Division developed a Challenge Statement detailing the various technical, logistical and other challenges laid out above.
- The Challenge Statement aimed to:
 - Clarify the main hurdles that any particular solution might face;
 - Avoid limiting the set of possible solutions.
- Proponents received this Challenge Statement along with concrete data on three substations: Alto, Fort Bragg, and Covelo.
- Challenge statement included objectives and a series of questions to be answered.



Challenge Statement Objectives

- Maximize the benefits to customers in safe-to-energize areas subject to transmission outages.
- Minimize the need to reserve a large fleet of diesel generation for the purpose of providing substation-scale power in 2021.

Rationale: During PSPS events, transmission outages may require otherwise-safe substations to be deenergized. The large majority of diesel generation is slated to serve these substations.



Challenge Statement Questions

Primary Question: Does your solution replace diesel generators by supplying power to all customers at a substation level?

Secondary Questions

- Temporary/Portable or Permanent/Stationary? (safely and quickly deployable to multiple locations or fixed in place)
- Islanding Duration? (can sustain electrical island for 48 and/or 96 hours)
- Ready by 2021? (including all labor and equipment)
- MW by Year? (how many MW can be deployed over time)



Key Questions

- Are there clean and portable non-diesel solutions that meet the technical and logistical requirements of powering substations and are ready to deploy by 2021?
- To what extent should permanent solutions be considered, given the uncertainties and risk of large stranded costs?
- How should costs and responsibility for providing power during a PSPS outage be allocated?