Resiliency & Microgrids Working Group

Interconnection

Resiliency and Microgrids Team, Energy Division

September 17, 2021

California Public
Utilities Commission

WebEx and Call-In Information

Join by Computer:

https://cpuc.webex.com/cpuc/onstage/g.php?MTID=e0c2ca2373c797095833c81c38e2ab1e3

Event Password: RMWG (case sensitive)

Meeting Number: 2487 823 4564

Join by Phone:

- Please register using WebEx link to view phone number.

(Staff recommends using your computer's audio if possible.)

Notes:

- Today's presentations are available in the meeting invite (follow link above) and will be available shortly after the meeting on https://www.cpuc.ca.gov/resiliencyandmicrogrids.

- The meeting will not be recorded. There will not be meeting minutes.

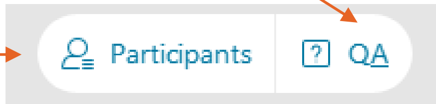
WebEx Logistics

- All attendees are muted on entry by default.
- Questions can be asked verbally during Q&A segments using the “raise hand” function.
  - The host will unmute you during Q&A portions [and you will have a maximum of 2 minutes to ask your question].
  - Please lower your hand after you’ve asked your question by clicking on the “raise hand” again.
  - If you have another question, please “re-raise your hand” by clicking on the “raise hand” button twice.
- Questions can also be written in the Q&A box and will be answered verbally during Q&A segments.

WebEx Tip

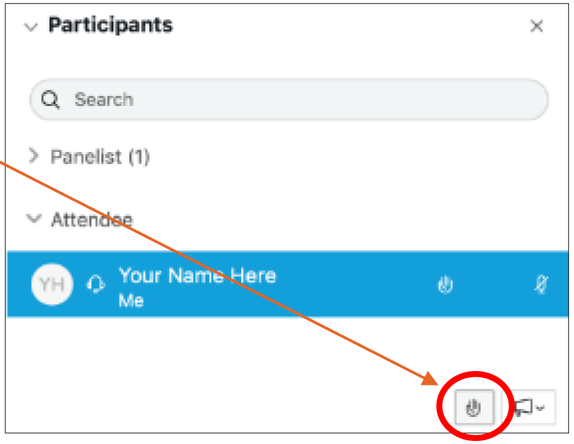
Access the written Q&A panel here

1. Click here to access the attendee list to raise and lower your hand.

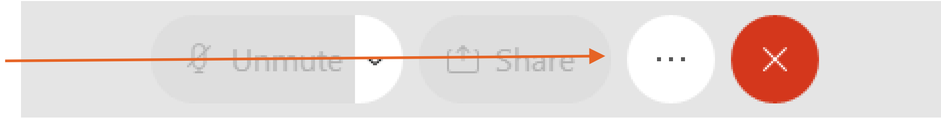


2. Raise your hand by clicking the hand icon.

3. Lower it by clicking again.



Access your meeting audio settings here



WebEx Event Materials

Event Information: Resiliency and Microgrids Working Group Meeting

Registration is required to join this event. If you have not registered, please do so now.

English : San Francisco Time

Event status: Not started (**Register**)

Date and time: Tuesday, March 2, 2021 9:30 am
Pacific Standard Time (San Francisco, GMT-08:00)
Change time zone

Duration: 1 hour

Description:

Event material: RMWG Meeting Material_EXAMPLE.docx (31.7 KB)

By joining this event, you are accepting the Cisco Webex Terms of Service and Privacy Statement.

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First name: Jessica

Last name: Tse

Email address: jessica.tse@cpuc.ca.gov

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Preliminary Resiliency & Microgrids Working Group Schedule

<table>
<tr><th>Month</th><th colspan="4">Resiliency and Microgrids Working Group Topics</th></tr>
<tr><td>February</td><td rowspan="3">Standby Charges</td><td rowspan="4">Multi-Property Microgrid Tariff</td><td></td><td></td></tr>
<tr><td>March</td><td></td><td></td></tr>
<tr><td>April</td><td></td><td></td></tr>
<tr><td>May</td><td></td><td rowspan="4">Value of Resiliency</td><td></td></tr>
<tr><td>June</td><td></td><td></td><td></td></tr>
<tr><td>July</td><td></td><td></td><td></td></tr>
<tr><td>August</td><td></td><td></td><td rowspan="4">Microgrid Interconnection</td></tr>
<tr><td>September</td><td></td><td></td><td></td></tr>
<tr><td>October</td><td></td><td></td><td></td></tr>
<tr><td>November</td><td rowspan="4">Customer-Facing Microgrid Tariff Revisit</td><td></td><td></td></tr>
<tr><td>December</td><td></td><td></td><td></td></tr>
<tr><td>January</td><td></td><td></td><td></td></tr>
<tr><td>February</td><td></td><td></td><td></td></tr>
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Interconnection: Working group participants will discuss interconnection and related issues as they specifically relate to microgrids. Topics will include interconnection requirements for grid-connected mode microgrid operations, controls, communications, and islanded mode microgrid operations where interconnection requirements are not applicable.

Agenda

I. Introduction *(CPUC Staff)* **10:00a – 10:10a**

- WebEx logistics, agenda review

II. San Diego Gas & Electric – Experience Integrating Microgrids *(SDG&E Staff)* **10:10a – 11:10a**

- Presentation
- Q&A

III. Green Power Institute – Experience Interconnecting Front of Meter Resources *(Tam Hunt, GPI)* **11:10a – 11:55a**

- Presentation
- Q&A

IV. Closing Remarks, Adjourn *(CPUC Staff)* **11:55a – noon**

- Provide information on the next meeting

SDGE™

Community Microgrids Experience

Resiliency & Microgrids Working Group
Interconnection Segment

September 17, 2021

Agenda

Definitions and Overview

Planning a Microgrid

Operating a Microgrid

Real-World Experience

Definitions and Overview

What is a Microgrid?

A microgrid is an independent electric grid with onsite energy generation and/or storage that can operate both while connected to and when disconnected or "islanded" from the larger utility grid. Characteristics:

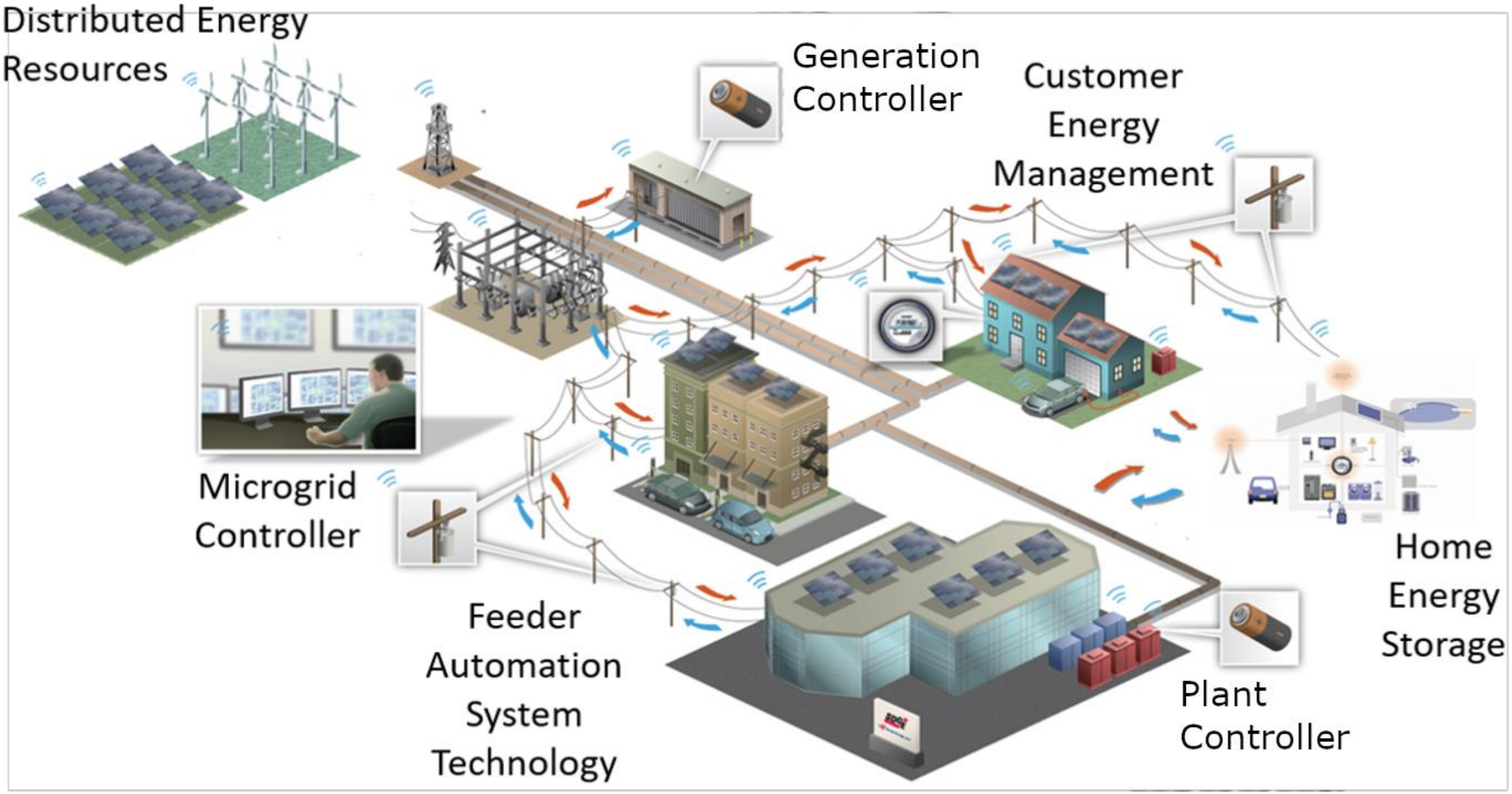
- Has a group of interconnected loads and distributed energy resources (DER) with clearly defined, isolatable electrical boundaries
- Can connect and disconnect from the grid to enable operation in both grid-connected or island modes
- Can act as a single controllable entity with respect to the grid

Key Microgrid Terminology and Definitions

Microgrid Controller	Site Controller, Plant Controller	Generation Controller
• Utility-owned • Grid-connected and islanded control and operations • Monitors and controls from the utility Distribution Control Center • Controls and operates infrastructure • Coordinates with utility- or third-party-owned resources that support the microgrid.	• Utility- or third-party-owned • Controls an aggregate of utility- or third-party-owned generators • Coordinates curtailment with generation controller	• Utility- or third-party-owned • Self-scheduling and direct-dispatch modes • Electric vehicle, photovoltaic, and other energy curtailment • Market operations

Islanding Isolation Device(s)	Grid-Forming Resource(s)	Black Start
• Point of common coupling (PCC) • Circuit breaker, recloser, underground switch	• Resources that provide balancing services (e.g., voltage and frequency) for the microgrid	• Process of initiating the microgrid from a state of no power (zero voltage), leveraging one or more DERs.

Example Microgrid Topology



SDG&E Microgrid in Borrego Springs

Battery Storage:

- ABB/Saft 1.0 MW or 3.0 MWh battery system
- Parker/Saft 0.5 MW or 1.5 MWh battery system
- Three 0.025 MW Community Energy Storage battery systems

Borrego Springs Solar:

- Clearway 26 MW solar plant, owned/operated by a third-party
- Desert Green 6.5 MW solar plant, owned/operated by a third-party
- Approximately 5 MW of third-party-owned rooftop solar

Other Assets:

- Two 1.8 MW diesel generators
- Maxwell 0.25 MW for 3 mins. ultracapacitor

The SDG&E Borrego Springs Microgrid is one of America's first and largest microgrids, supporting 2,800 customers.

Borrego Springs Microgrid Significance and Impact

- Community microgrid established in 2013
- “California's first renewable energy-based community microgrid” – CEC 2018
- Spans 1 distribution substation and 3 distribution circuits (2,800 customers)
- Incorporates utility and third-party (controlled and passive) resources
- Enhances community resiliency due to radial transmission service
- Proves advanced concepts and technologies for future applications: system protection, microgrid controls, scheduling of resources, and 100% renewable operations (Borrego 3.0)

Cameron Corners Microgrid

- 100% Renewable Community Microgrid
- 875 kW Photovoltaic Array (Fixed-Tilt, Bifacial)
- 540 kW or 2.4 MWh Energy Storage
  - Iron Flow Battery Technology
  - Non-combustible
  - Safe, clean, non-toxic
- Resiliency for 11 customers with community services:
  - Cal Fire
  - Fueling station (gas, diesel, propane)
  - Restaurants
  - Healthcare facility
  - Telecom Hub
  - School
  - Cool Zone
- Resources will participate in CAISO markets under blue-sky conditions

Ramona Air Attack Base

- 522 kW or 2.1 MWh energy storage (lithium-ion battery technology)
- Resiliency for 2 critical customers
  - Cal Fire
  - US Forest Services
- Approximately 34 hours of continuous islanding operation
- CAISO market participation

Miguel Vanadium Redox Flow Battery System

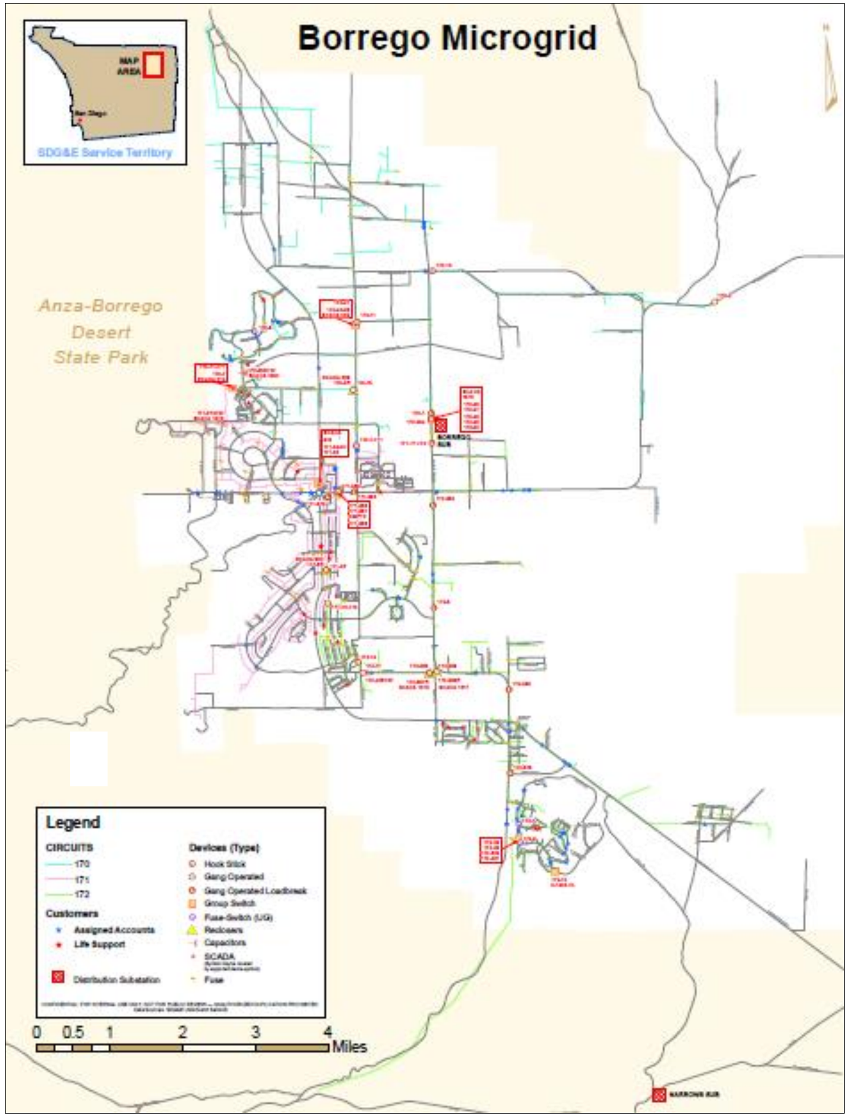
- 2 MW or 8 MWh energy storage (VRF battery technology)
- Commissioned in June 2017
- CAISO Energy Market in December 2018 and Ancillary Services Market in June 2019
- Microgrid Demonstration in October 2021
  - Approximately 60 residential and commercial customers
  - Remote Point of Common Coupling

Planning a Microgrid

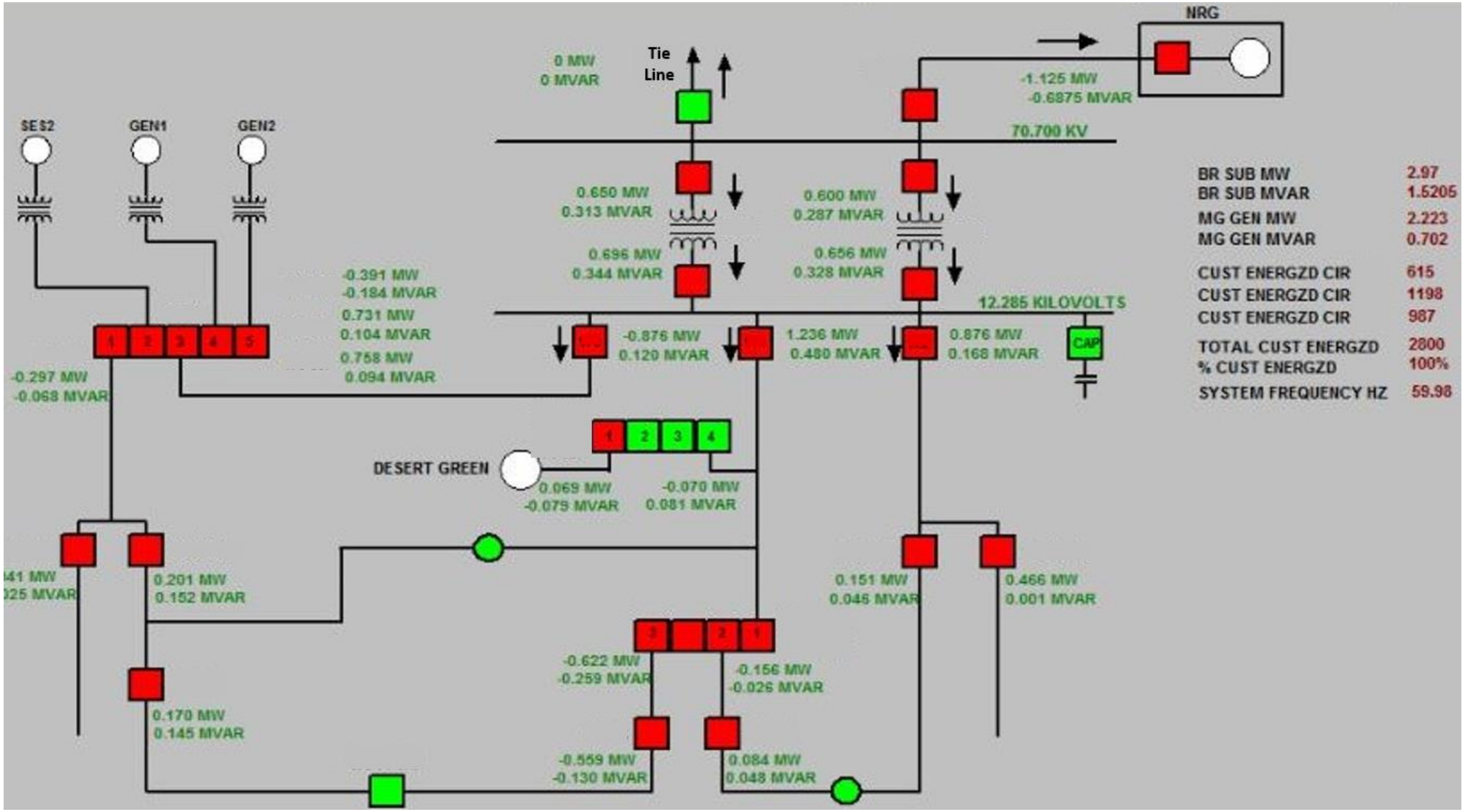
Microgrid Design Considerations

Activity	Description
Define microgrid boundary	Customers, substation, circuit, circuit segment, along with isolation points
Match load and generation	Voltage, frequency and power factor within tolerances
Determine transition time(s)	How long to restore power in island (*e.g.*, seamless, black-start)
Define loads	Critical, demand response, peak load
Determine island duration	Typical outage or extreme weather event (hours)
Define generation needs	Renewables, energy storage, fossil generation with contingencies

Borrego Springs Topology



Microgrid SCADA Device Topology



Load Estimation

PI/SCADA Data

High, circuit-level historical data

AMI Data

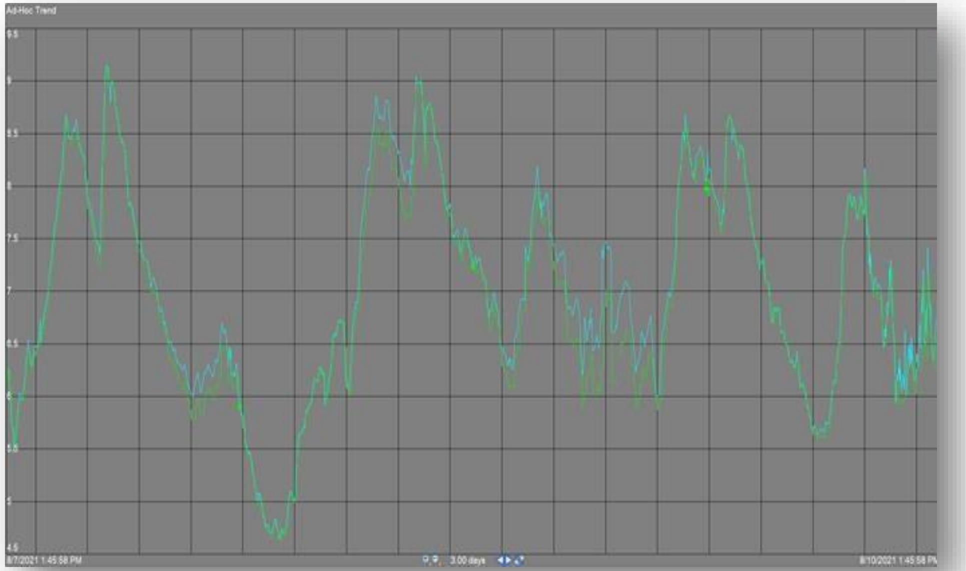
Individual customer data

PMU Data

Sub-cycle real and historical data

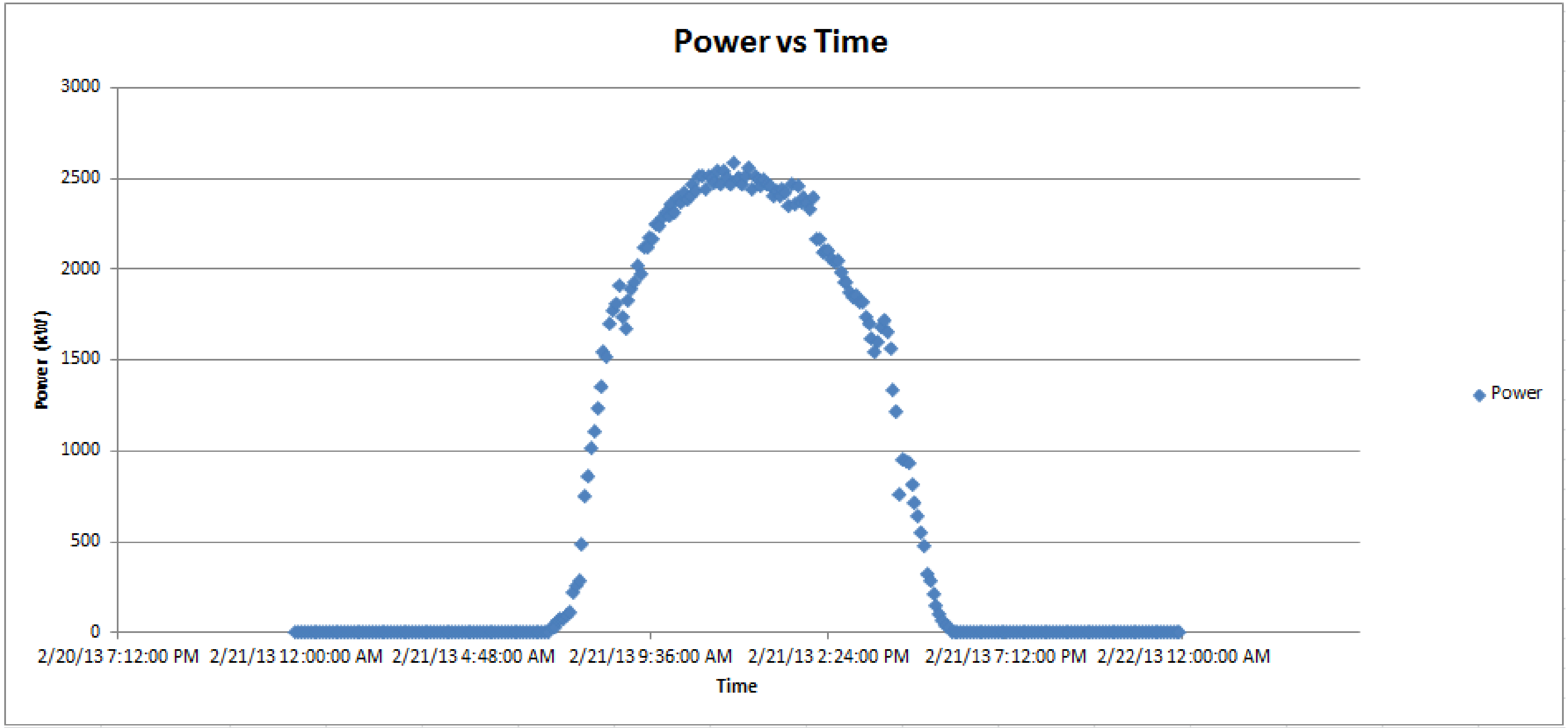
Synergi Electric

Power-flow and load-flow software



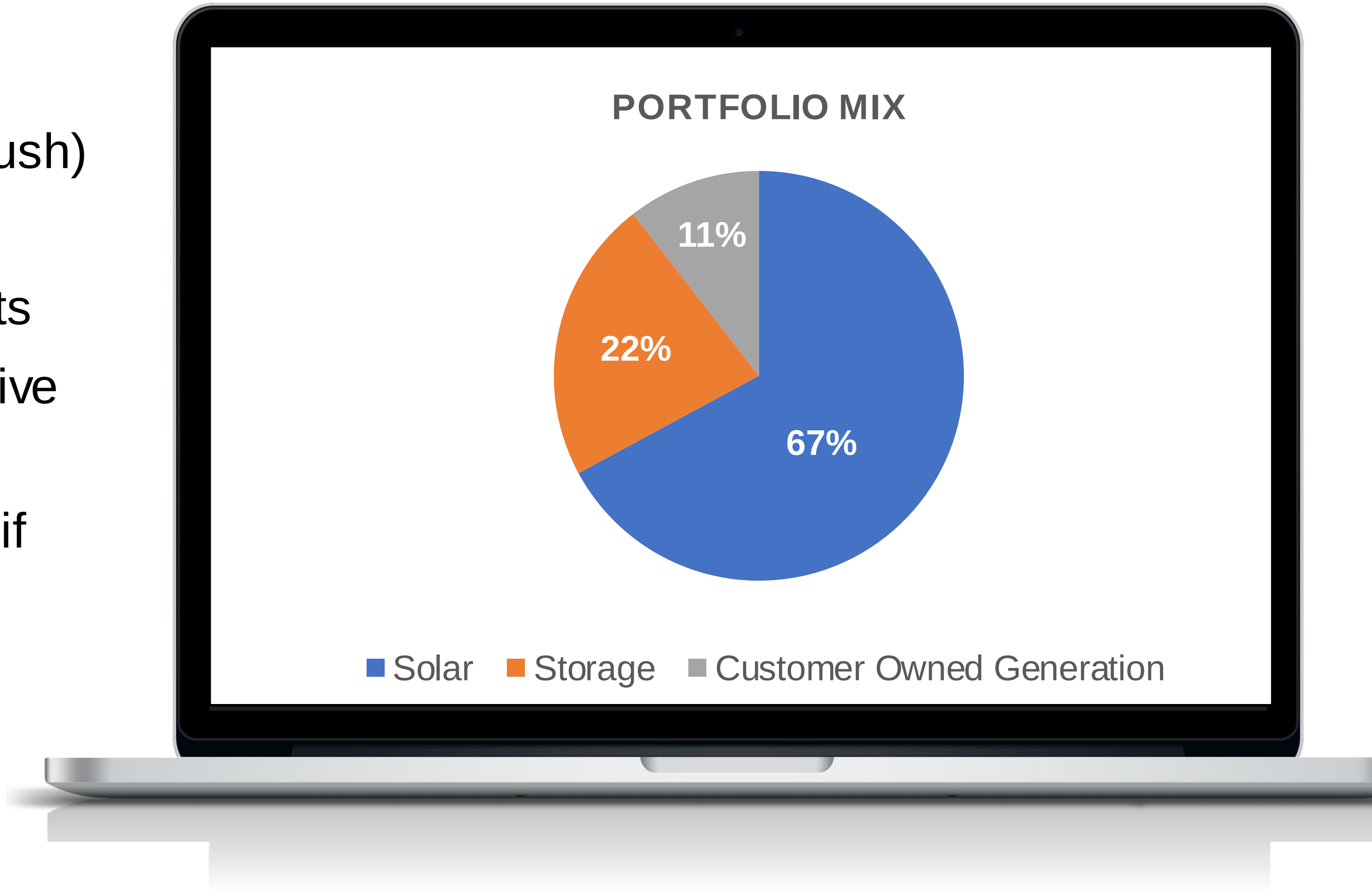
DER Resources Managed by Controllers

- **Passive grid-connected:** distributed generation non-controllable
- **Active grid-connected:** distributed generation controllable
- **Grid-forming:** resources with the capability to island



Resource Estimation Example

- Duration (72 Hours)
- Energy (4.8 MWh)
- Black-start requirements (cold load/ inrush)
- Generation portfolio mix
- Peak power and balancing requirements
- Load management to increase time to live
- Contingencies added for:
  - Generation resource intermittency, if applicable
  - Future load growth



Hardware-in-the-Loop (HIL) and Modeling

- Advanced modeling with optional HIL testing via Real Time Digital Simulator (RTDS)
- Help ease transition from legacy systems to new emerging technologies by means of validation before deployment
- Capable of simulating both generation and load, testing equipment like inverters, energy storage systems and their impact on our distribution grid

Operating a Microgrid

Operating a Microgrid

Planned Islanding

- Coordination with the Distribution Control Center, following a switch plan to comply with pre-arranged planned work – *seamless operation*

Emergency Islanding

- Following pre-existing switch plan – *seamless operation*

Black Start

Restoring load in steps depending upon load and generation pre-outage – *outage occurs prior to restoration*

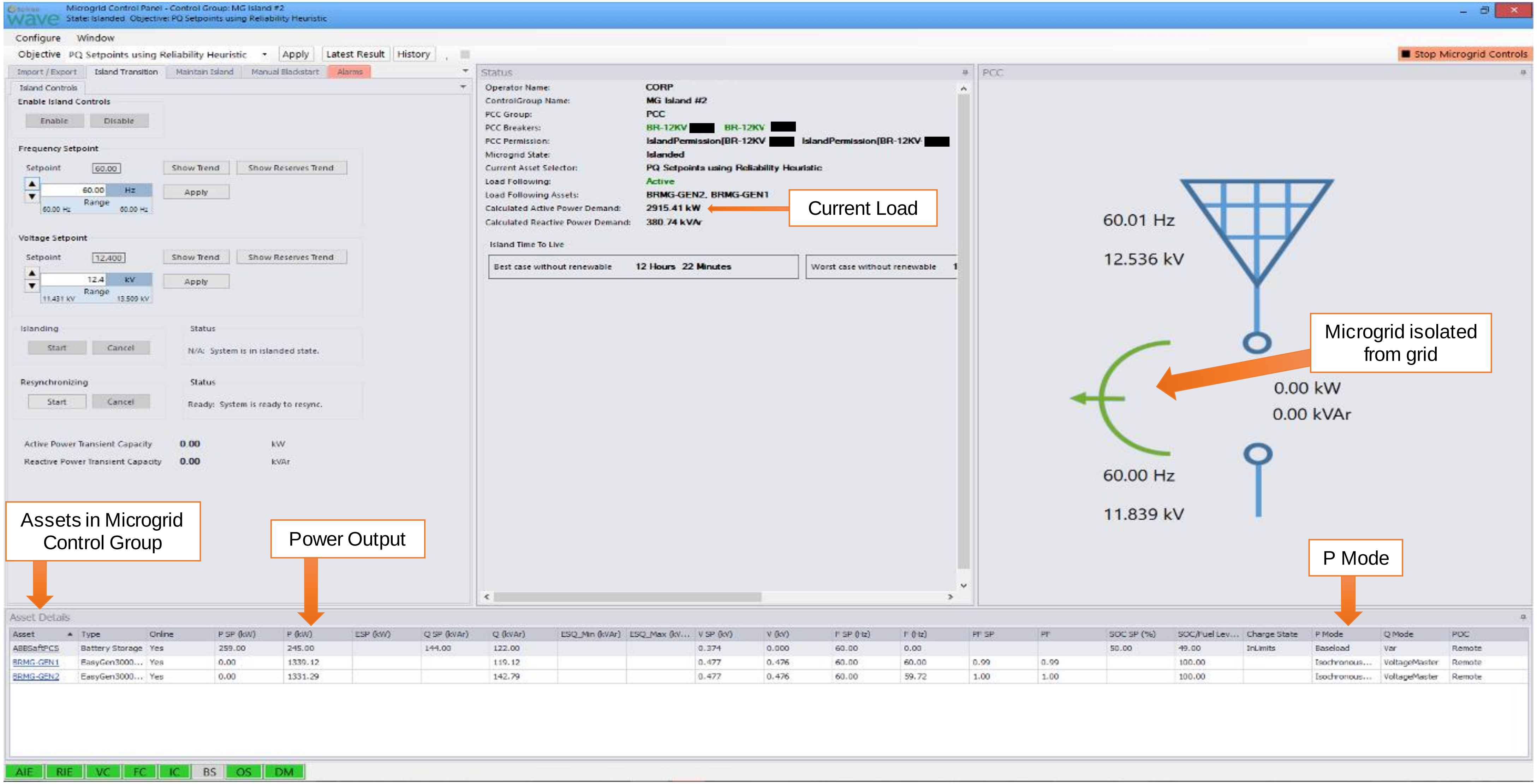
Load-Shedding

Utilizing field ties, distribution switches, and other equipment to shed load if it exceeds microgrid capabilities – *microgrid duration, or generation constraint*

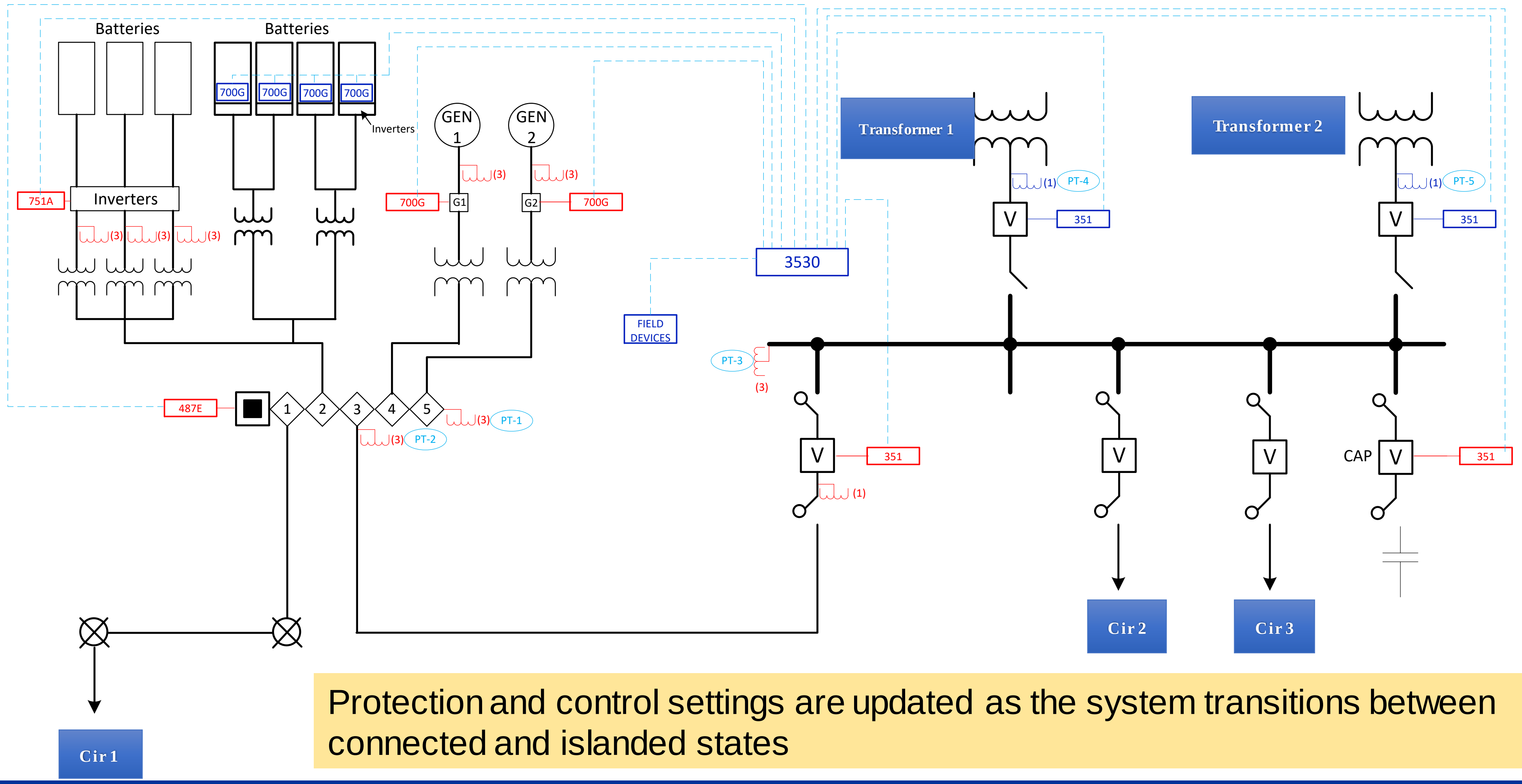
Resync-to-Grid

- Local grid-forming device begins to synchronize the restored electric grid upon a sync request
- SDG&E will verify the two sources are synchronized before closing the isolation device at the PCC

Microgrid Control System

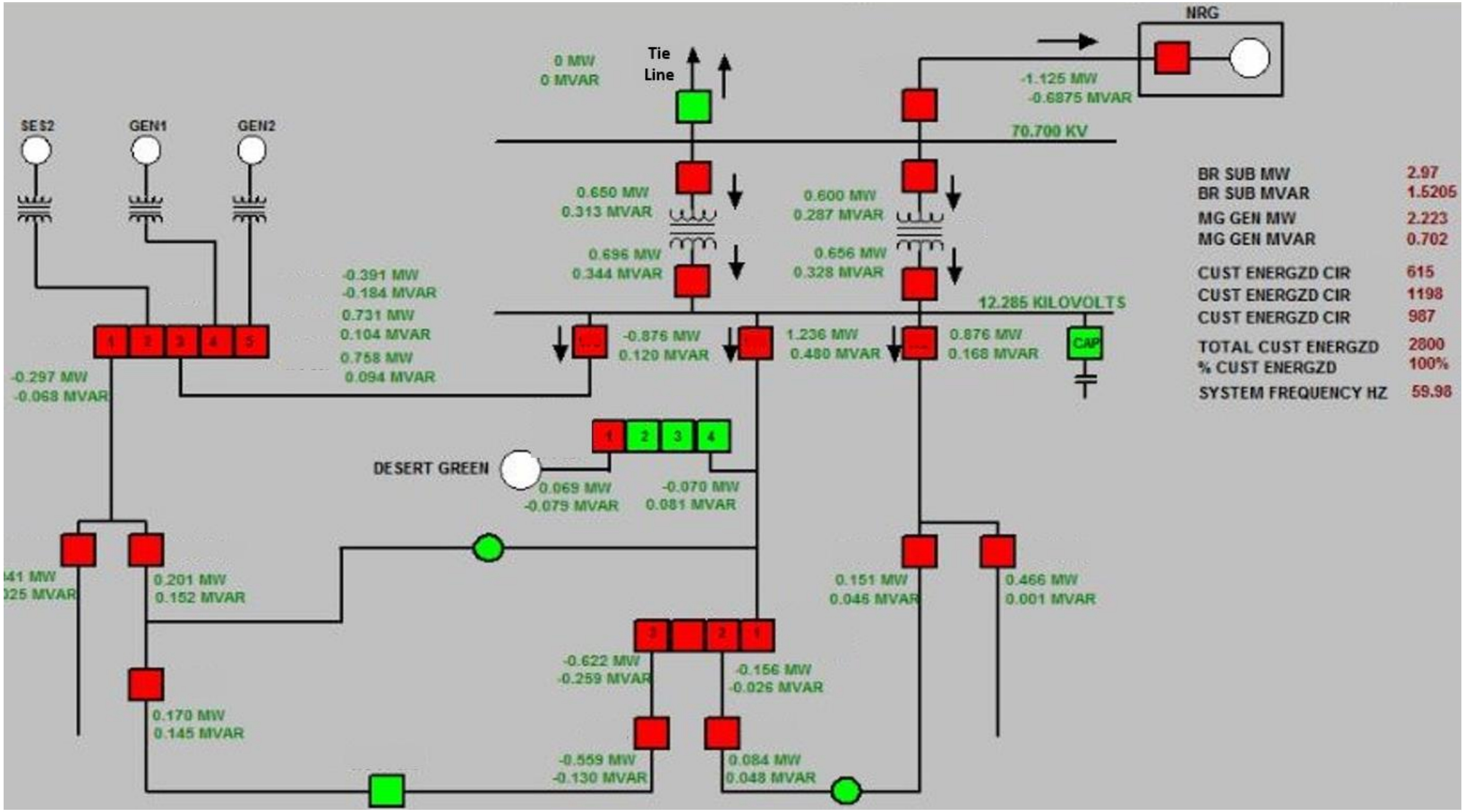


Protection and Controls

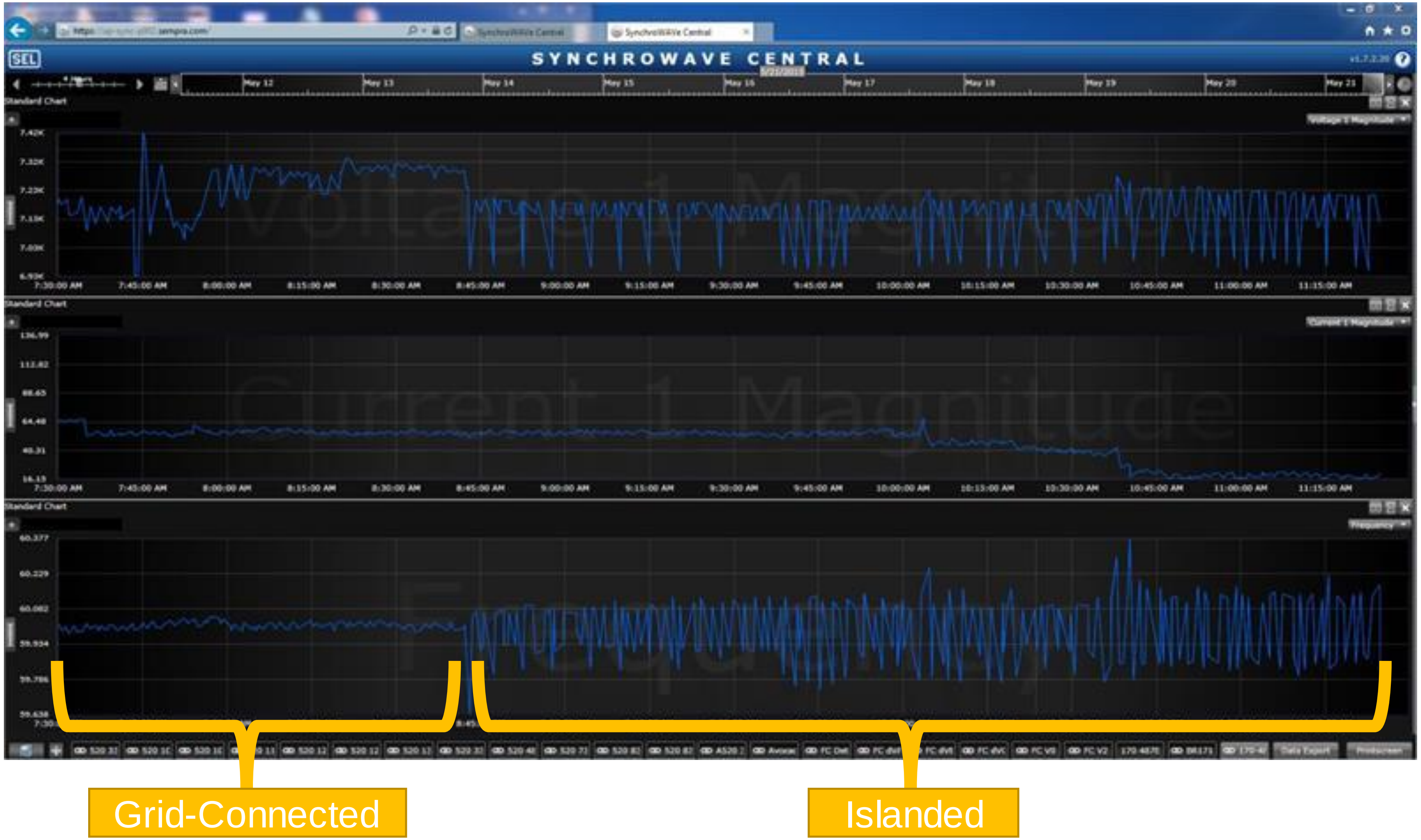


Protection and control settings are updated as the system transitions between connected and islanded states

Switching and Real-Time Topology



Monitoring a Microgrid



Real World Experience

Emergency Operation

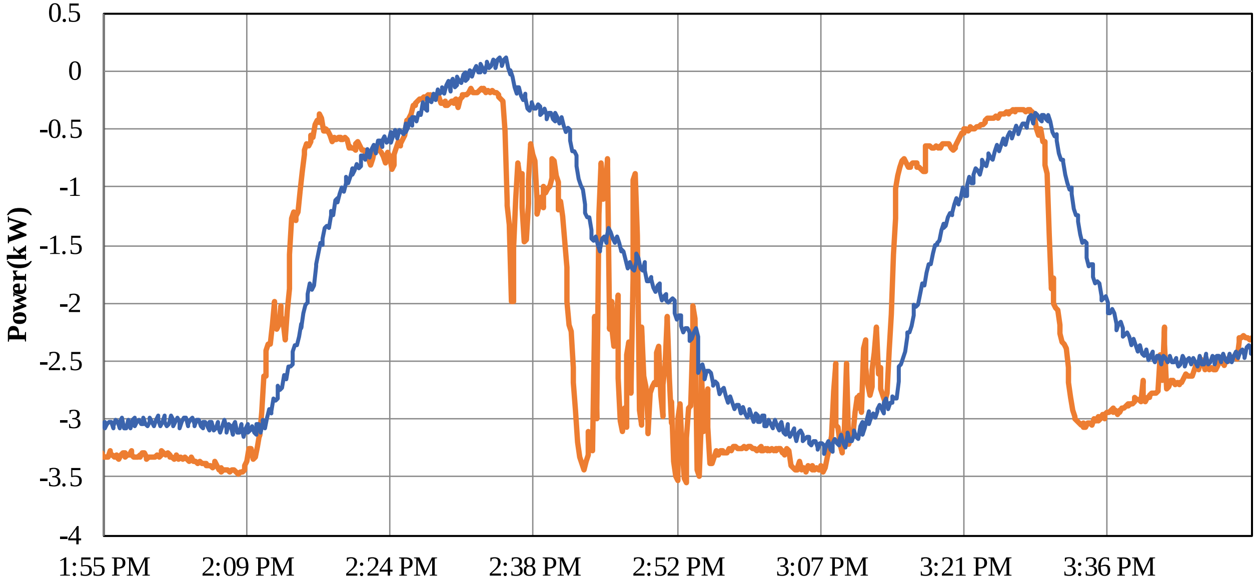
- In September 2013, there was a microburst weather event that passed through Borrego Springs, knocking our transmission lines onto the distribution lines severing utility service to Borrego Springs.
- 9 transmission poles and 11 distribution poles
- SDG&E repair crews quickly arrived on the scene and worked throughout the night to restore power to all customers.
- This wasn’t a run-of-the-mill power restoration, as crews were able to make use of a special advantage: *SDG&E’s Borrego Springs Microgrid.*
- 1,056-customers, including critical facilities and cool zones, were safely energized with the microgrid
- Restoration efforts took +25 hours
- More than 200 SDG&E employees were involved

Blue Sky Operations

How can resources be used under blue-sky conditions?

- Wholesale market participation
- Peak-shaving to mitigate system constraint
- Deferral purposes
- Power quality

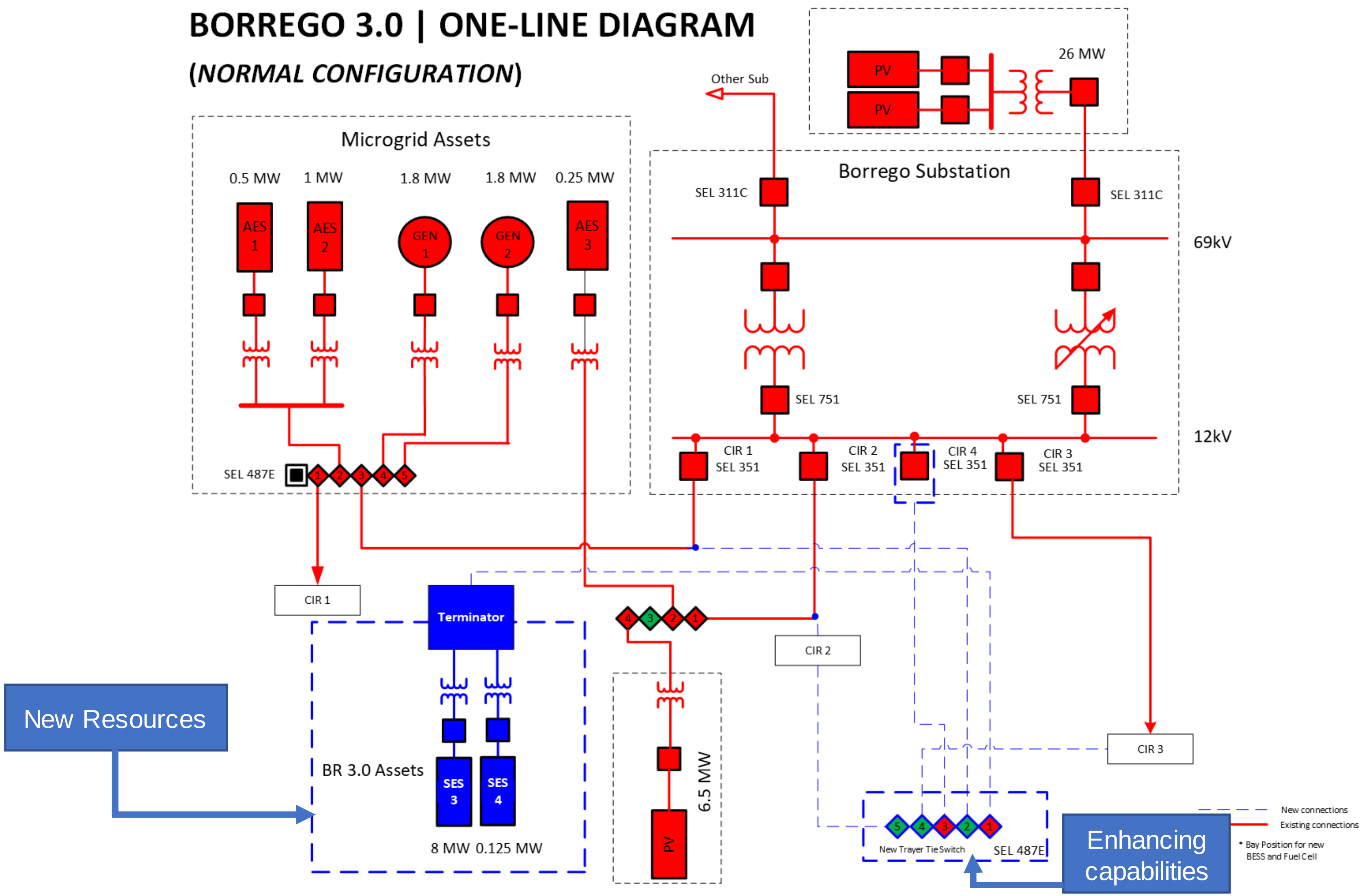
Note: Specific DER capabilities determine blue-sky candidate operational usage.



Lessons Learned

- Operational capabilities of emerging technologies
- Where likely points of failure will occur and how to mitigate them (*e.g.*, low inertia environment, transients)
- Limited standards and specifications can result in unknowns and require additional testing and configuration
- Integration of various technologies is complex and requires more modeling/simulations and clearly defined testing requirements
- The complex nature of microgrids requires operational coordination across multiple parties - especially when "stacking" DER services beyond resiliency (*e.g.*, market participation)
- Cyber and physical security requirements are constantly evolving and to ensure a safe system, all resources must be up to date

Borrego 3.0 and Future Enhancements

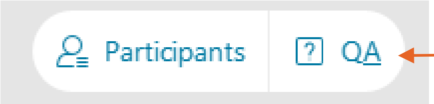


Questions?

Q&A and Discussion

WebEx Tip

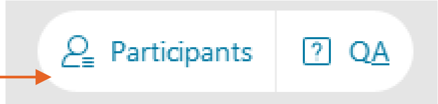
Option 1:



Access the written Q&A panel here

Option 2:

1. Click here to access the attendee list to raise and lower your hand.



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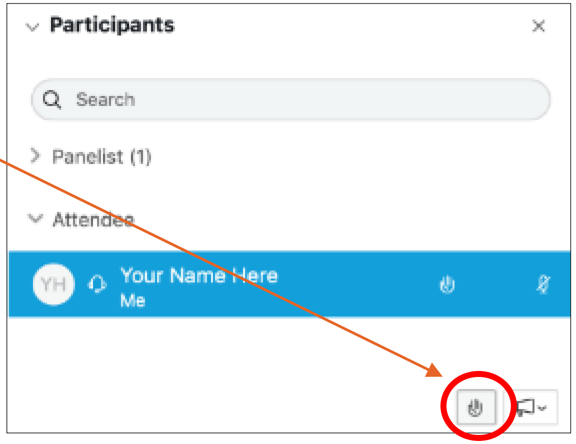
3. Lower it by clicking again.



Interconnection hurdles for community microgrids and potential solutions

Tam Hunt

Consulting attorney for the Green Power Institute

September 17, 2021

Overview

- Background on front-of-meter DER program procurement and interconnection issues relevant to microgrids
- Review of interconnection data
- Potential solutions for microgrid—specific interconnection reform
  - Choosing the appropriate forum for reform
  - Interconnection automation and streamlining
  - Creating a new Rule 21.1 specific to microgrids

The CPUC OIR (Sept. 9, 2019)

- “The Commission initiates this Order Instituting Rulemaking (OIR) to begin crafting a policy framework surrounding the commercialization of microgrids. This rulemaking will focus on implementation of Senate Bill (SB) 1339.”

Front of meter DER program track record in CA is not good

- GPI wrote "A Modern Cinderella Story" in 2019 (updated in 2020 and soon to be updated for 2021), which looked in detail at the track record of seven wholesale DER programs in CA over the last decade
- Part of our summary statement:
  - "California's renewable energy success story is mostly a story about utility-scale renewables, with at least 57 percent of the development over the last decade coming from these large projects. California's residential and commercial renewables market segment has also done well, with about 33 percent of the market coming from this segment. Only 10 percent or less has been community-scale renewables. This is a massive missed opportunity."
- Microgrids will face the same challenges, with additional challenges unique to microgrids

Cinderella Report summary table of 7 previous FOM DER programs found an average of just 24% of approved MWs were installed

- **Programs covered:**
  - PURPA
  - IOU PV PPA programs (rooftop and groundmount solar 2-20 MW)
  - AB 1969 (precursor to ReMAT)
  - ReMAT (pseudo-FIT for up to 3 MW)
  - BioMAT (biomass ReMAT for up to 3 MW)
  - RAM (renewable auction mechanism for projects up to 20 MW)
  - SB 43 (green tariff shared renewables)

	PG&E	SCE	SDG&E	Total
PURPA MW allocated	NA	NA	NA	NA
PURPA contracted 2007-2017	39.2	0	30	69.2
PURPA online 2007-2017	0	29.8	0	29.8
Online as % of MW allocated	***NA***	***NA***	***NA***	***NA***
PV PPA MW allocated	500	500	0	1000
PV PPA contracted	272.5	64.9	0	337.4
PV PPA online	199	56.9	0	255.9
Online as % of MW allocated	***40%***	***11%***	***NA***	***26%***
AB 1969 MW allocated	209.2	247.6	40.2	497
AB 1969 contracted	64.5	120.1	15	199.6
AB 1969 online	64.5	115.6	9.5	189.6
Online as % of MW allocated	***31%***	***47%***	***24%***	***38%***
ReMAT MW allocated	218.8	226	48.4	493.6
ReMAT contracted	62.45	54.7	19.8	136.95
ReMAT online	31.65	45.4	7.6	84.5
Online as % of MW allocated	***14%***	***20%***	***16%***	***15%***
BioMAT MW allocated	111	114.5	24.5	250
BioMAT contracted	19.8	6	3	28.8
BioMAT online	4.6	0	0	4.6
Online as % of MW allocated	***4%***	***0%***	***0%***	***2%***
RAM MW allocated	653	756	165	1574
RAM contracted	370.4	635.4	87.6	1093.4
RAM online	331.2	635.4	57.6	1024.2
Online as % of MW allocated	***51%***	***84%***	***35%***	***65%***
SB 43 MW allocated	272	269	59	600
SB 43 contracted	21.16	3.45	2.1	26.71
SB 43 online	0	0	0	0
Online as % of MW allocated	***0***	***0***	***0***	***0***
All seven programs MW online as % of MW allocated				**24%**

The record is even worse for equity-focused FOM DER

- Almost no megawatts have come online under the following programs:
- DAC-GT Solar, reserved only for ~4 MW size projects or less located in DACs
  - Program was approved by Res. E-4999 in May 2019
  - PG&E has procured ~29 MW of its 55 MW DAC-GT allocation
    - Nothing online as of June 2021
  - SCE has procured 0 MW of 45 MW allocated
  - SDG&E has procured 0 MW of 18 MW allocated
- 1 MW and below “Environmental Justice” carveout for SB 43 renewables
  - Only 2 out of 98 MW are online, in PG&E’s share of the SB 43 GTSR EJ carveout, as of end of 2020

	Target capacity	GT procured and online	ECR procured	Capacity remaining
SDG&E unrestricted	49	40	2.4	6.6
SDG&E EJ	10	0	0	10
Total	59	40	2.4	16.6
PG&E unrestricted	227	50.75	5.31	150.94
PG&E EJ	45	2	0	43
City of Davis	20	0	0	20
Total	272	52.75	5.31	213.94
SCE unrestricted	224	60	6	158
SCE EJ	45	0	0	45
Total	269	60	6	203

SB 43 Green Tariff programs as of end of 2020. Source: IOU annual program reports

A large part of why DER programs have struggled is interconnection issues

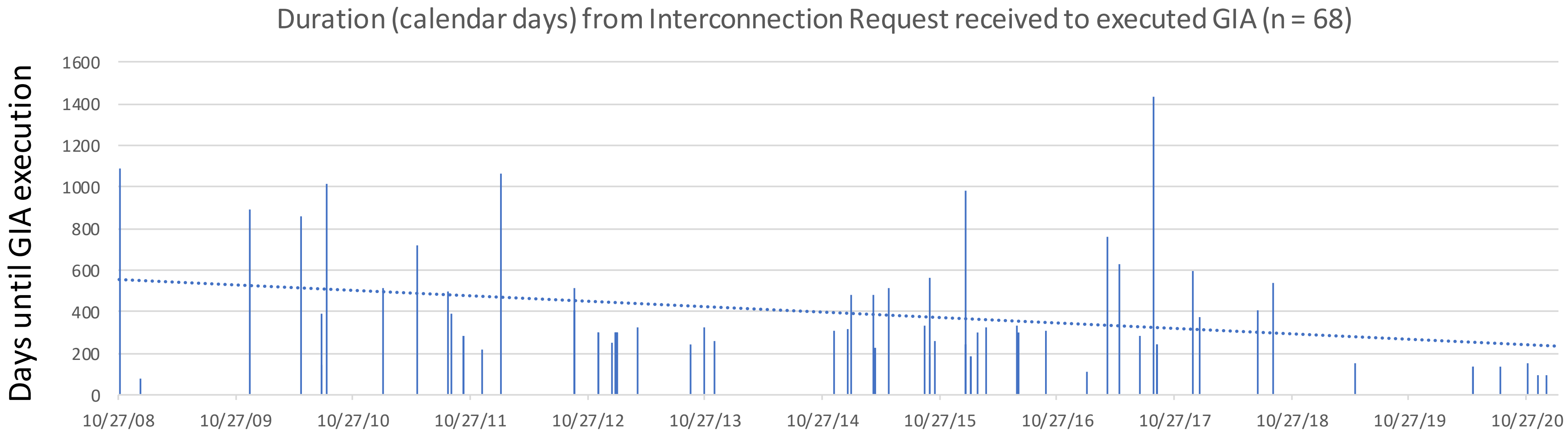
- Despite the presence of a “Fast Track” process in Rule 21 and WDAT/WDT, interconnection for DER is still extremely difficult in many cases
- And many front-of-meter DER interconnect with WDAT/WDT
- We confine our data here, however, to Rule 21
- Microgrids will face even more hurdles due to islanding, etc.

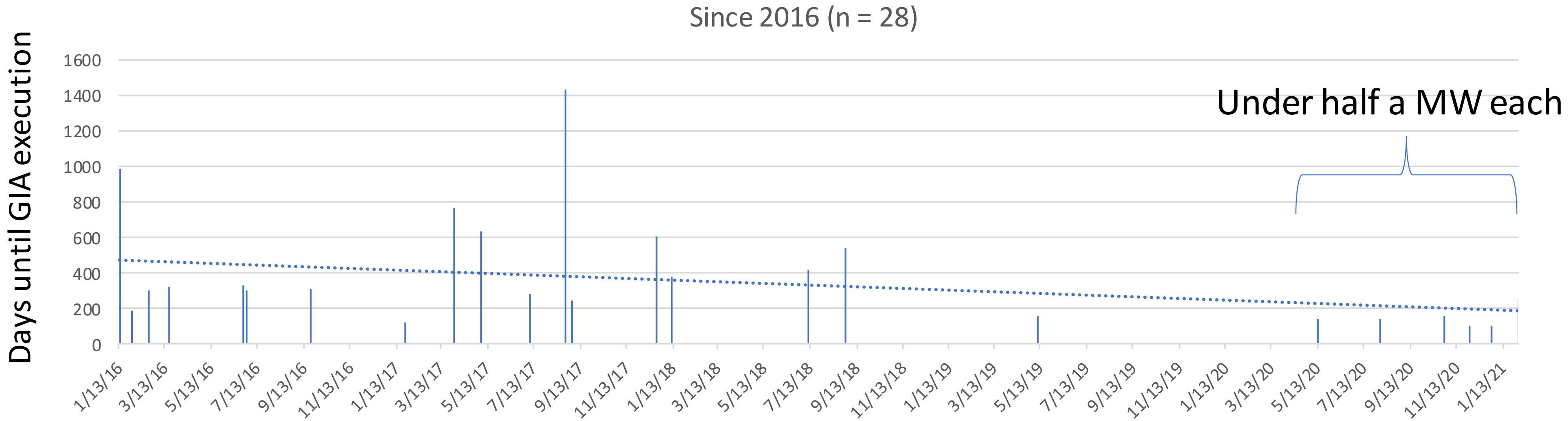
	# of exporting FT applications 2008-pres.	# of GIAs executed/ in serv.	% of GIAs executed/ in serv.	Average size	Ave. time for executed GIA
SCE	526	51	9.7%	1.4 MW	391 CD
PG&E	1,300	70	5.4%	1.0 MW	?

* We do not rely on the Guidehouse review of Rule 21 interconnection data b/c that review was incomplete and its analysis was flawed in various areas

SCE Rule 21 exporting Fast Track interconnection applications

Average size 1.4 MW





Source: SCE wholesale interconnection queue Sept. 1, 2021; data compiled by GPI

So … how do we ensure that interconnection hurdles for DERs don't prevent timely deployment of community microgrids?

Questions for stakeholders and Commission:

1. Rule 21 and WDT/WDAT reform is necessary for expedited MG interconnection, but what is the best venue for expedited reform?
2. Automation is promising but has seen a slow rollout
3. Should a separate interconnection process (Rule 21.1) for community microgrids be created?

1. What is the best venue for MG interconnection reform?

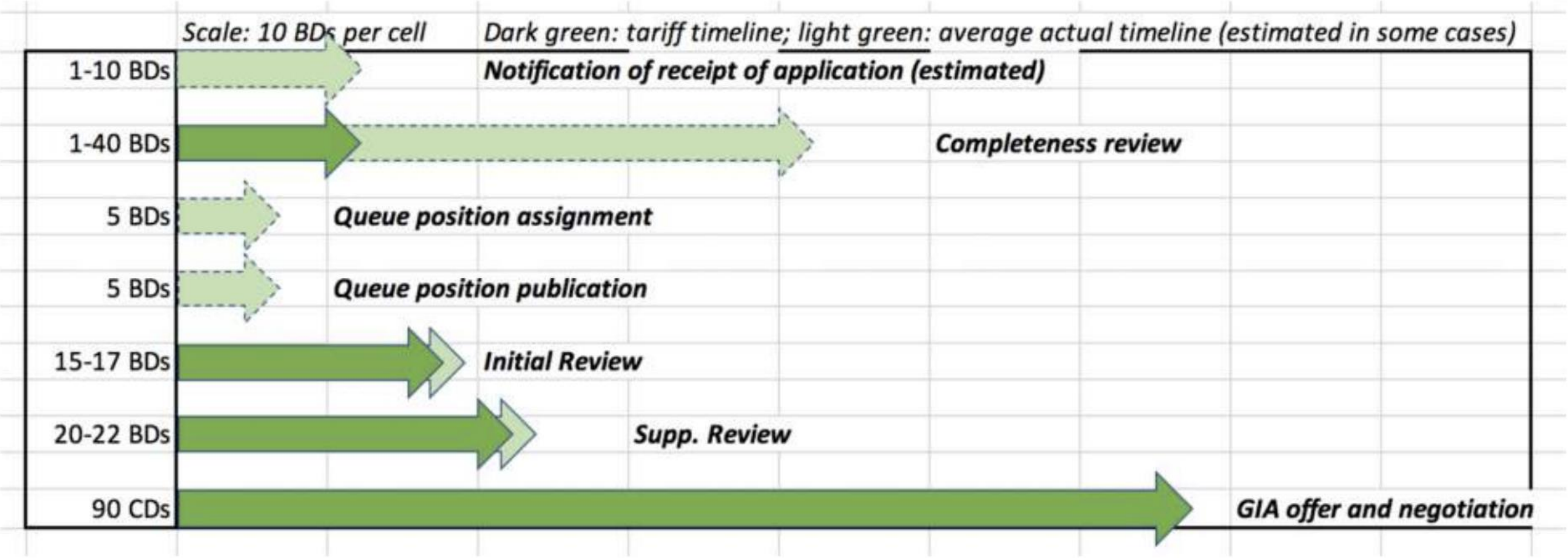
Possible venues for microgrid interconnection reform

- This proceeding (R.19-09-009)
- Rule 21 proceeding (R.17-07-007)
- Emergency reliability (R.20-11-003)
- New proceeding?

2. Interconnection automation and streamlining

GPI/Clean Coalition automation of interconnection recommendations

Figure 1. *Fast Track timelines under Rule 21.*



GPI/Clean Coalition automation recommendations

- **These come from the Rule 21 Working Group Two Final Report Issue 8 Appendix, drafted by GPI and Clean Coalition in 2018:**
- **Automating the application process and completeness review**. Utilities must inform the applicant whether the application is deemed complete, or must be corrected, within 10 business days (BDs) after receipt of the Interconnection Request (E.5.a). In practice, this step can take two months or longer if multiple corrections are required (as is common for larger projects). Automation of the interconnection portal and application processing could reduce this step to one day for those projects that don’t need corrections, as well as dramatically reduce the time required for each round of corrections, and can build upon existing on-line application portals for net-metered projects, which already significantly reduce application processing times through partial automation. PG&E states that it has already planned for the work required to automate the application portal and its small NEM application review is already automated. SCE has gone out to bid for similar work to update and partially automate its interconnection portal, but the full extent of this effort is not known at this time. SDG&E currently has no plans to further automate its DIIS application portal.

GPI/Clean Coalition automation recommendations

- **Automating (at least partially) Initial Review**. Initial Review must be delivered within 15 BDs of the application being deemed complete (F.2.a). If applicable screens can be cleared automatically through use of data from the online application inputs and ICA data, it may be feasible to reduce the Initial Review to 1 BD. This report identifies feasible ways for achieving this level of automation. PG&E agrees with the merits of automating IR, and notes that all screens except F and G are already automated, but considers it necessary to maintain the 15 BD review in order to allow engineers to study mitigation options for projects that fail IR.
- **Automating (at least partially) Supplemental Review**. Supplemental Review must be completed within 20 BDs (F.2.c). Parts of SR may already be automated with the existing ICA (screens N and O are already automated with the current ICA). Under the currently-defined SR screens, this leaves only screen P, a “catch all” safety and reliability screen, to be completed in SR. PG&E agrees that parts of SR can be automated but note that a cost/benefit analysis should be completed before a decision on full automation is made by the Commission.

GPI/Clean Coalition automation recommendations

- **Frontloading Supplemental Review screens N and O into Initial Review.** Projects that are less than or equal to displayed ICA value, or otherwise expect to interconnect without need for Supplemental Review, may be susceptible to largely automated initial review. Frontloading screens N and O into IR will allow an easier automation of Initial Review because screen N makes screen M redundant and screen O renders some IR screens, or at least part of those screens, redundant.
- **Combining Initial Review and Supplemental Review**. [This recommendation was adopted in D.20-09-035 and is in the process of being implemented by advice letters submitted in December 2020 but not yet ruled on by the Commission]
- **Frontloading and automating the Generator Interconnection Agreement** (GIA) generation and offer process. A GIA currently must be offered to most applicants within 15 BDs of passing Initial Review or 15 BDs of applicant's request after passing Supplemental Review (F.2.c.iv). This step could be "frontloaded" by offering a fully or partially populated provisional GIA once an application is deemed complete, allowing the applicant to begin detailed review of the draft GIA much earlier than under the existing process. Execution of the final GIA may be streamlined by such frontloading and also by including the key IR or SR results in a second, automatically-generated, GIA, such that the fully populated draft GIA generation process takes only 1 BD for the large majority of projects instead of the 15 BDs currently allowed in the tariff. Frontloading of the initial GIA should also reduce the 90 CD negotiation period. PG&E is already planning this work but notes that it will be difficult to automate inclusion of mitigation options into the GIA. SCE has recently completed a behind-the-meter energy storage interconnection pilot that included frontloading the GIA; SCE has no plans currently to expand this pilot approach to additional technologies. GPI notes that the utilities don't generally offer mitigation options until Supplemental Review is completed, so it is not clear that a 15 BD timeline for IR is necessary if this is the case, even for projects that fail IR. In GPI's experience, IR results in a short report, usually sent as an email, stating which screens, if any, are failed, with information about the applicant's choices for how to proceed.

3. Create a new Rule 21.1 microgrid interconnection tariff

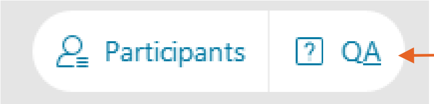
Creating a new interconnection tariff for microgrids

- PG&E's CMET is best characterized as a supplemental interconnection tariff specific for microgrids
  - The primary item it describes is the Microgrid Islanding Study
  - And it also provides for the possibility of reimbursement for islanding equipment costs
- GPI suggests that a new tariff Rule 21.1 be created that is specific to interconnection of microgrids, as follows:
  - Provides applicants an option to study all MG components jointly in a single application
  - Includes a Microgrid Islanding Study
  - Includes timelines to the same or better granularity than the current Rule 21
  - Would apply to all IOUs, including PG&E

Q&A and Discussion

WebEx Tip

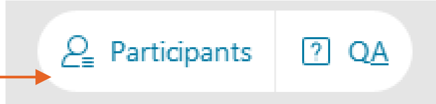
Option 1:



Access the written Q&A panel here

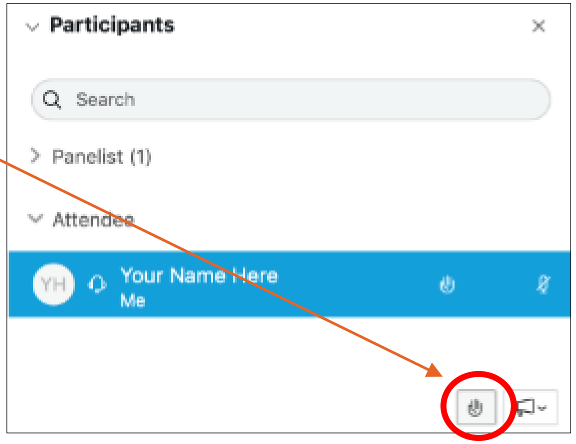
Option 2:

1. Click here to access the attendee list to raise and lower your hand.



2. Raise your hand by clicking the hand icon.

3. Lower it by clicking again.



Closing and Upcoming Meetings

Upcoming Meetings

- **Friday, October 1, 2021 (10 am – noon) (tentative)**
  - Selective De-energization Within a Microgrid Island
  - Additional Participant Presentations on Interconnection Concerns

- **Friday, October 15, 2021 (10 am – noon) (tentative)**
  - Potential microgrid controller specifications and requirements
  - Ensuring microgrid interoperability with evolving distribution grid

California Public Utilities Commission

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https://www.cpuc.ca.gov/resiliencyandmicrogrids/