EPIC 3.11B

Leverage FTM and BTM DERs for customer enabled microgrids

Chris Moris

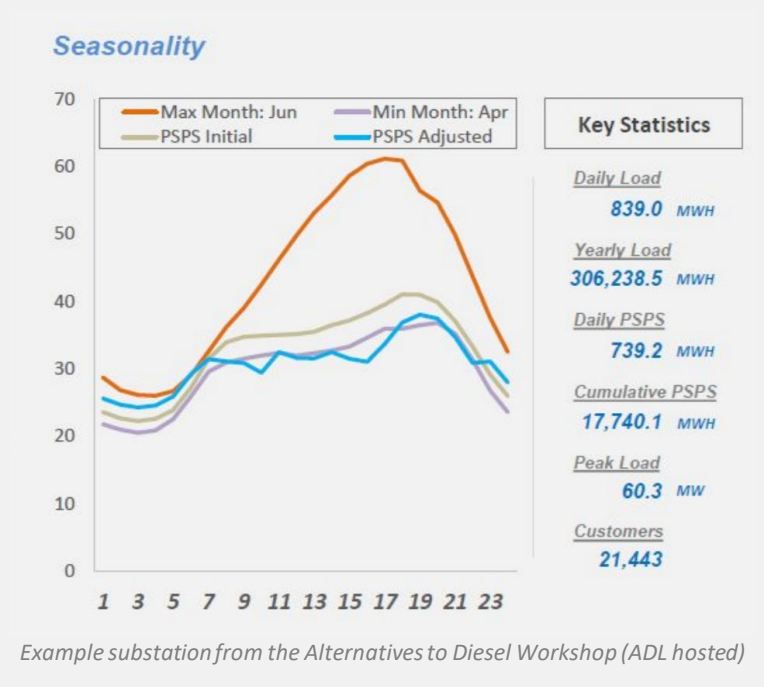
December 14th, 2021

Clean PSPS Substations Leverage BTM DERs

Challenge

Determine the cleanest, affordable solution to PSPS at an example substation

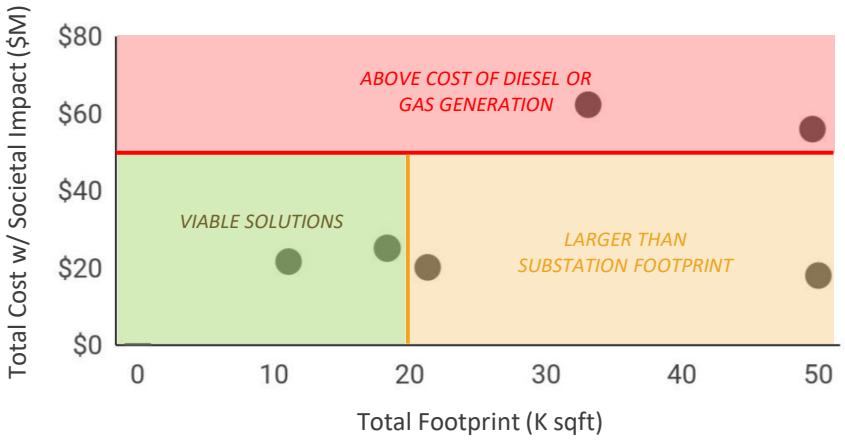
- 40MW base load
- 19,000 sq.ft. max



Example substation from the Alternatives to Diesel Workshop (ADL hosted)

Leading Solution: BTM DERs*

All cost-effective solutions included BTM DERs…



The ***only*** solutions that fit within the substation footprint relied on significant BTM DERs:

#1 – 40MW Turbine w/ 40MW BTM Solar Storage

#2 – 30MW Gas Recip. w/ 30MW DER & Storage

*Source - ADL Ventures: An Economic, Technical, and Environmental Analysis of Diesel Alternatives to Mitigating the Impact of Public Safety Power Shutoffs on PG&E Customers

EPIC 3.11B – BTM DERs in Microgrids

EPIC 3.11B will develop the technical capabilities and the production ready operational processes to utilize BTM DERs for resiliency in microgrids

- Use Case #1: BTM DERs support resiliency in microgrids for cleaner PSPS
- Use Case #2: High penetrations of BTM DERs in multi-customer microgrids (e.g. CMEP)

Gap 1: Technical Ability

1.1 – Real Time Controls

Smart inverter capabilities for charging/discharging based on real time island load balance

1.2 – System Protection

Protection settings that are appropriate for high penetrations of small size inverter-based generators

Gap 2: Path-to-Production

2.1 – Risk and Liability

Accounting for risk and liability, especially in relation to interacting with 3rd party owned assets

2.2 – Validate Adv. Inverter Functions for Islanding

Smart inverter firmware setpoints to enable supporting a utility island

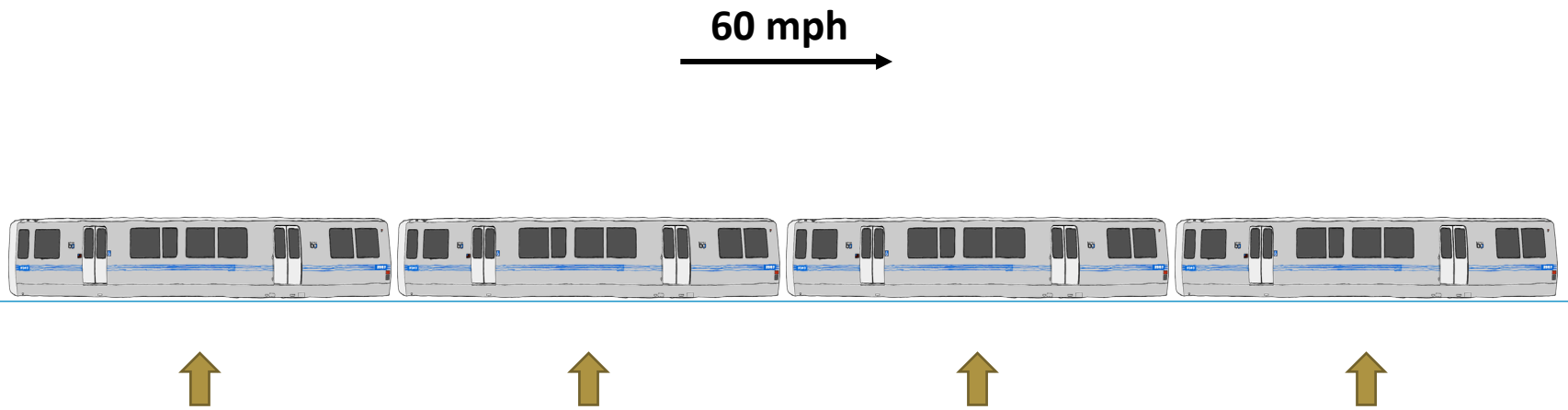
2.3 – Operational Processes

Implementing BTM resiliency procedures within the organization

Internal

Controls Concept

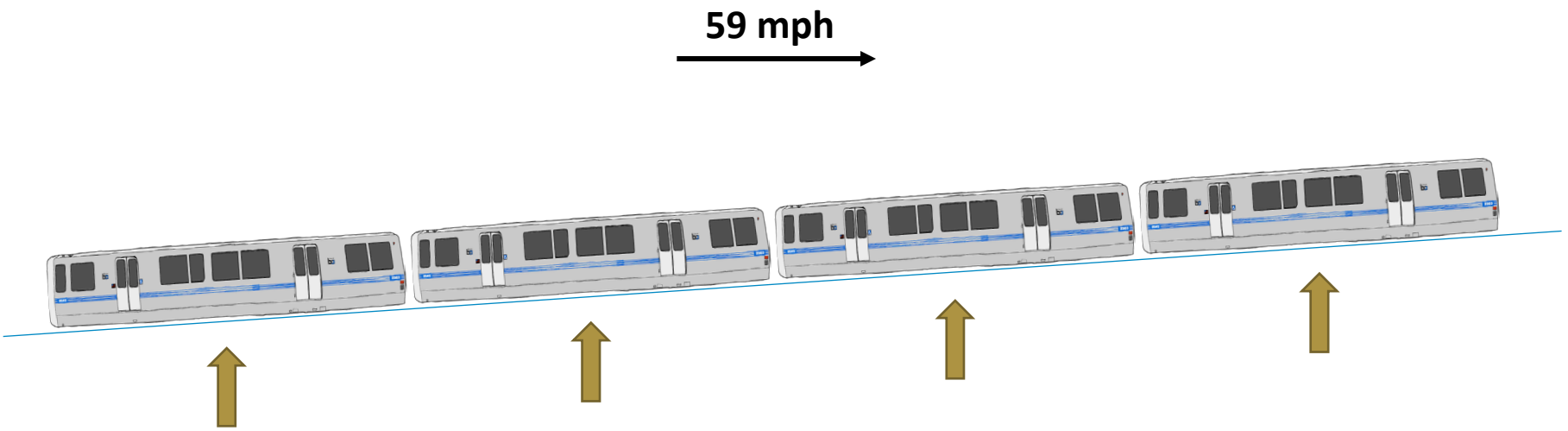
Imagine a BART train traveling 60mph…



- All cars are connected and go the same speed
- Each car provides the same amount of power

Controls Concept

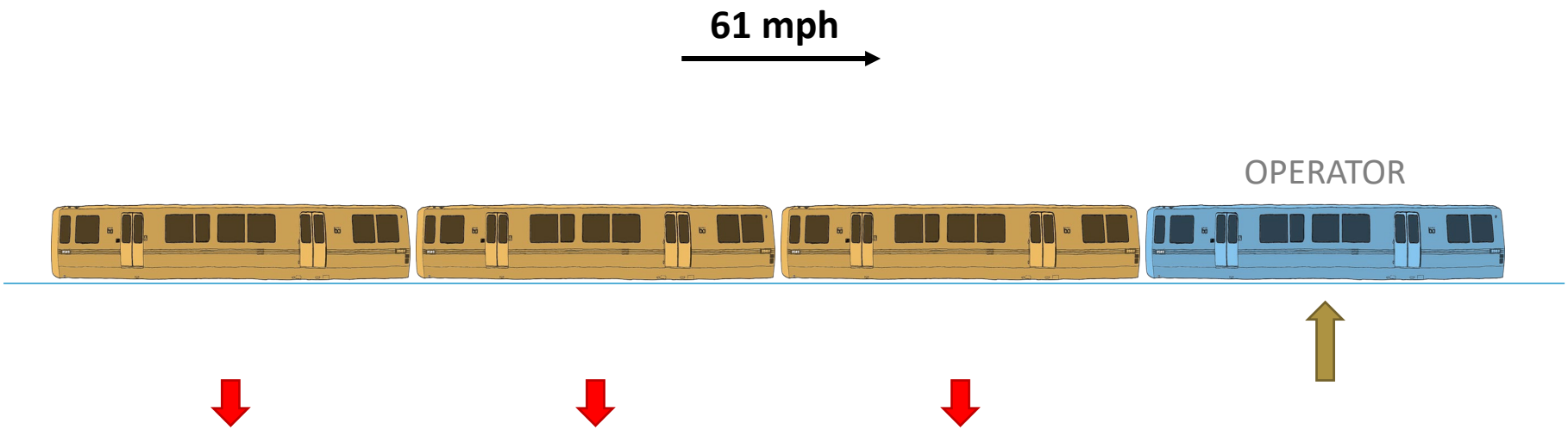
The train encounters a hill…



- The train slows down, and the cars add power to try and maintain 60 mph
- If the train were going down hill, they would brake to keep the speed at 60 mph

Controls Concept

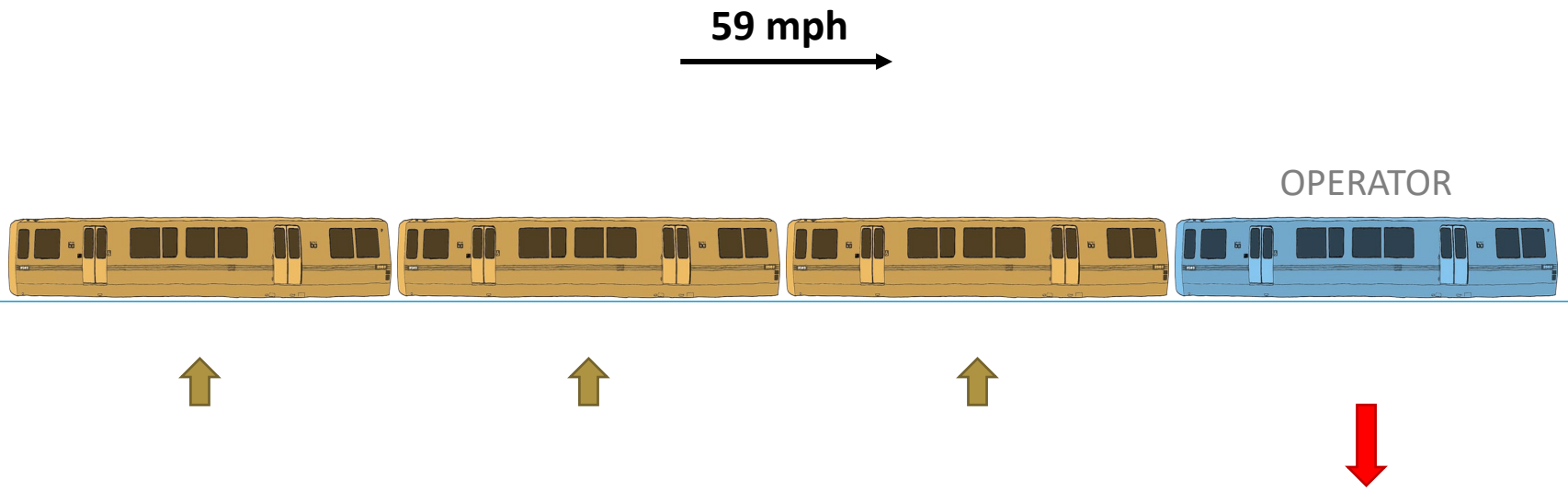
If the operator accelerates…



- All cars are connected and go the same speed
- The following cars must brake to keep the train at 60 mph

Controls Concept

If the operator brakes…



- All cars are connected and go the same speed
- The following cars must increase their power to keep the train at 60 mph

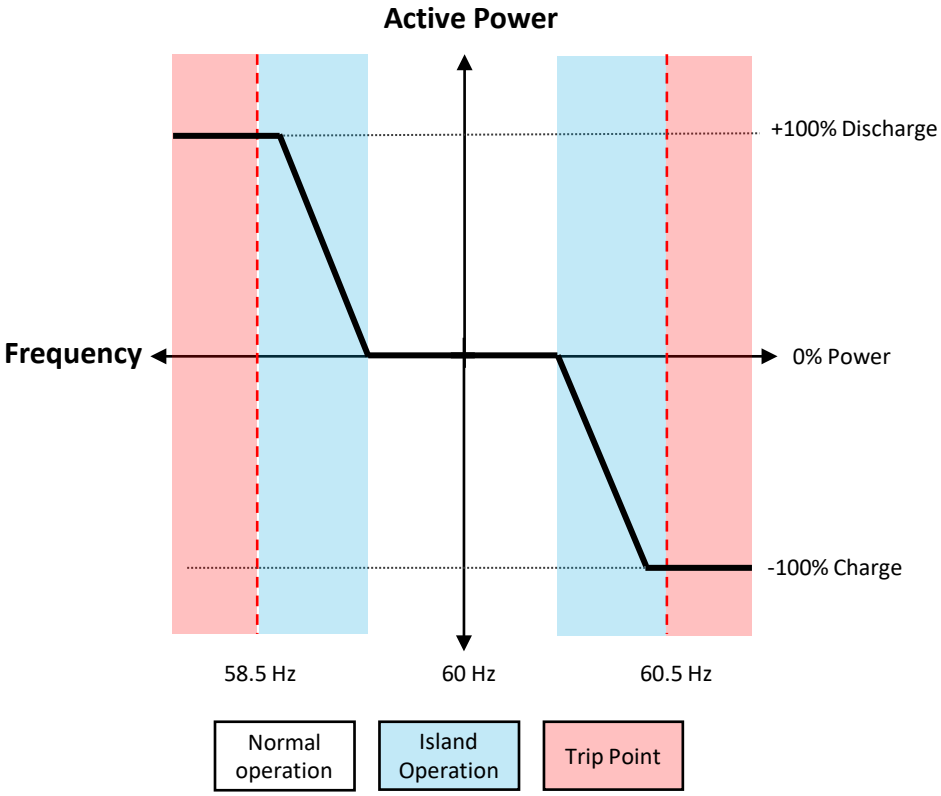
By varying the output of the Operator car (FTM asset), the following cars (BTM assets) can be controlled

Controls Concept

Leverage frequency-based controls within IEEE 1547 compliant DERs

Scenario	Frequency Range	DER Control	DER Behavior
Normal grid operation	59.8 to 60.2 Hz	Customer	Market programming (e.g. TOU)
PSPS event or Microgrid	58.5 to 59.5 Hz – or – 60.3 to 60.5 Hz	Utility	Follow utility frequency signal to charge or discharge
Momentary Trip	<58.5 Hz – or – >60.5 Hz	Firmware default	Frequency ride through
Utility outage			Customer island backup

NOTE: Frequency values are illustrative



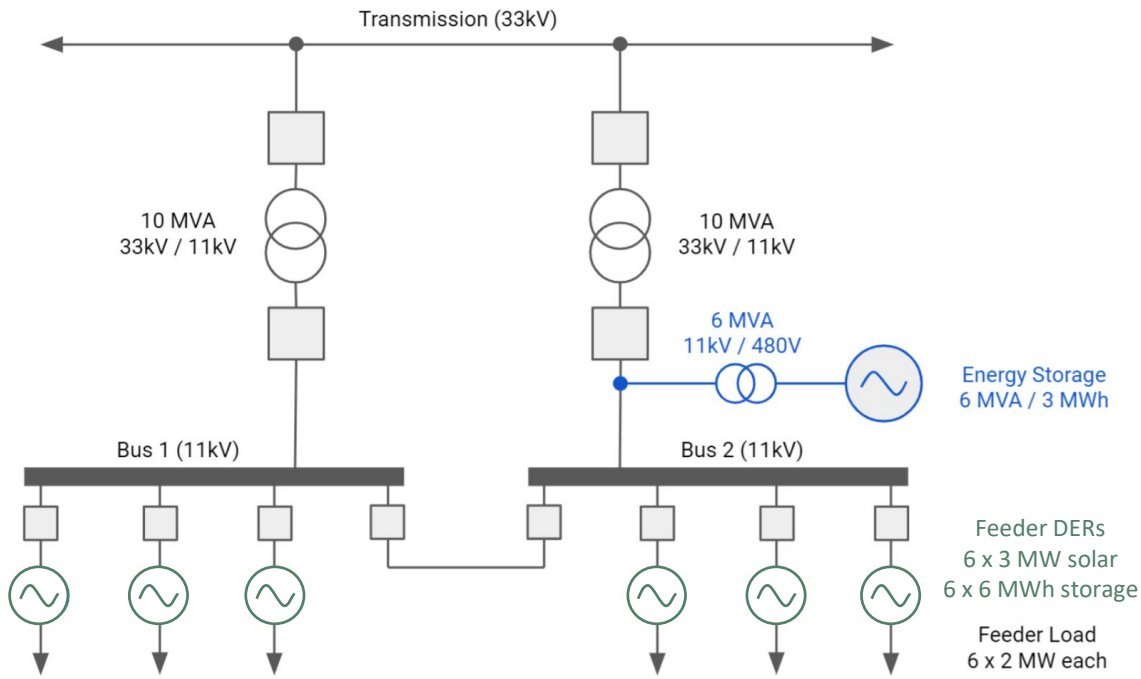
- Control any interconnected Rule 21 compliant DER (after 2017) – DERs ***must comply***
- FTM generator could operate in an isochronous mode with an intentional frequency offset to trigger BTM DER response

Potential Future Grid Architecture

Self-forming microgrids independently island from transmission, resynchronize seamlessly, network into macrogrids, and then reconnect to the greater bulk electric power system.

FTM
- PG&E owned substation storage
- SCADA controlled islanding devices

BTM
- 3rd party mix of solar, storage, and vehicles
- PG&E direct control via R21 adv. Inverter functions
- Renumeration scheme potential



Example substation with minimal centralized storage for forming distribution island, individual feeder generation greater than feeder load, and many multiples total feeder generation vs. centralized storage

Thank You

Chris Moris
CGM0@pge.com