



Soft Energy Storage Systems

August 20, 2014

FESC Meeting



Saft. A world leader for advanced and innovative applications



Saft is the world's leading designer, developer and manufacturer of advanced technology batteries for industrial and defense applications.



The Group is implementing its strategy for high technology lithium-ion batteries for clean vehicles and energy storage systems.



With 3,856 employees worldwide,
Saft is present in 18 countries

Intensium Max Containerized Systems

- Intensium Max for ancillary services and renewables smoothing
- 20-foot ISO containers
- Separate PCS
- Allows for maximum flexibility
 - Transportation
 - Siting
- Flexible power-to-energy ratio



	IM20M	IM20P
Power (kW)	1100	1600
Energy (kWh)	580	420



Intensium Max Plus Containerized System

- Intensium Max Plus for energy & medium power services
- Improved energy density options:
 - IM+20E: 1 MWh energy, 500kW power
 - IM+20M: 950kWh, 2MW power (available 2H2015)
- Transportation fully assembled
- Flexibility in siting



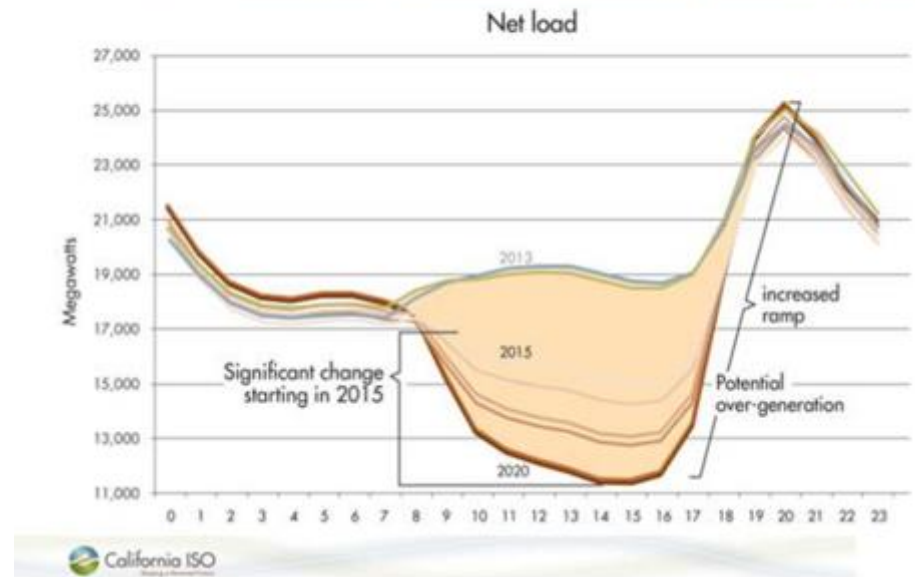
NAM activity highlights

- FERC orders 755 and 784
 - Recognizing speed and accuracy of storage
- California AB2514 – CPUC Rulemaking R.10-12-007
 - 1.325 GW of storage purchases by IOUs by 2020
 - So Cal Edison RFO for 50 MW to 650 MW of storage for resource adequacy
- SDG&E \$55M rate case for storage
- New York City energy storage incentives
- Puerto Rico interconnection requirements for 580MW of renewables
- ERCOT (Texas) rewriting rules for ancillary services
- Ontario long-term energy plan
 - \$50M target for energy storage
- Alberta AESO stakeholder process to integrate storage
- Mexico draft interconnection standards for PV

Importance of Flexibility

- “Feeding the duck”
- CAISO and CPUC working on FRAC-MOO
 - “Flexible resource adequacy criteria and must offer obligations”
- Flexible resources
 - A 100 MW gas turbine offers ~60 MW of flexibility
 - A 100 MW storage resource offers 200 MW of flexibility

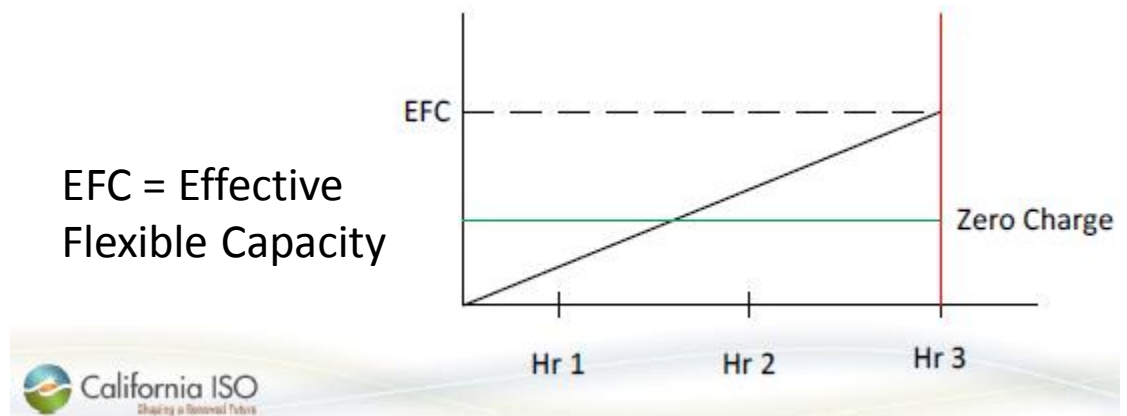
The Duck: Growing need for flexibility starting 2015



California ISO

FRAC-MOO

- Category 3 – ‘super-peak flexibility’
- 3 hours of ramping from full charge to full discharge
- Developers offering storage resources to an IOU under a PPA should be able to offer regulation service also

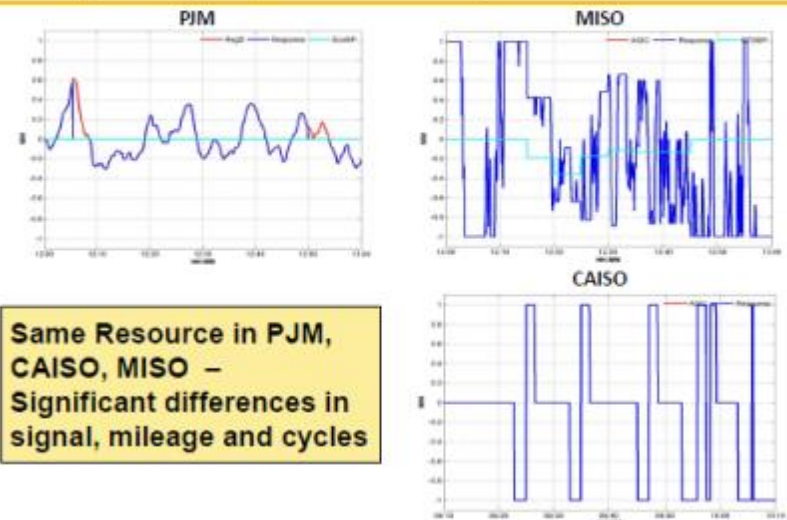


Storage for frequency/area regulation

- Different approaches by ISO
 - Fast-first vs. dynamic signal
- PJM was first to implement FERC order 755
 - PNNL-22010 test protocol includes PJM profile
- Generally accepted storage rating
 - ± 1 MW of power
 - 250 kWh of usable energy



Signal Comparison: PJM, CAISO, MISO



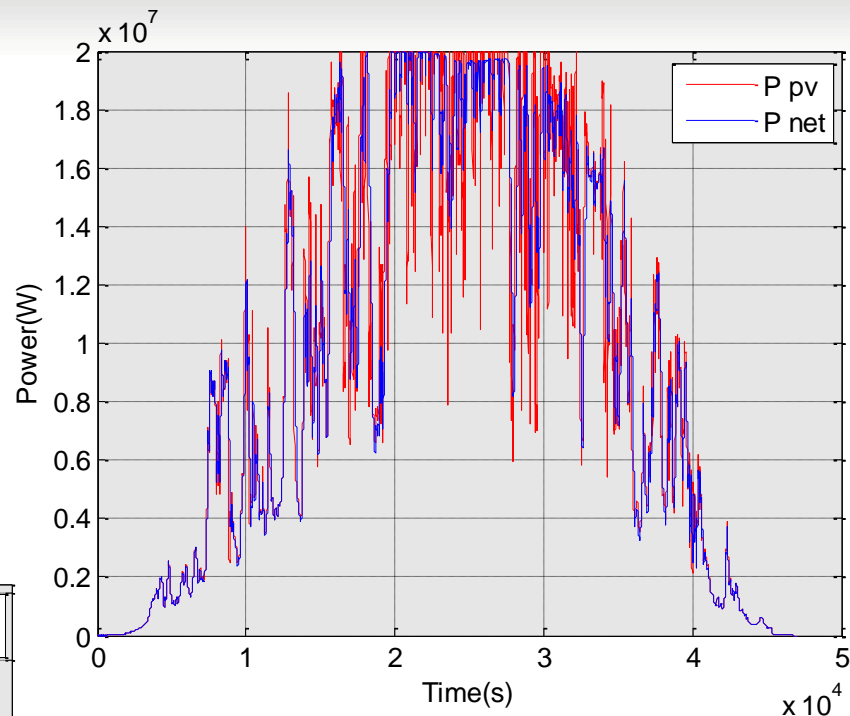
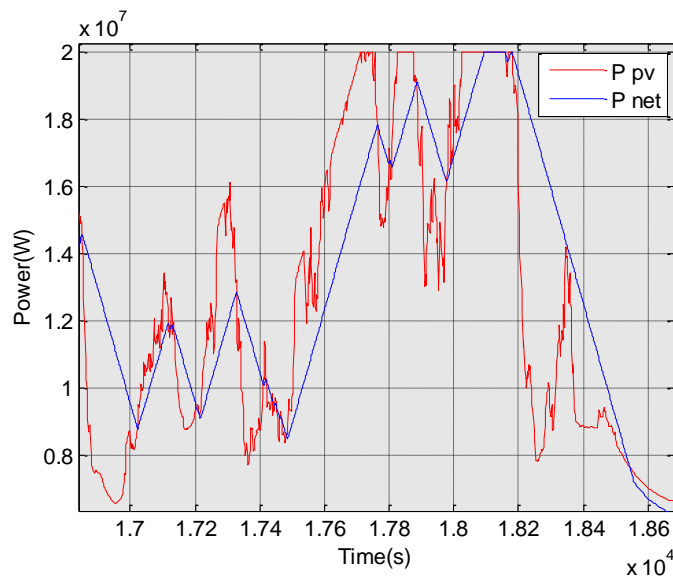
Matlab models

- Modeling electrical and thermal characteristics of Li-ion battery modules
- Developed in Matlab-Simulink
- Extensively validated
- Used for battery sizing and 'what-if' analyses
- Latest models incorporate aging analysis

Model outputs – PV smoothing

■ Example: PREPA Minimum Technical Requirements

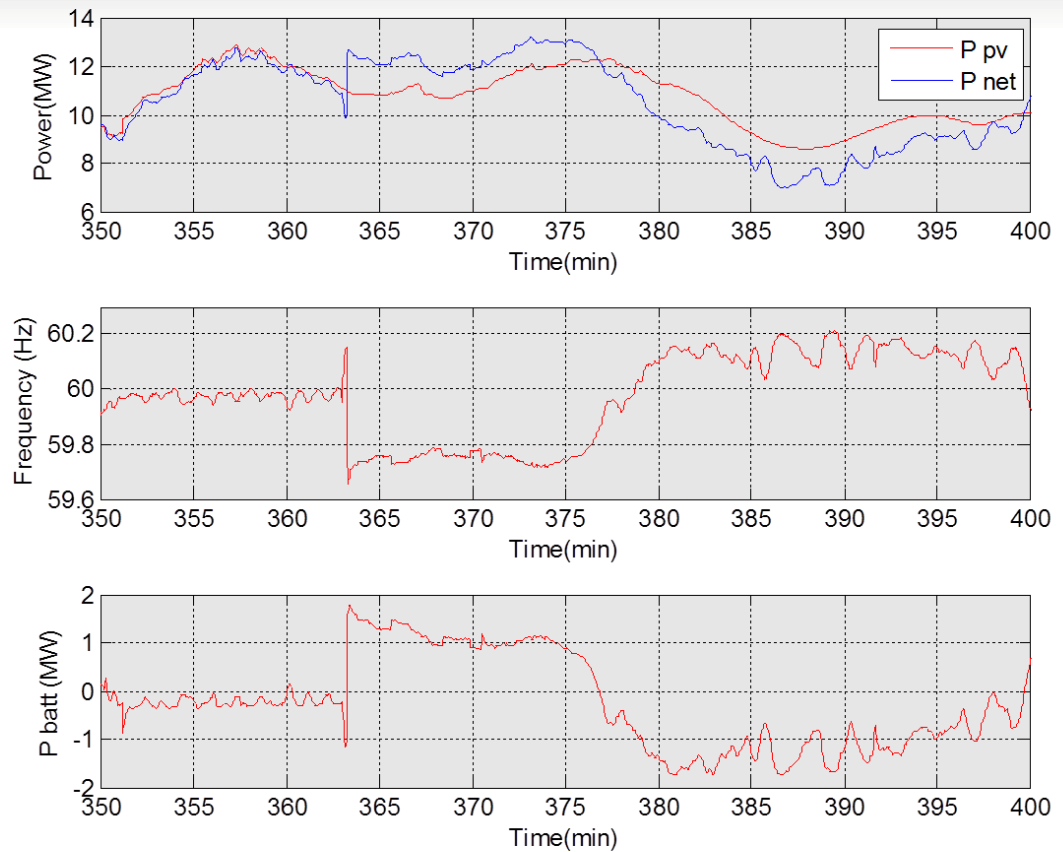
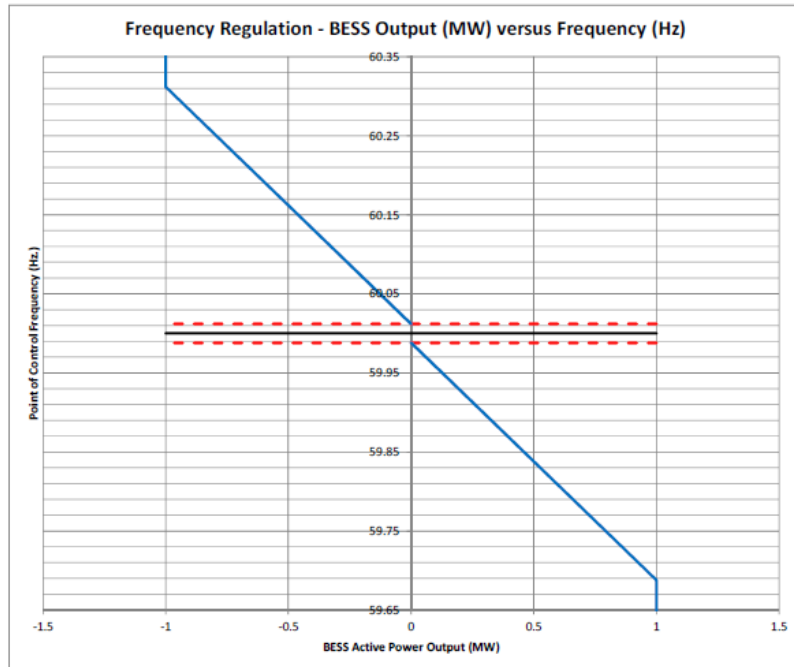
- 10% ramp rate
- Frequency response with 5% droop characteristic



PREPA ramp-rate control
(PV smoothing)

PV smoothing with frequency response

5% droop characteristic





6. Questions?