Renewables & BESS Operational Management with the AVEVA™ PI System™

Sobia Naqvi - Arizona Public Service Company
Arizona Public Service Company

- Serving ~ 2.7 million people
- 11 of Arizona’s 15 counties
- 34,646 square mile service area
- 430 substations
- 300,000 transformers,
  More than 550,000 poles and structures
- More than 35,000 miles of transmission and distribution lines
2020 Clean Energy Commitment

Imagine a world with 100% clean energy.

We are.

Clean energy commitments
- 100% clean, carbon-free electricity by 2050
- 65% clean energy by 2030 with 45% renewable energy
- Eliminate coal by the end of 2031

A clean economic future
- Meet our responsibility to power a low-carbon economy in Arizona
- Guided by sound science to advance a healthy environment
- Market-driven energy innovation and a strong Arizona economy are critical
- Starting from an energy mix that is 50% clean, including energy efficiency and carbon-free and clean energy from Palo Verde Generating Station

Pathways to 100% Clean

Policy decisions
Support policy decisions that leverage market-based technology and innovation to attract investment in Arizona

Existing power sources
Near-term use of natural gas until technological advances are available to maintain reliable service at reasonable prices

Evolving market-based solutions
Participation in the Energy Imbalance Market provides access to clean energy resources while saving customers money

Electrification
Electrification will drive a cleaner environment and more energy-efficient operations throughout the economy

Modernization of the electric grid
Continue to advance infrastructure that is responsive and resilient while providing customers more choice and control

Energy storage solutions
Storage creates opportunity to take advantage of midday solar generation and better respond to peak demand

Next Steps: Collaboration, alignment and innovation
- Reliability and affordability are foundational
- Collaborate with customers, stakeholders and regulators
- Promote economy-wide electrification of industry, transportation and buildings
- Support innovation, research and development of new technology
Renewables Operations

- Solar, Wind, Geothermal, Bioenergy, and Hydro
  - Over 10 years in operations
  - Metrics
  - Performance
  - Preventative & Maintenance
  - Track & Trend
  - Off the shelf solutions
Example – Solar Dashboard

- Built on the AVEVA™ PI System™
BESS Operations

- The Next Frontier in a galaxy not so far away

- Utility scale vs. DERMS
- Safety
  - Alarms
- Sheer amount of data points
- Fear of Unknown
- Tracking and trending
- Lack of Standardization
- Home grown solutions/systems – no consistency
- Overlay existing systems
State of Charge (SoC) = How full is the battery?

- Actual vs Usable
  - Rated Capacity = Usable
  - Overbuild

- Charge Time > Discharge Time
- End of Day (EOD) & End of Hour
- (EOH) SoC = Tools in CAISO and SOC Management
- Round Trip Efficiency (RTE) - is the ratio of energy that the battery can discharge relative to the amount of energy injected

Figure 1 – Source: EPRI Common Functions for Smart Inverters, 4th Edition (3002009217)
BESS Installations

- 260 MW BESS in operations
  - 10 Facilities, PV+Storage
  - All APS PV+S Facilities designed as Co-located CAISO resources
  - Combination of ownership and PPA

- First stand-alone 80 MW/320 MWh BESS operational by Q4 2023

IRA update
- Amending contracts to allow for grid charging of co-located BESS resources

Awarded ~2.5 GW of new resources for 2025 operations (mostly BESS)

All-Source RFP for 1,000 MW of new resources
BESS System

- Many Components

Battery Rack

Battery Container

BESS Energy Management System

Rack level monitoring and controls system
BESS System Operations

- Various levels of expertise/knowledge
- Limited SMEs across organization
- No standardization of data
- Each system is unique and different
- Early solar development days

Handful of Integrators

BESS EMS
- Individual Cell Monitoring
- Battery System
- Battery Health
- Alarms
- Temperature

Site Controls
- Photovoltaic POI Constraints Management
- State of Charge
- Alarms
- Regulatory

End Customer
- ISO Customer/Utility Energy Management System
- Performance Management System

Integration of each EPC/PPA different

- Today, there is no Standard Site Controls Commercial off the shelf product
- Each Developer asks a third-party controls vendor to build a site/PPA/EPC specific controls system
Constraints & Management of BESS

Constraints

➢ Throughput / Cycles
➢ Round Trip Efficiency
➢ State of Charge
➢ Interconnection Agreement
➢ Settlements
  ❖ Payments
  ❖ Market settlements

Investment Recovery Act

➢ Final guidance in process
➢ Many upfront requirements
➢ Effective Jan 1, 2023

Regulatory

➢ Development of reporting requirements
# BESS PI Visualization

**Real Time Facility Operations/Status**
- BESS Condition (Charging, Discharging, Stand-By, Off-line)
- State of charge (as a % and MWh, how much is useable)

**Alarms & Faults**

**Battery container status**

**Facility status**

**Performance monitoring**
Battery Energy Storage System Operating Status

**BESS 1**
- Capacity: 51.0 MWh
- Rating: 17.0 MW
- POI Limit: 17.0 MW

**Generation**
- BESS: -0.1 MW
- POI: 15.0 MW

**Usable State of Charge**
- Charge: -0.1 MW
- Discharge: 17

**Available MWhs**: 3.2 MWh

**BESS 2**
- Capacity: 30.0 MWh
- Rating: 10.0 MW
- POI Limit: 10.0 MW

**Generation**
- BESS: -5.0 MW
- POI: 4.8 MW

**Usable State of Charge**
- Charge: -5.0 MW
- Discharge: 10

**Available MWhs**: 24.6 MWh
BESS Sites

- Alarms

### Alarms

- E-Stop
- Containers Fire
- Containers Fire Suppression
- Containers Fire Trbl
- Containers Hydrogen
- Control Enclosure E-Stop Ext
- Control Enclosure E-Stop Int
- Control Enclosure Fire Suppression
- Control Enclosure Hydrogen
- Control Enclosure Smoke
- Control Enclosure Temperature
- POI Exceedance

### Warning

- SEL-3610 Port Server Alarm
- Backup Generator
- Battery Summary Alarm
- Central Fire Control Panel Trbl
- Containers Fire Supervisory
- Control Enclosure Fire Panel Trbl
- GPS Clock Alarm
- RTU 1 Alarm
- RTU 2 Alarm
- Cell Temperature Maximum

### Alarms & Faults

- Alarm - Critical
  - Count: 0
- Alarm - Warning
  - Count: 0
- Comms Fault
  - OK
- Faults - PCS
  - Count: 0
- Faults - Battery Rank
  - Count: 0

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BESS Implementation Observations

- State of Charge
  - Each BESS Integrator has different performance characteristics
  - Each Integrator only provides an Actual SOC Calculation needed to determine Useable SOC (changes annually with degradation)

- POI
  - For Co-located Facilities, ensuring setpoint signals provided for POI limitation
  - Ensuring all operational systems acknowledge and adhere to POI

- Facility Controls
  - Longest time to integrate Facility Controls during project execution
  - No standardization, each Facility has different control systems
  - Solar curtailment, charging of co-located BESS

- Auxiliary Power / Metering / Station Service
  - Separating charging energy and auxiliary use
  - Each Facility has unique design, including self-cooling, containers and cubes
BESS Implementation

**Frequency Regulation**
- Constant cycling of BESS creates an imbalance of the cells, cells begin to heat leading to possible thermal runway

**Inverter issues**
- Typical inverters, de-rate with extreme weather conditions (hot or cold)

**Tools**
- Lack of standardization for managing, reporting

**Stacking Functions**
- Transmission deferral, capacity, ancillary functions (Blackstart, Frequency Regulation, Response)
OPERATIONALIZATION OF CLEAN RESOURCES

APS implementation of New Clean Resources

Challenge
- New parameters to measure and manage
- New Industry
- No standardization

Solution
- Used existing PI platform to manage parameters
- PI platform for data analytics and measurement

Results
- Managing operations of resources ensuring reliable operations
- Protecting degradation and augmentation
- Market participation
- Customer Affordability
- Diversification of Resources
SOBIA NAQVI

New Resource Implementation Manager

• Arizona Public Service Company
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Questions?

Please wait for the microphone.
State your name and company.

Please remember to...

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