

OCTOBER 25, 2023

SRP battery storage and AVEVA™ PI System™

Dag Reppen, Salt River Project

AVEVA

Salt River Project

- US Bureau of Reclamation Project
- Supply water & power to the Salt River Valley in Arizona and large portions of the Phoenix Metropolitan area
- SRP facts per end of FY23
 - 1,135,988 electric customers
 - Peak system load: 7620 MW
 - Available MW resources: >8800 MW
- Generation Resources
 - Gas, coal, nuclear, hydro, solar, battery storage, wind, biomass & geothermal



Solar and battery storage at SRP

- SRP currently has over 500 MW of solar resources available
- SRP is adding 2,025 MW of solar by 2025
 - Sonoran Energy Center: 250 MW solar + 1,000 MWh battery
 - Others as well, with consideration for when the sun sets
- SRP has Li-ion batteries already (180 MWh worth)
- Bolster Substation Battery System, Peoria, AZ

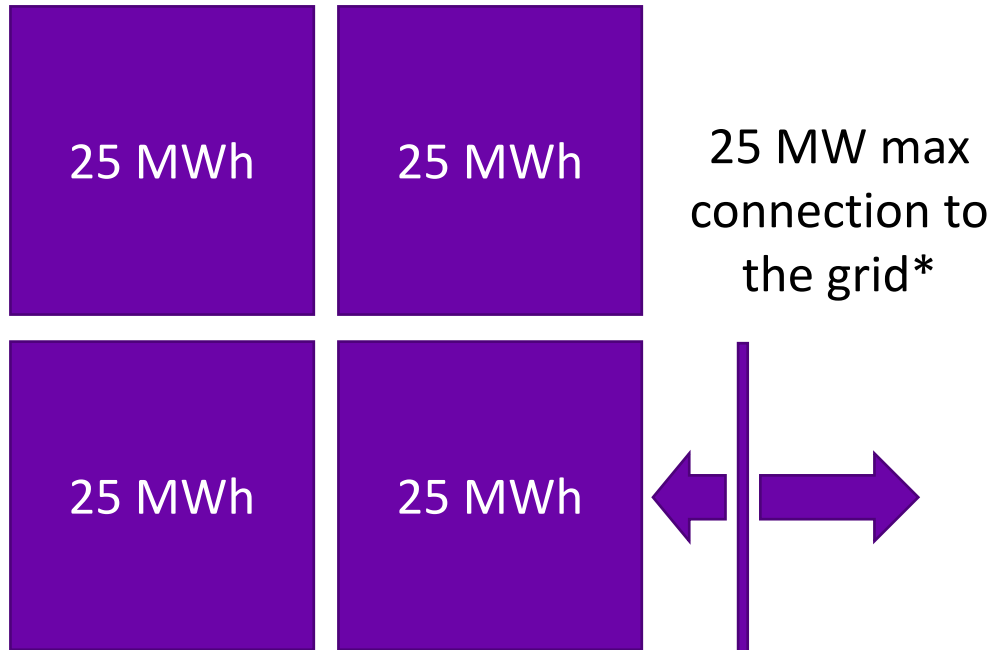


Challenge

SRP demand for solar power is growing fast. Battery storage is required to support the intermittent nature of solar and wind power. In order for SRP to incorporate battery storage into our system, we will need to better understand the capabilities, limitations and other characteristics of battery storage.

Quick Bolster background

100 MWh
storage capacity



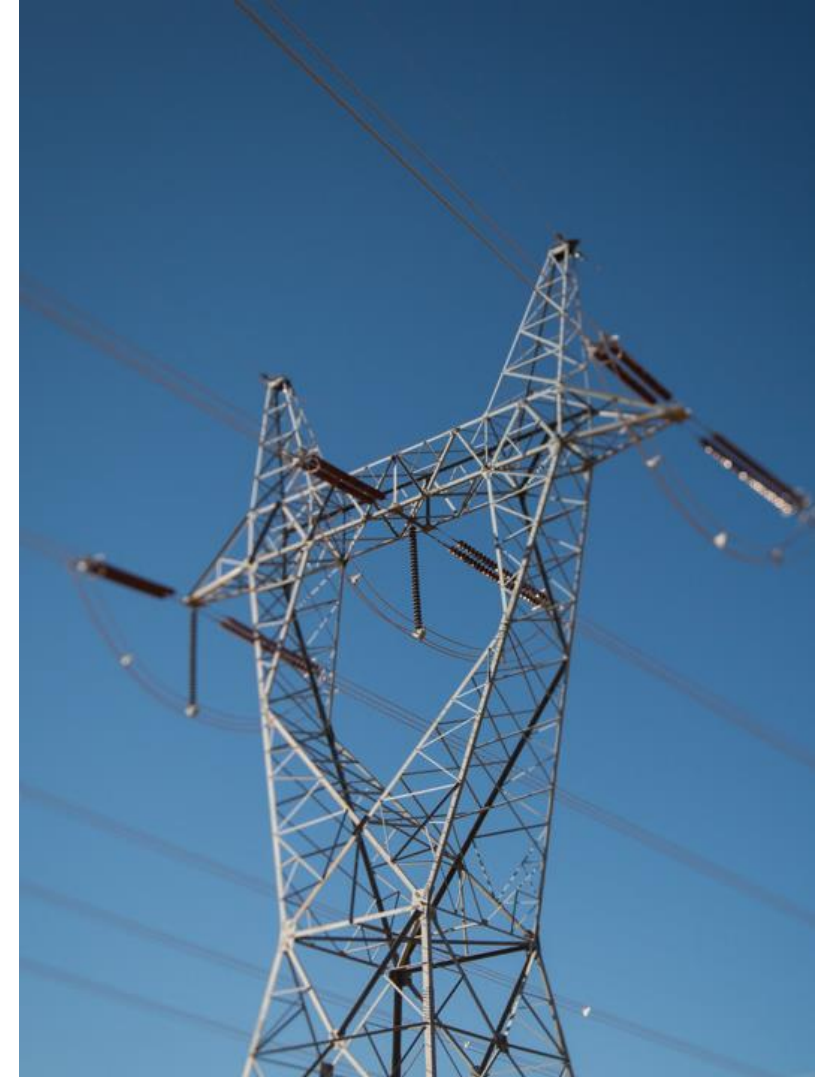
*during normal
operation



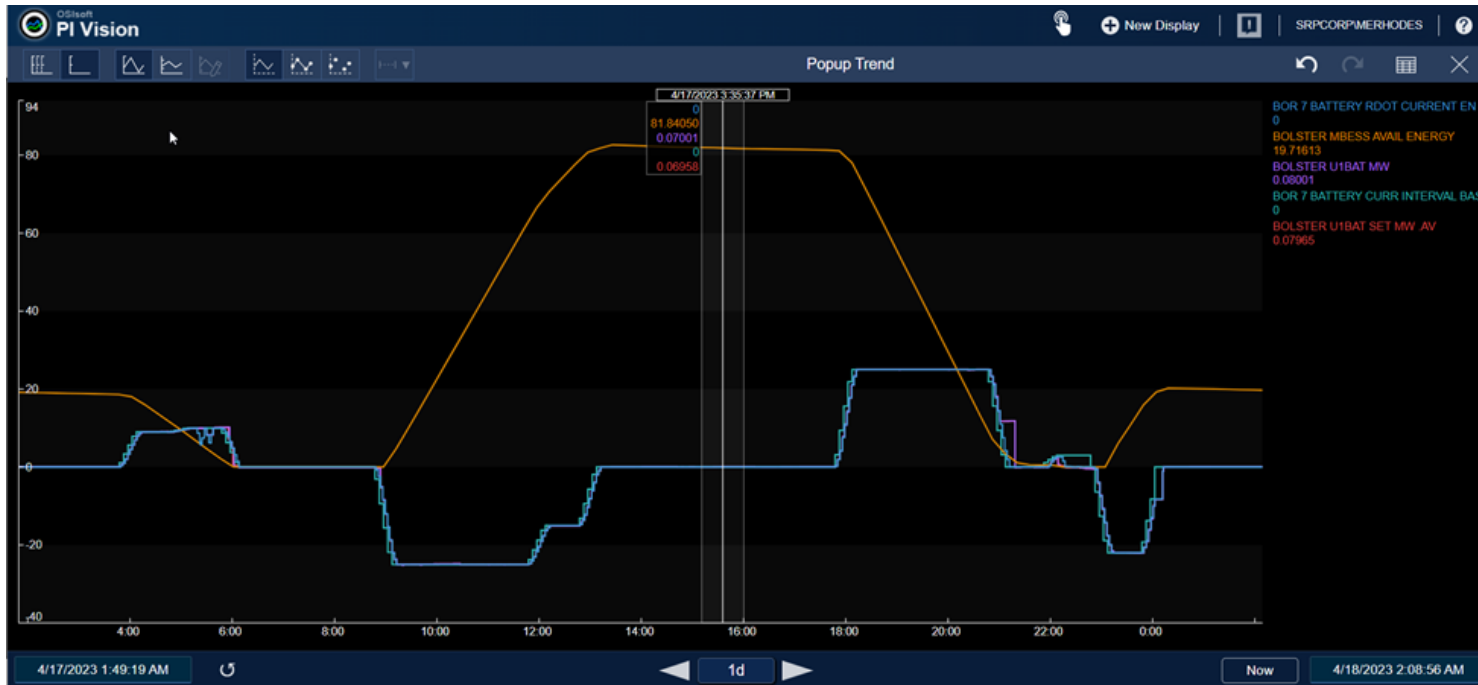
- Bolster is connected to SRP's 69 kV system, and is charged during low-cost, low-load hours to be used during high-cost, high-load hours.
- Bolster is warranted for 20 years if SRP operates it per specifications.
- Max energy storage capacity decreases every year, but max power level connection to the grid will remain the same.
- Bolster is a 25 MW/4-hour battery meaning a max energy capacity of 100 MWhr (25 MW x 4 Hours).

Bolster scheduling and operating practice

- Look at average electricity market prices each month.
- Optimize with ~88% efficiency (means charging is 88% efficient so it takes more than 4 hours to charge from 0% to 100%. Discharging is about 100% efficient as it takes 4 hours to go from 100% to 0%).
- Send monthly schedule to SRP's internal optimizer (PCI).
- SRP PCI > CAISO EIM > SRP Energy Dispatch System.
- SRP's dispatch system receives 5-minute dispatch targets to follow a monthly optimized schedule.
- Both the dispatch targets and actual charge/dispatch values are saved in the AVEVA™ PI System™.



Tracking State of Charge and Battery Dispatch



- EMS Ramped DOT
- Bolster Available Energy in MWHrs (State of Charge)
- Bolster Actual Output
- Bolster Base Schedule

Solar and Battery Operations Display



- Site Net MW
- Solar Output
- Battery Output

Battery Performance Monitoring Data

Site Level Points

SUB_BOR.TSC Loss of Battery Meter Communication
SUB_BOR.TSC Battery Controller to Inverter Communication
SUB_BOR.TSC Battery Fault
SUB_BOR.TSC Status_Command_Source
SUB_BOR.TSC RealPower_Command_SC_to_Batteries
SUB_BOR.TSC ReactivePower_Command_SC_to_Batteries
SUB_BOR.TSC Status_Full_Charge_Energy
SUB_BOR.TSC Status_Remaining_Energy
SUB_BOR.TSC Status_Maximum_Charge_Power
SUB_BOR.TSC Status_Maximum_Discharge_Power
SUB_BOR.TSC BatteryMeter_3PH_RealPower
SUB_BOR.TSC BatteryMeter_3PH_ReactivePower
SUB_BOR.TSC BatteryMeter_3PH_ApparentPower
SUB_BOR.TSC BatteryMeter_3PH_ACVoltage
SUB_BOR.TSC BatteryMeter_3PH_ACCurrent
SUB_BOR.TSC BatteryMeter_3PH_ACFrequency
SUB_BOR.TSC BatteryMeter_3PH_RealEnergyExported
SUB_BOR.TSC BatteryMeter_3PH_RealEnergyImported

x1

Megapack Level Points

Analog Points

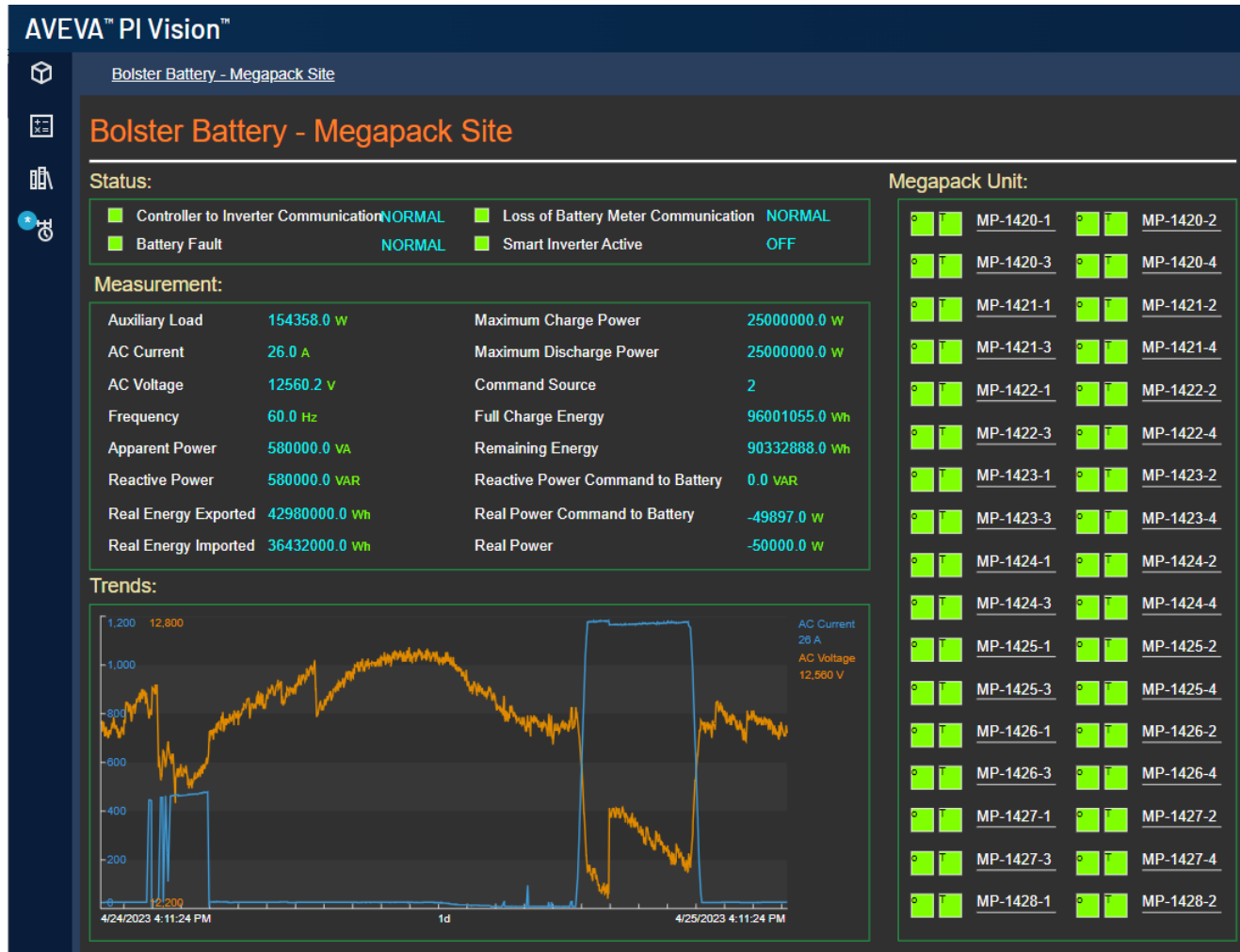
MP3-1_real_power_target
MP3-1_real_power_output
MP3-1_reactive_power_target
MP3-1_reactive_power_output
MP3-1_state_of_energy
MP3-1_usable_energy_remaining
MP3-1_usable_energy_to_be_charged
MP3-1_usable_full_pack_energy
MP3-1_nominal_full_pack_energy
MP3-1_frequency
MP3-1_ac_voltage_average
MP3-1_ac_voltage_phaseA
MP3-1_ac_voltage_phaseB
MP3-1_ac_voltage_phaseC
MP3-1_inverter_phaseA_current
MP3-1_inverter_phaseB_current
MP3-1_inverter_phaseC_current
MP3-1_dc_voltage
MP3-1_max_battery_temperature
MP3-1_ambient_temperature
MP3-1_available_charge_power
MP3-1_available_discharge_power
MP3-1_nominal_charge_power
MP3-1_nominal_discharge_power

Digital Points

MP3-1_megapack_loss_of_comms
MP3-1_megapack_iso_failure
MP3-1_inverter_fault
MP3-1_hv_interlock_broken
MP3-1_keylock_open
MP3-1_door_switch_open
MP3-1_ac_breaker_open
MP3-1_bus_controller_prolonged_fault
MP3-1_remote_shutdown
MP3-1_coolant_low
MP3-1_battery_overnight_temperature_warnin
MP3-1_thermal_event_active
MP3-1_grid_uncompliant
MP3-1_low_state_of_energy

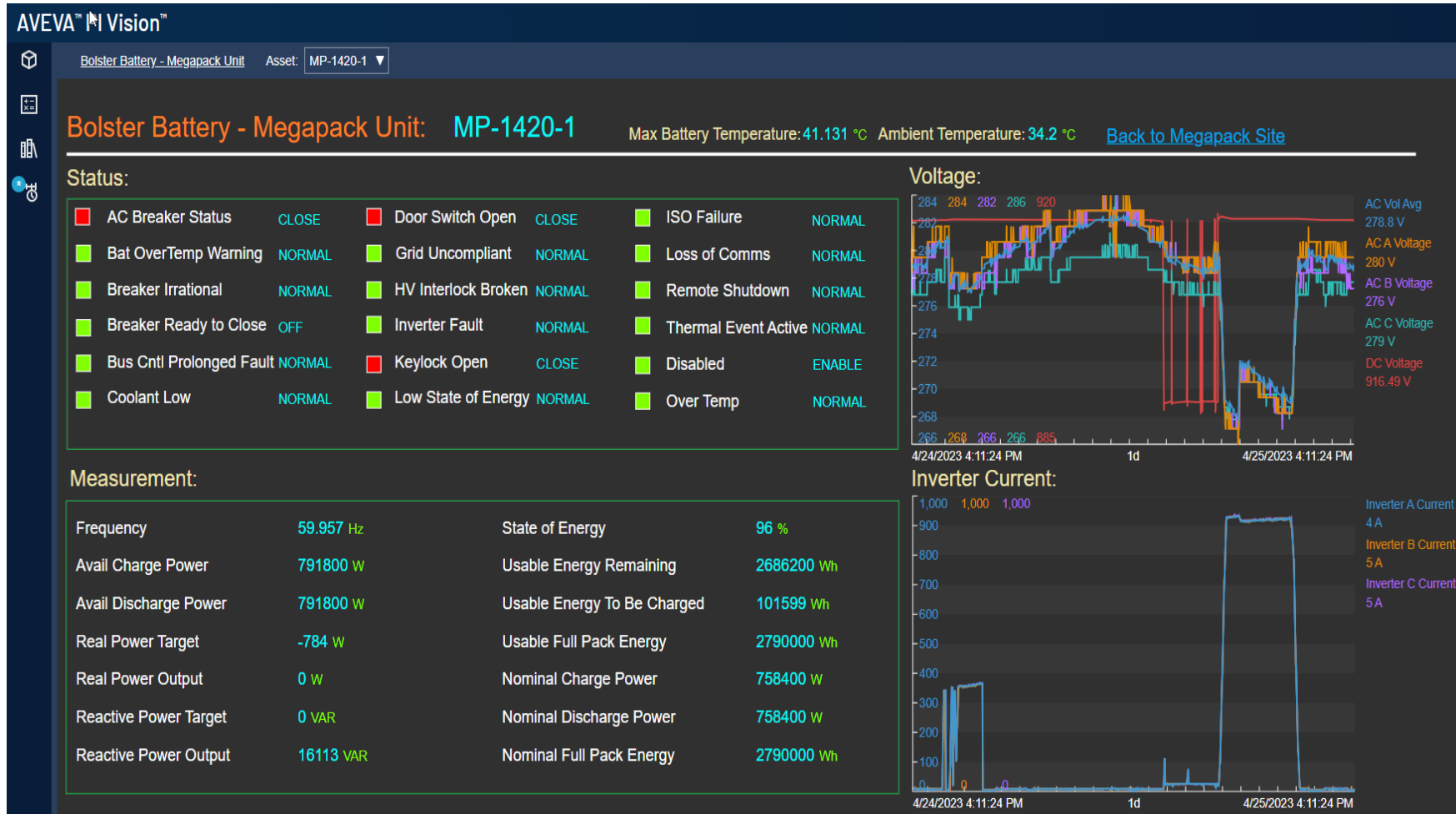
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Bolster Site Level Dashboard



- Total battery output data including:
 - Auxiliary load
 - Full charge energy (amount of MWhr energy capacity available)
 - Real and reactive power setpoint commands from the site controller to the battery.
- Bolster is made up of 34 "Megapacks", each delivering 700kW
- Right side has Megapack overview alarms for:
 - General alarms
 - Critical battery thermal event active (potential fire)

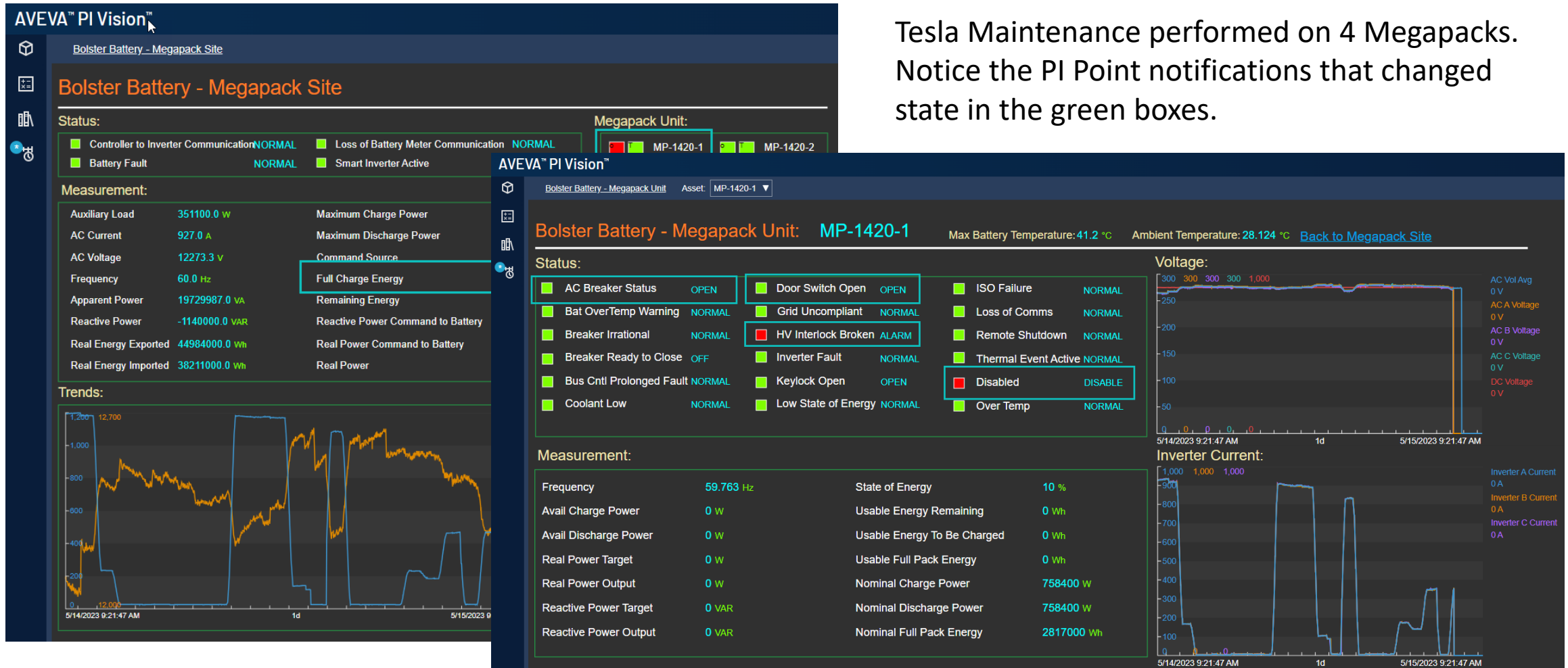
Bolster Megapack Level Dashboard



- Digital statuses
 - 480V AC breaker
 - Internal fault detection
- Numeric data
 - Available power
 - Nominal power
 - Nominal energy
 - Real and Reactive Power command targets
- Trending analog data
 - 480V AC voltage
 - 480V AC current
 - DC voltage

Battery maintenance semi-live dashboard

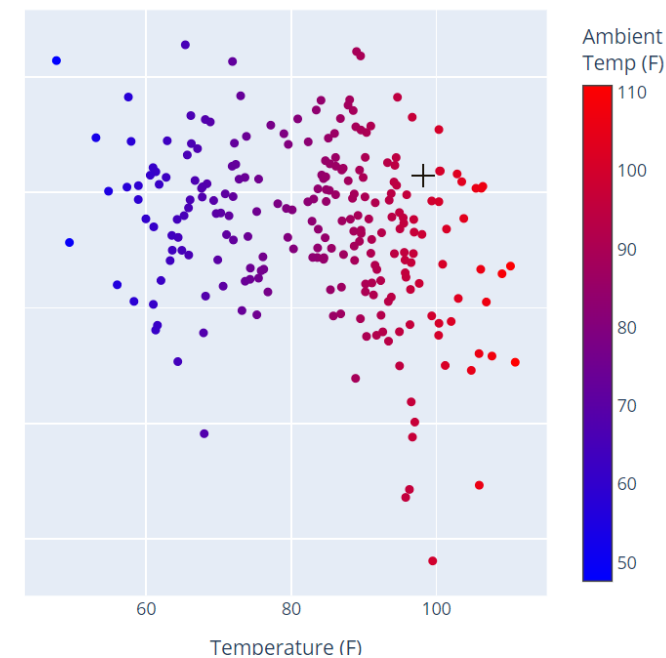
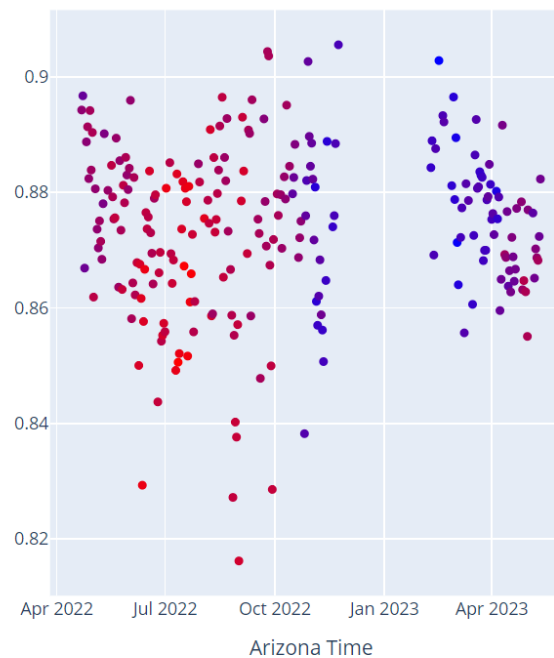
Tesla Maintenance performed on 4 Megapacks. Notice the PI Point notifications that changed state in the green boxes.



Bolster PI Data value

- Current Notifications and Alarms value:
 - Megapack outage/dropouts – Identify when capacity is impacted.
 - Ramping MW plateauing – Identify abnormal ramping behavior.
 - High state of charge – Identify possible battery self-curtailment and resultant EMS control issues.
- What we think could provide some value to real-time operations:
 - Advanced knowledge of potential battery failure.
 - Reduction in energy availability.
- What we think could provide some value for performance:
 - Idle Degradation
 - Battery site level analysis via EPRI Foresight project

RTE vs. Time and Temperature



Real-time value of PI Data

- Alarm trigger: Current State of Charge has reached to 95% of current available energy for greater than 10 seconds.

Alert - Bolster Battery Charge High



PGPMC - DEPT ID

To Matthew E Rhodes

Retention Policy SRP Deleted Items (60 days)

Start your reply all with: Thank you! Approved. Just got this. Feedback

State of Energy Warranty Performance A 2023-05-12 15:09:18.000

Battery Charge High

Start Time: 5/12/2023 3:09:18 PM US Mountain Standard Time (GMT-07:00:00)

Value at Start Time: 95.005 Charged

Threshold for Notification: Above 95% Max Charge for >10 seconds.

Event Details: [Event Details Hyperlink](#)

ALERT - Bolster Battery Unexpected Power Output Shift



PGPMC - DEPT ID

To Matthew E Rhodes

Retention Policy SRP Deleted Items (60 days)

Start your reply all with: Just got this. Thank you! What is this about? Feedback

Event: Bolster Battery Unexpected Power Output Shift

Threshold for Alert: Battery output dropped by more than 600kW within 2 seconds.

Event Start Time: 5/8/2023 11:14:34 PM US Mountain Standard Time (GMT-07:00:00)

Notification Send Time: 5/8/2023 11:14:43 PM US Mountain Standard Time (GMT-07:00:00)

Event Details: [Event Details Hyperlink](#)

PI Server: pmcafprod

- Power output (MW) has changed by 600kW in less than 2 seconds. One Megapack is 700kW.

Value realized and actions taken

Unexpected power output shift alarm

- Megapack dropout
- Ramped operation plateau ACE effect.



Megapack dropout – Action: Submit a service ticket to Tesla to investigate.

ACE Effect – Action: Contact SRP EMS teams or check ACE PI Vision display to investigate ACE action for verification of ramping commands interruption and prevent aggravating system balancing issues.

Bolster Testing Project - Regulation

How it works

ACE (Area Control Error) is a measure of SRPs generation to load balance. Specific generation units can be selected to aid with regulating ACE

Test Results

Bolster successfully provided ACE Regulation particularly as the SOLE SRP system regulation generator



Future

- Full energy capacity degradation monitoring – Identified battery Megapack reduction of available energy capacity.
- EPRI Research Project - Megapack level analytics (EPRI Foresight) – Battery education into battery module behavior.
- Use EMS and Meteorological data from PPA sites to further our understanding in BESS operations.





Power Generation | USA

SRP uses AVEVA PI system to manage solar generation and energy storage.

Challenge

- SRP demand for solar power is growing fast. Battery storage is required to support the intermittent nature of solar and wind power. In order for SRP to incorporate battery storage into our system, we will need to better understand the capabilities, limitations and other characteristics of battery storage.

Solution

- SRP has acquired and installed a 100 MWh Tesla battery storage system, Bolster
- Data from the battery site and the individual Megapacks are brought into SRP's centralized enterprise AVEVA™ PI System™ to streamline data collection, access, analysis, and reporting.

Results

- **The system is already providing a better understanding of how SRP will deploy large-scale batteries in the future.**
- **By utilizing SRP's centralized, enterprise AVEVA™ PI System™, battery storage operations data is made available across the enterprise in order to make intelligent operational and planning decisions**





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Questions?

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



Please remember to...

Navigate to this session in the mobile app to complete the survey.



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