



Real-time microgrid and DERMS control using the PI System and PXiSE Advanced Control Technology

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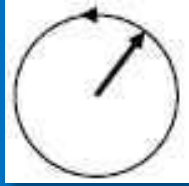
A Modern Grid Control Solutions Company

Located in San Diego, CA

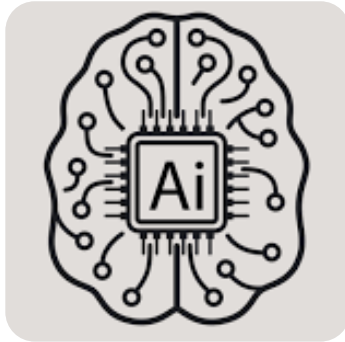
Backed by Sempra Energy and Mitsui



PXiSE utilizes bigger data and artificial intelligence



Untapped
synchro-phasor
data / insights

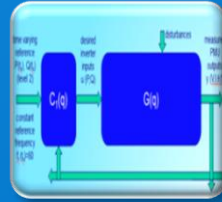


- Adapting high resolution data 60 samples per second for MRI-like visibility and precision control
- GPS time-synchronized “State” measurements provide powerful real-time insights
- Advanced neural network technology for event detection
- Clustering technology for forecasting
- On-line control system tuning
- Adaptive control technology

PXiSE brings new intelligence and autonomy to grid control



Insightful
high-speed
phasor data



Multi-level
system
feedback
control



System model,
optimization, &
artificial
intelligence



OSIsoft PI data
technology

Intelligent software
in common hardware



PXiSE Advanced Control Technology (ACT)

Software

- PXiSE ACT 3.0 control
- PI 2017 server
- Windows 2016 server

Hardware

- 64 bit computer
- Substation hardened, or
- VM on premise or cloud server
- Existing sensors (*PMUs from relays)

*Users should not be confused with PMUs application in transmission system, time-synchronized phasor data from a few PMUs offer new insights for modern grid control

The problems we solve

Operate grids with any percentage of renewables supported by a battery energy storage system (BESS)

Coordinate any mix of energy resources

Cost-effective and reliable grid control solutions

What we do

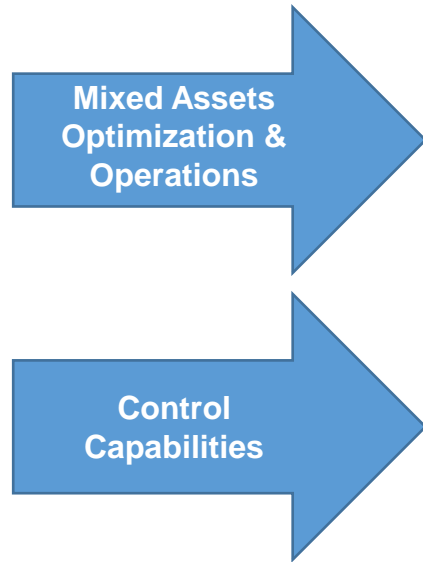
Advanced SCADA and grid control automation

Renewable generation output performance control

Microgrid controls (islands, remote communities, comm./industrial)

Autonomous DERMS with optimization

How we are different



Legacy Control

Results differ from claims:

Energy management and
dispatch focus

Slow response to changes
Operate few devices

Logic-based, inflexible to
operate as system conditions
change

Higher cost (low assets use)
Low performance

PXiSE Advanced Control

Delivers differentiating benefits:

- A real control system with
multi-level feedback
- Fast and adaptive software
configurable
- Designed for 1000's devices

- Optimization-based, fast and
adaptive to real-time conditions
 - Lower (optimal use)
 - Higher performance cost

Who's using PXISE ACT?

Auwahi Wind Farm (24 MW, 11MW/4.4 MWh
Battery Energy Storage System)

Copper Mountain Solar Farm (58 MW, Grid-tied)

Silver Oak Winery microgrid (200+ kW Solar and 120kW/420kWh
Battery Energy Storage System)

Sempra Headquarters microgrid (Solar PV, EV Chargers, and
250kW/625kWh Battery Energy Storage System)

Great Valley Solar Farm (200 MW with Switching Capacitors,
Grid-tied)

PXiSE ACT application in microgrids

A comprehensive solution to manage and control all DERs logically organized within the Microgrid in an hierarchy

Level 1 – Microgrid control of all DERs (islanded or grid connected)

•**Utility Point of Interconnection (POI):**

- Total controllable supply/demand balance and power quality management

Level 2 – Group of mixed DERs control

Logical grouping within microgrid:

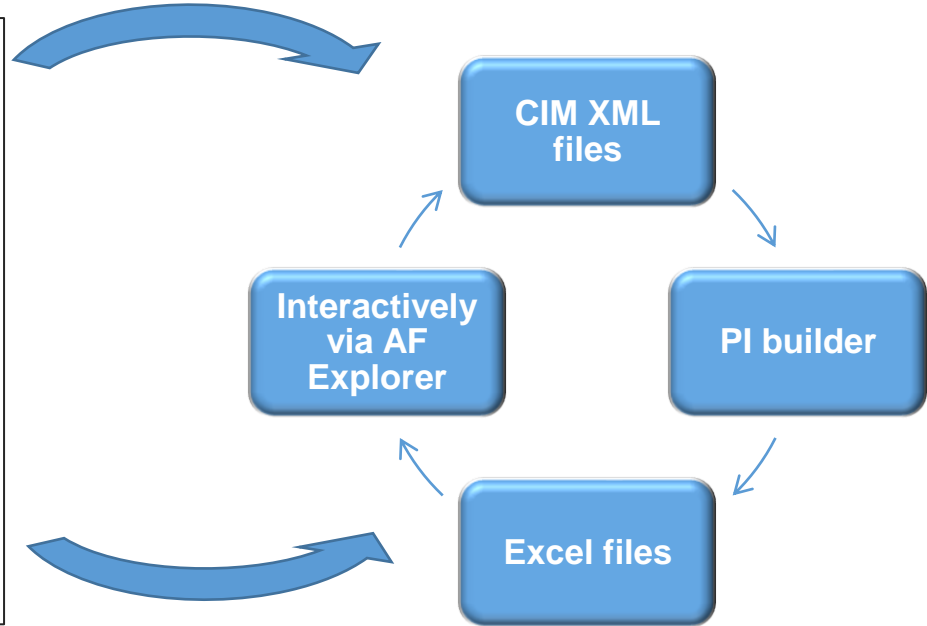
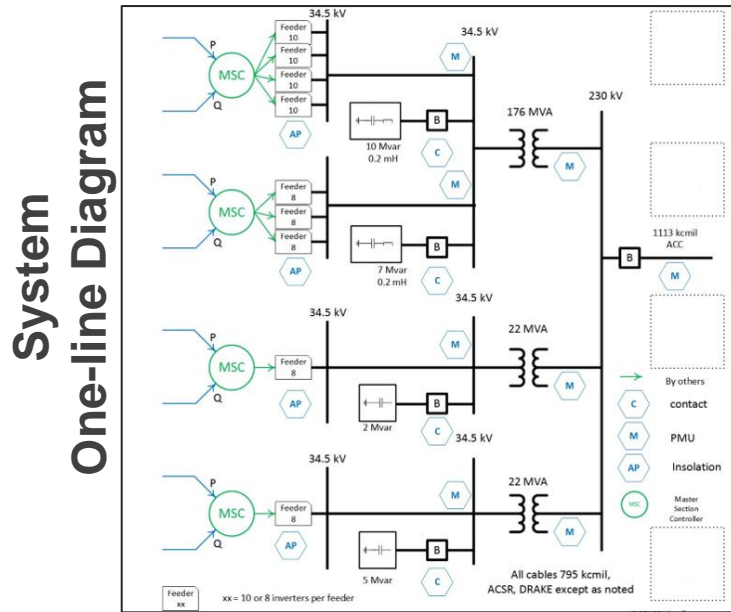
A mix of DERs including BESS, renewables, and thermal generators

Level 3 – DER control

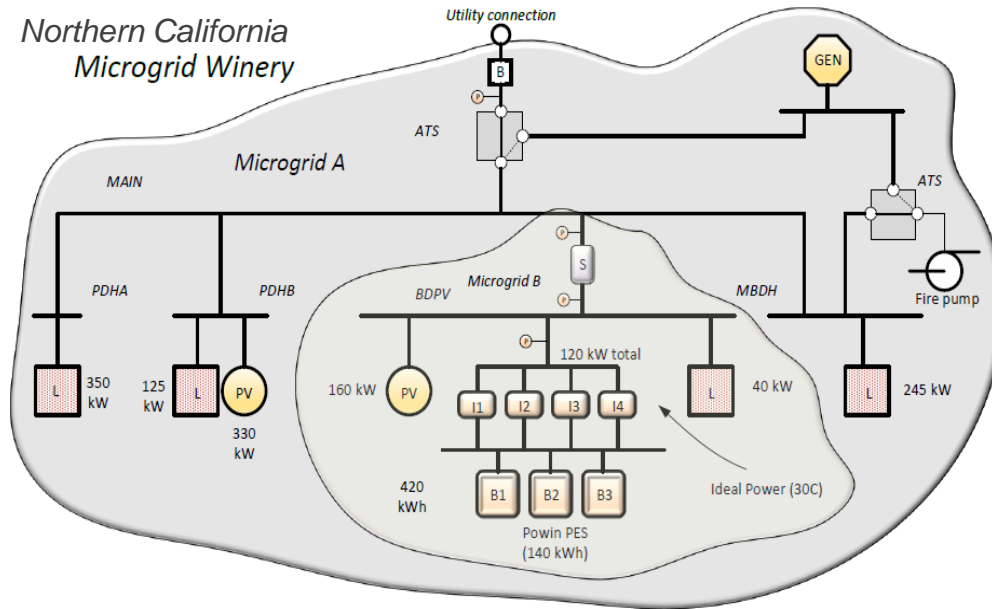
Individual DER:

- Solar PV
- BESS
- Generators
- Controllable loads

Flexible data input and configuration



User configurable microgrid software for many DERs



120kW / 420kWh Battery
600kW Solar PV
2 Microgrids



PXiSE ACT winery microgrid

- Control system dashboard is flexible to accommodate local needs
- User configurable and interactive display
- Powered by industry standard PI Vision



Controlled by PXiSE 8 Solar Inverters, 4 Energy Storage Inverters and 1 ASCO Switch

High-rise building microgrid

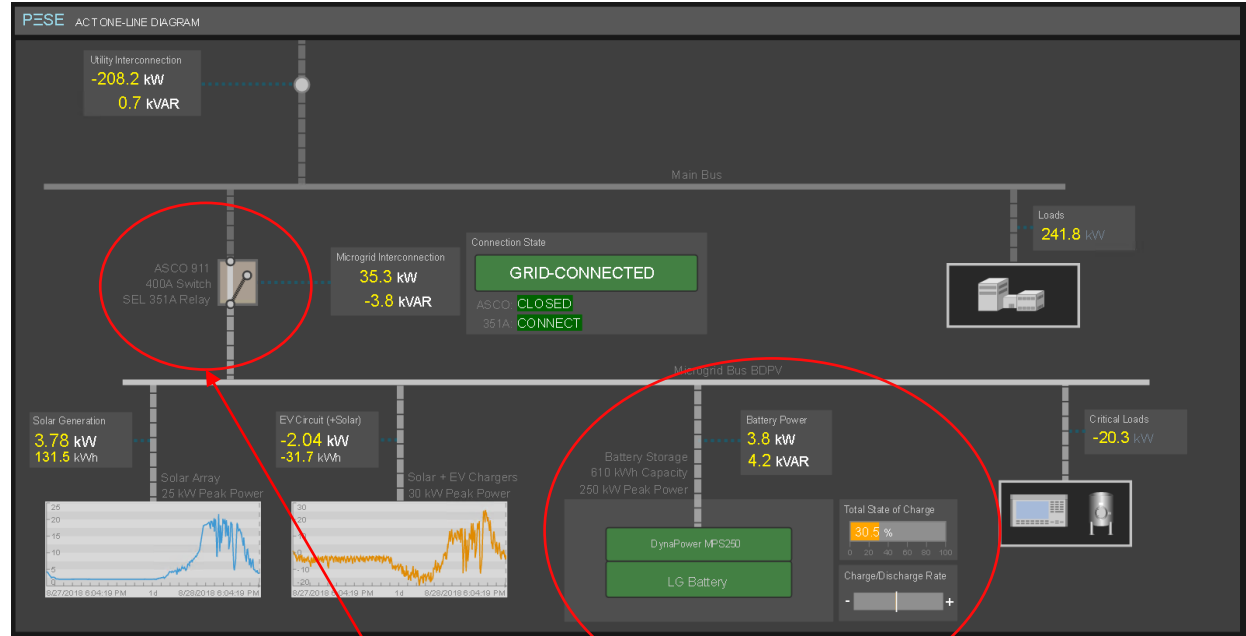
Same hardware and user configurable software advantages by OEM PI functions

120kW / 615kWh battery
50kW solar PV
EV charging
3rd floor microgrid



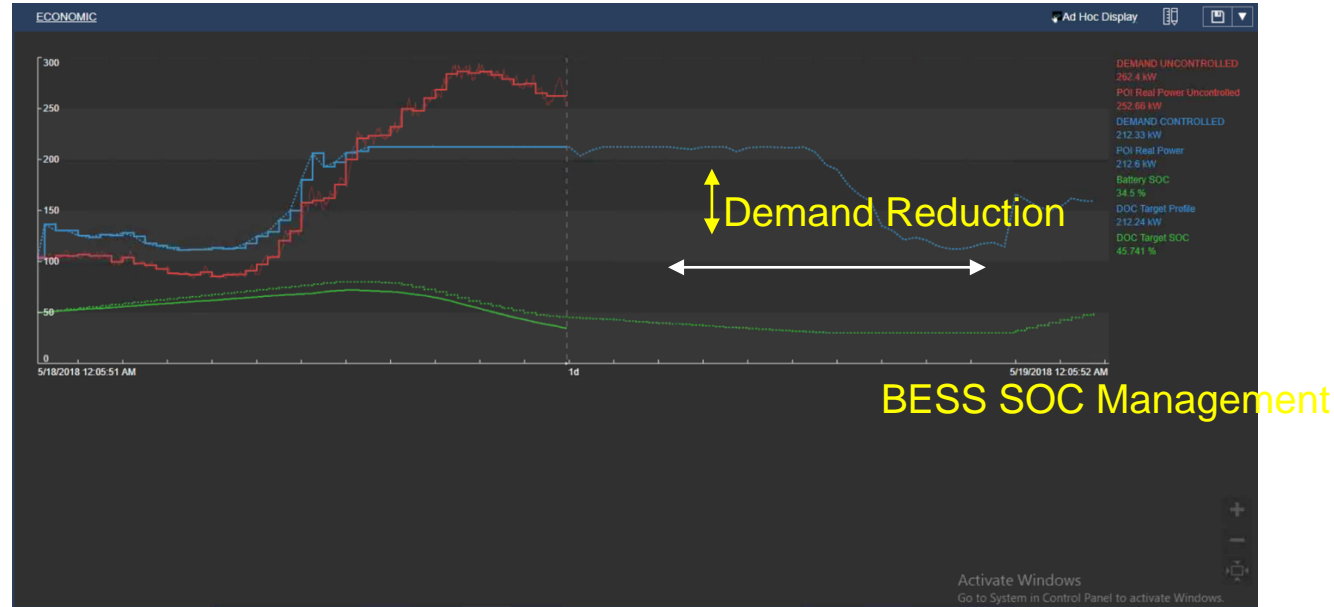
Configured to achieve maximum energy bill savings

Flexible control configured for one BESS, solar and EV chargers benefited by PI AF structure and import functions



Optimization included forecasting of resources and load

Non-linear optimization of assets using real-time conditions far better than hard-coded logic of other solutions



PXiSE display screens can be customized by users

- PI Vision screens
- PXiSE add-ins
- Standardized displays for solar, wind, and microgrid applications



Standard faceplate for real-time monitoring and control

- Manual
- Auto
- Auto-remote
- Real power control
- Reactive power control
- Demand control targets



Differentiated PXiSE disturbance mitigation improves power quality

- High data rate and fast inverter control by PXiSE cancels disturbances in the grid
- Supported by high resolution data in PI



AF database for connected distributed energy resources

Built-in
notifications and
alarms

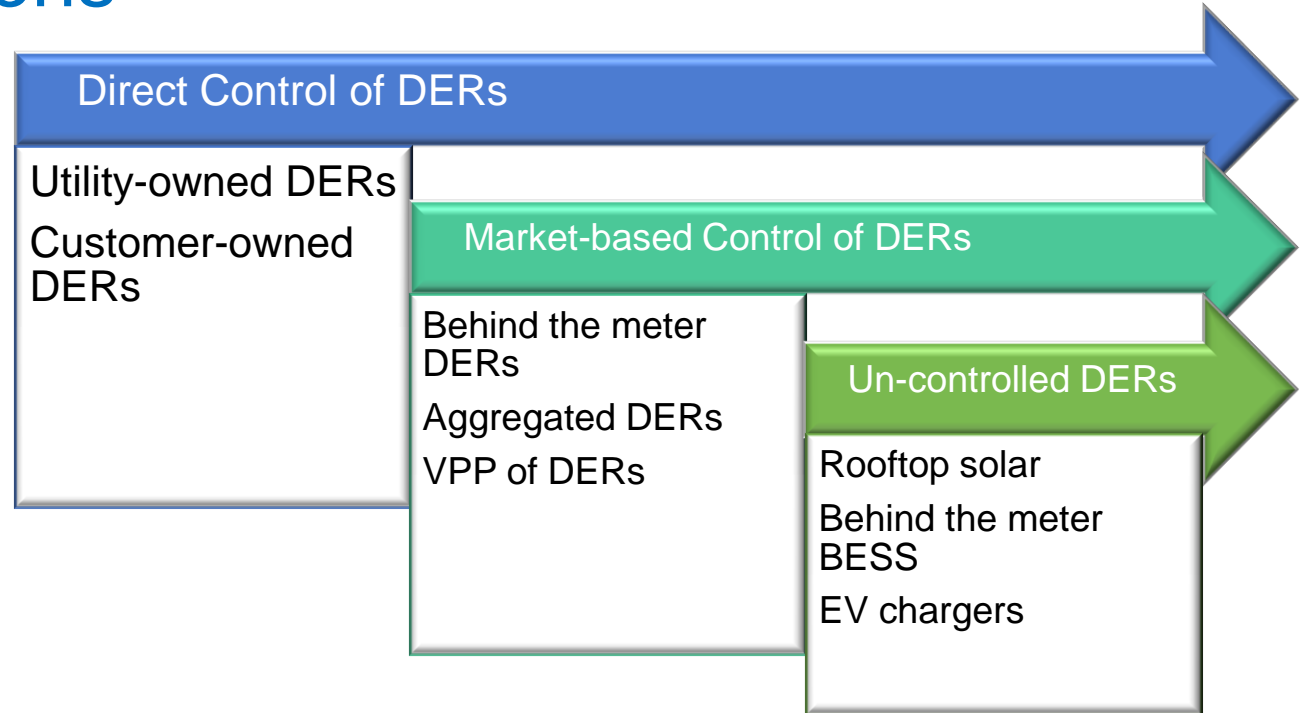
The screenshot displays a software interface with two main components. On the left, an email inbox titled 'Sempra Headquarters ...' shows a list of alerts from 'pxisealerts@sempra...' with the subject 'PXISE Alert :: Sempra HQ M...' and the date '7/25/2018'. The selected email body reads 'New PXISE Alert'.

On the right, a detailed view of an email from 'pxisealerts@sempraglobal.com' is shown, dated 'Wed 7/25/2018 8:38 PM'. The subject is 'PXISE Alert :: Sempra HQ Microgrid :: B_INV:01'. Below the email header is a table with columns: Filter, Name, Value, Time Stamp, and Description. The table contains data for various categories including METADATA, SITE, ACT, ANALYTICS, DERIVED, SENSORS, FREQUENCY, and Neutral.

Filter	Name	Value	Time Stamp	Description
Category: METADATA	Site Name	PHILIPY	1/12/2018 12:00:00 AM	Device Name
	Site Parent	SOLAR	1/12/2018 12:00:00 AM	Topological Parent
Category: SITE	Prefix	SHQ	1/12/2018 12:00:00 AM	Tag Name Prefix
	Site	Sempra Headquarters	1/12/2018 12:00:00 AM	Device Site
Category: ACT	Active Power (ACT)	-	1/12/2018 8:30:54 AM	
	Reactive Power (ACT)	-	1/12/2018 8:30:54 AM	
Category: ANALYTICS	Frame Count	0 count	8/26/2018 1:07:13 PM	AF Analysis
	Positive Sequence - Current Angle Wrap C...	PI Created	5/8/2018 9:23:56 AM	AF Analysis
	Positive Sequence - Voltage Angle Wrap C...	PI Created	5/8/2018 9:23:56 AM	AF Analysis
Category: DERIVED	Active Power	18.97809791354494 kVA	8/26/2018 1:07:13.733 PM	PHILIPY
	Reactive Power	-31.8504476165771 kVAR	8/26/2018 1:07:13.933 PM	PHILIPY
Category: SENSORS	Angle Diff	Data was not available for attribute Sync - Voltage	8/26/2018 1:07:18.9 PM	
	Time Offset	0 s	8/26/2018 1:07:20 PM	
Category: FREQUENCY	Frequency	60.0257608306148 Hz	8/26/2018 1:07:18.9 PM	
	ROCOF	-0.28213179105798617	8/26/2018 1:07:18.9 PM	
Category: Neutral	Neutral - Current Angle Wrapped	-34.9967942102251 °	8/26/2018 1:07:18.9 PM	
	Neutral - Current Magnitude	0.05947338362496 A	8/26/2018 1:07:18.9 PM	
Category: Phase A	Phase A - Current Angle Wrapped	35.2175218674805 °	8/26/2018 1:07:18.9 PM	
	Phase A - Current Magnitude	104.05117767816 A	8/26/2018 1:07:18.9 PM	
	Phase A - Voltage Angle Wrapped	-22.5866046142578 °	8/26/2018 1:07:18.9 PM	
	Phase A - Voltage Magnitude	121.77731942688 V	8/26/2018 1:07:18.9 PM	

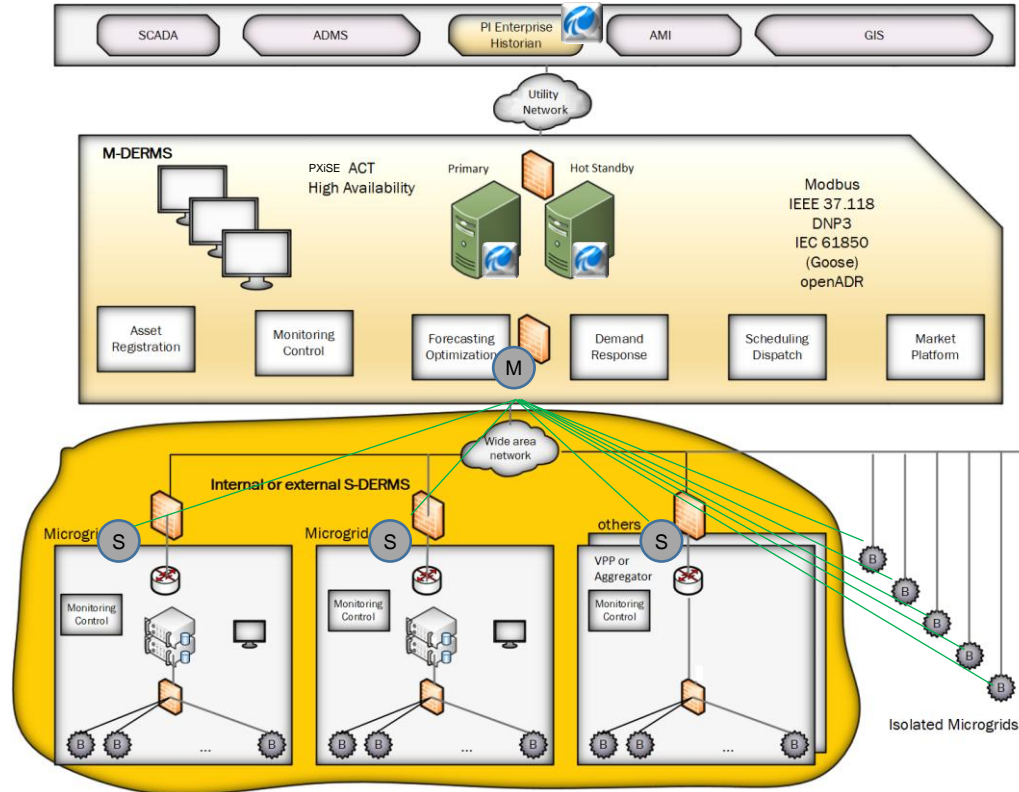
PXiSE ACT is a complete solution for modern grid operations

A comprehensive solution to manage and control all DERs logically organized as microgrids, VPPs, and aggregated resources



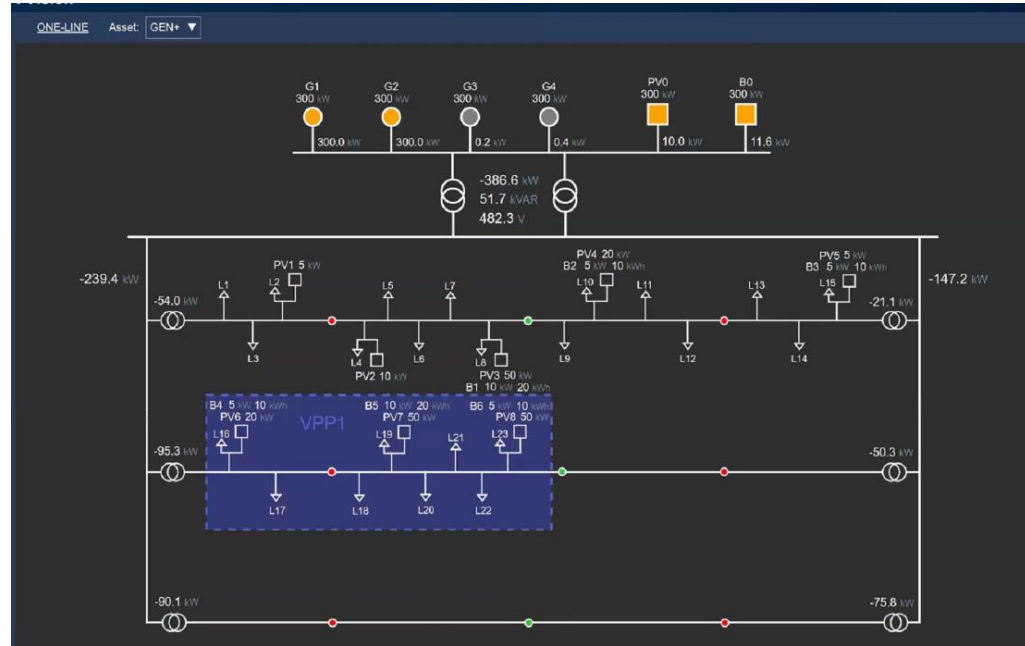
PXiSE DERMS multi-level control architecture

- Master controller
- Supervisory microgrid or virtual power plant (VPP)
- Controllable DER or an aggregated resource



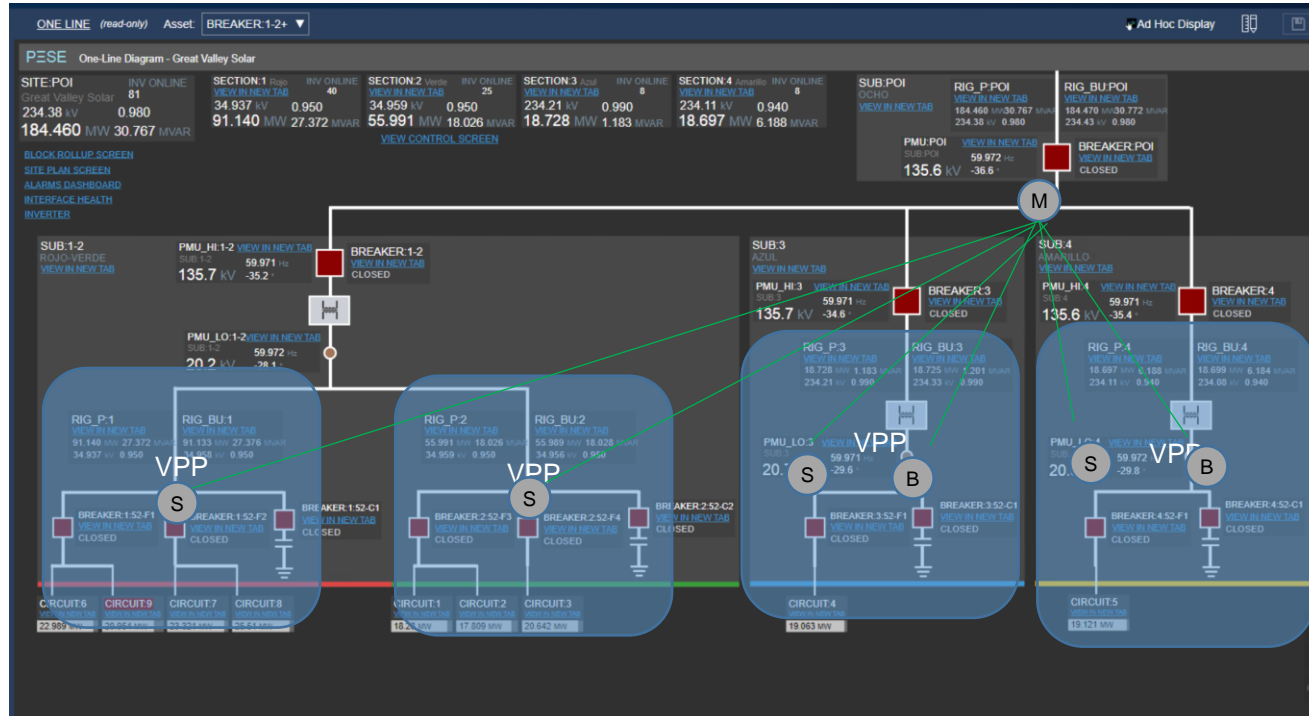
PXiSE DERMS - a real “control system” for 1,000s of DERs

- Extensive use of PI AF
- Coordinate real-time switching and control of DERs
- Control of Virtual Power Plants
- Control of Aggregators
- Optimization of a mix of energy resources

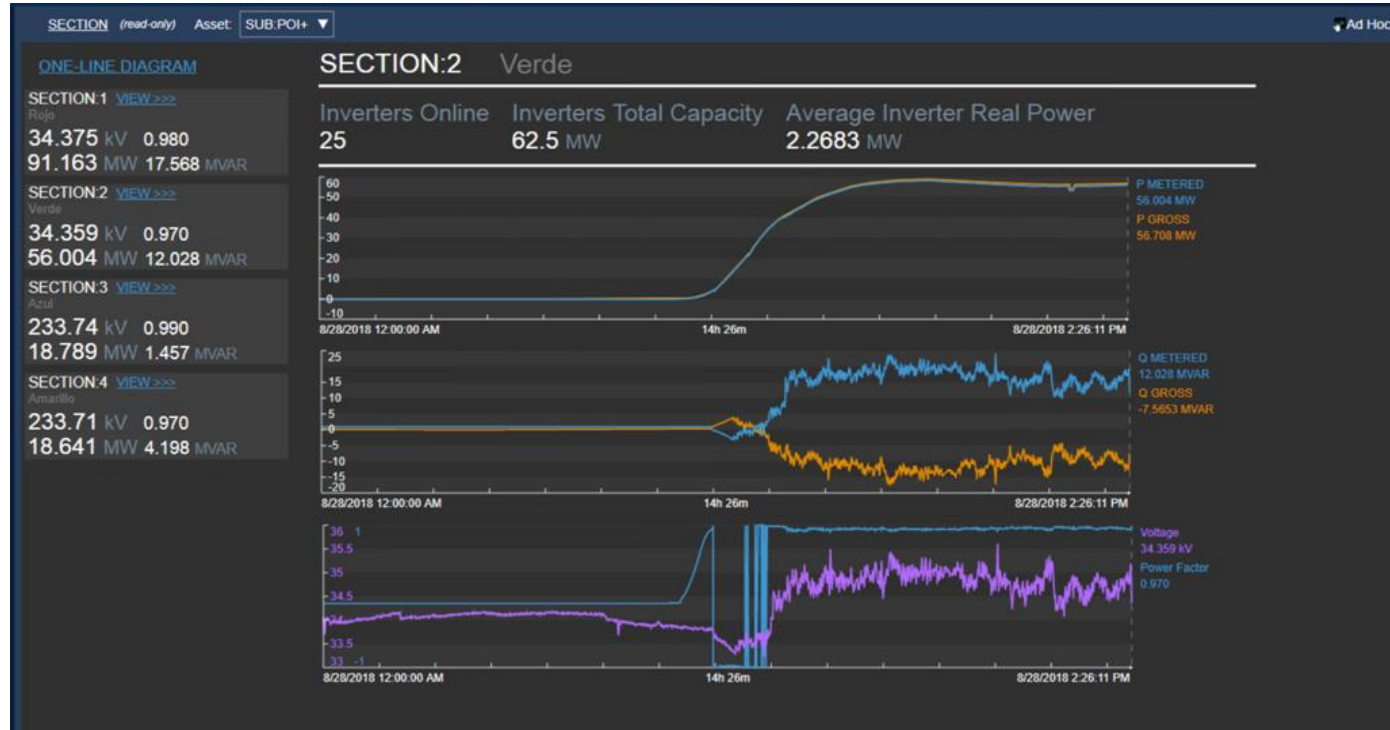


Comprehensive design: control directly managed DERs, market response DERs, and accounting for unmanaged DERs

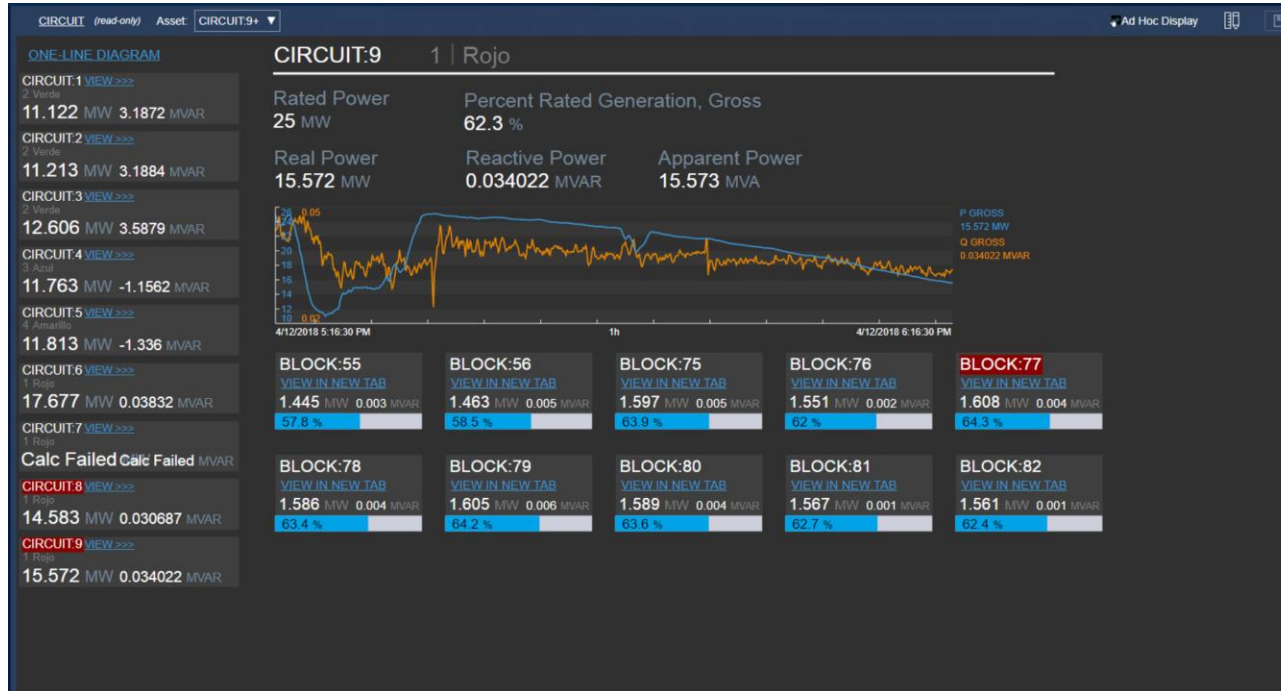
Software implemented at large solar farm (same architecture as DERMS control)



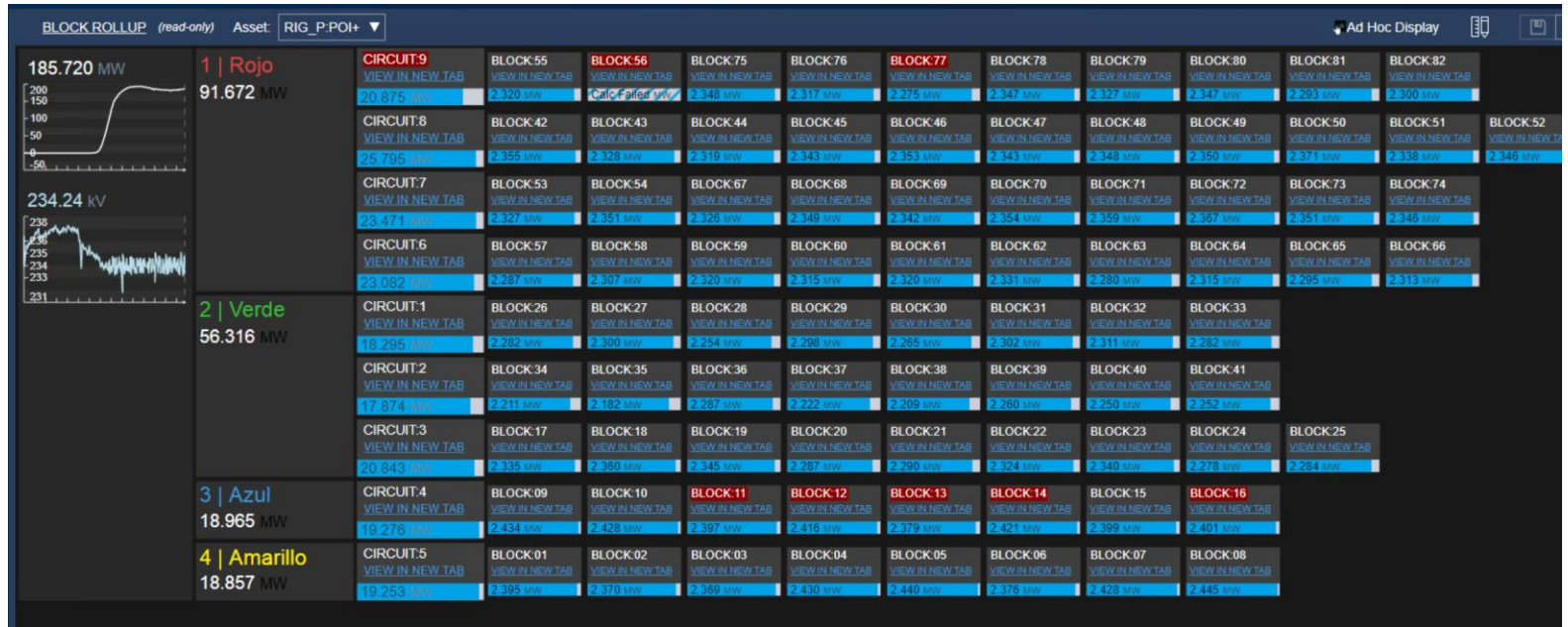
Large solar section display



Display and control of individual controllable inverters



Circuit display in a Solar section – “like aggregated DERs within the VPP”



Summary

Important to select the right microgrid and DERMS solution in a modern grid



Better accuracy of DER control
Faster response to dynamic changes



Better sensors and data (Bigger data)
System level intelligence with AI



Commonly available industrial hardware
Proven data platform (OSIsoft PI)

Contact



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- Chuck Wells
- Chief Technology Architect

THANK YOU

OSIsoft. PIWorld

謝謝 KEA LEBONA
TAPADH LEIBH 고맙습니다
БАЯРЛАЛАА MISAOTRA ANAO
DZIĘKUJĘ CI NGIYABONGA TEŞEKKÜR EDERIM GRACIES
OBRIGADO شڪرا
DANKON TANK TAPADH LEAT SALAMAT
DANKIE TERIMA KASIH
KÖSZÖNÖM
СПАСИБО
PAKMET CIZGE
GO RAIBH MAITH AGAT
БЛАГОДАРЯ GRACIAS
ТИ БЛАГОДАРАМ
MAHADSANID
TAK DANKE
RAHMAT
HATUR NUHUN
MERCİ
CẢM ƠN BẠN
WAZVIITA
FALEMINDERIT
DANK JE
ΕΥΧΑΡΙΣΤΩ GRATIAS TIBI
AČIŲ SALAMAT MAHALO IĀ 'ŌE TAKK SKALDU HA
GRAZZI PAKKA PĒR
PAXMAT CAĞA
SIPAS JI WERE TERIMA KASIH
UA TSAUG RAU KOJ
ТИ БЛАГОДАРАМ
СИПОС
MULTUMESC
FAAFETAİ
ESKERRIK ASKO
HVALA ХВАЛА ВАМ
TEŞEKKÜR EDERIM
GRAZIE
DI OU MÈSI
ĐAKUJEM
MATUR NUWUN
HVALA
DЗЯКУЙ