

Advanced Functionalities of an Integrated Distribution Management System (IDMS)

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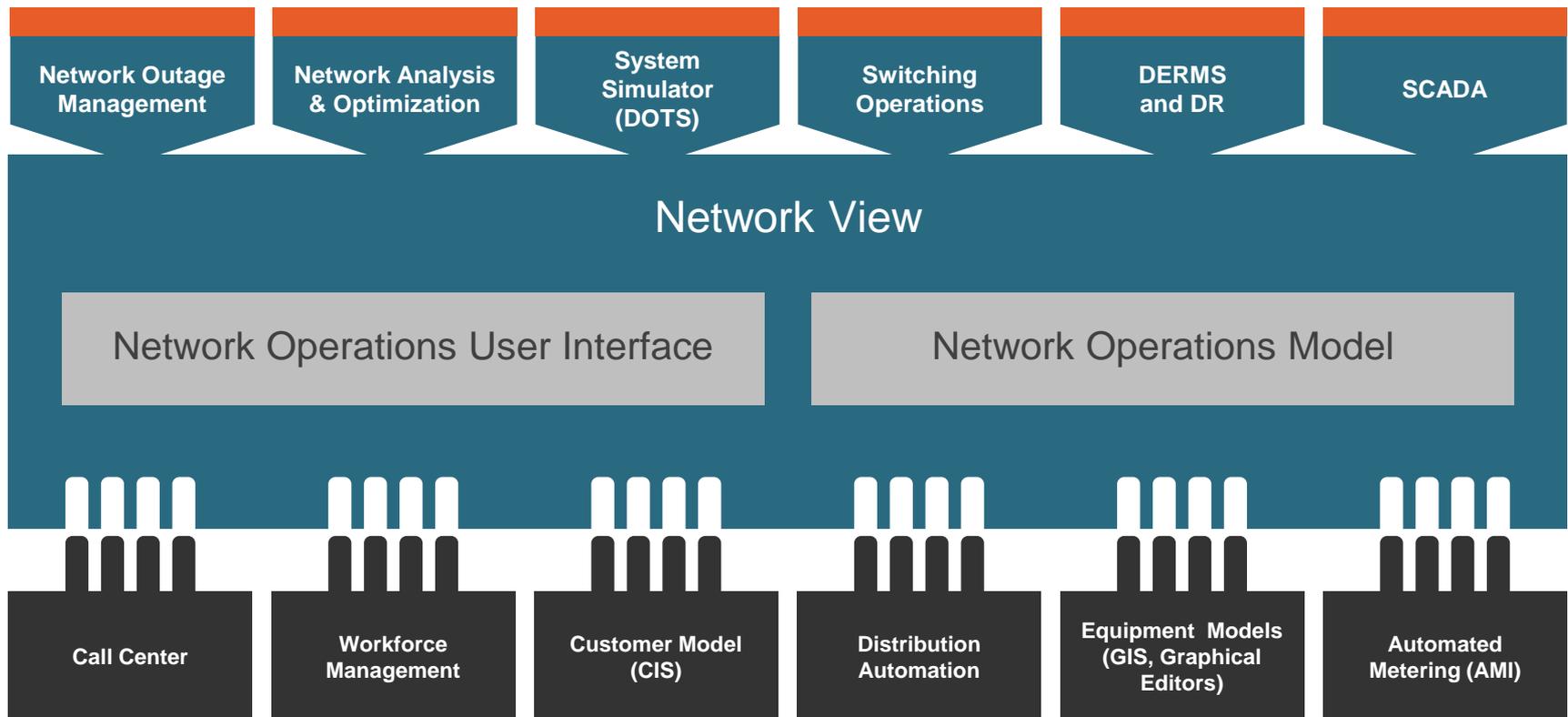
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Shaping the future

The Emerging Smart Distribution Grid presents an increasingly complex system to manage

- Distribution Operators still have their hands full safely coordinating crews doing switching and restoration – keeping the lights on with no time for “advanced functions”
- Distribution Analysts may work with advanced functions to maximize system and energy efficiency, often via automated systems like FLISR and IVVO
- Still others may coordinate demand response participants, distributed energy producers, and manage AMI/MDM
- In smaller utilities, Operators may do it all!
- Increasingly mobile users need to interact remotely
- A comprehensive network management system improves efficiency of users, safety, and system support

IDMS - A Single Network Operations Model & UI

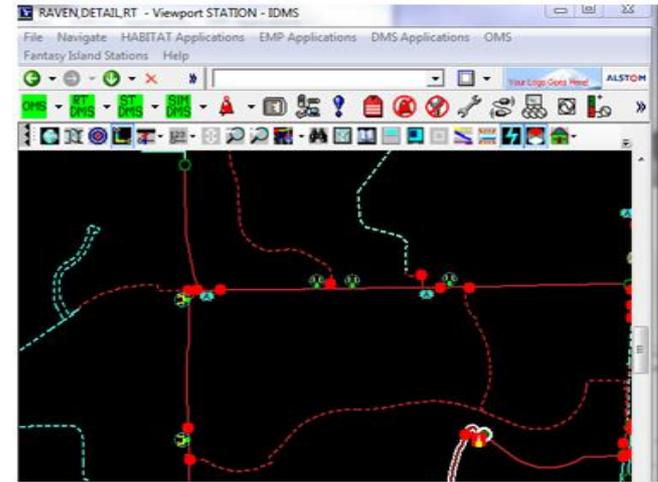
Supports Multiple Functional Modules for Ease of Use



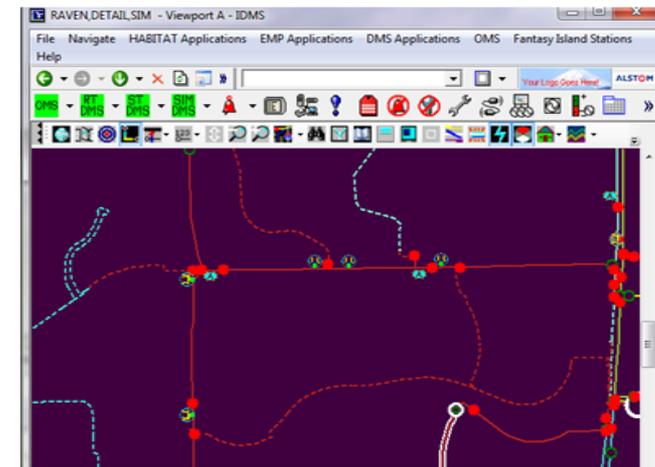
Distribution Operations Training Simulator (DOTS)

- Simulation vs. Event Playback
 - Simulator uses real SCADA, ADMS, OMS to process scripted events and scenarios (fully interactive)
 - Playback tool re-enacts recorded events (not interactive, view only)
- Calculated Response to Events
 - Power Flow, SC Analysis
 - Correct System Response
- Simulated System Response
 - IVR, Call Center, Crew, AMI
 - Tagging, Alarms, Operation of Protective Devices (Relay, CB, Reclosers, Fuses, etc.)

Real-Time System View

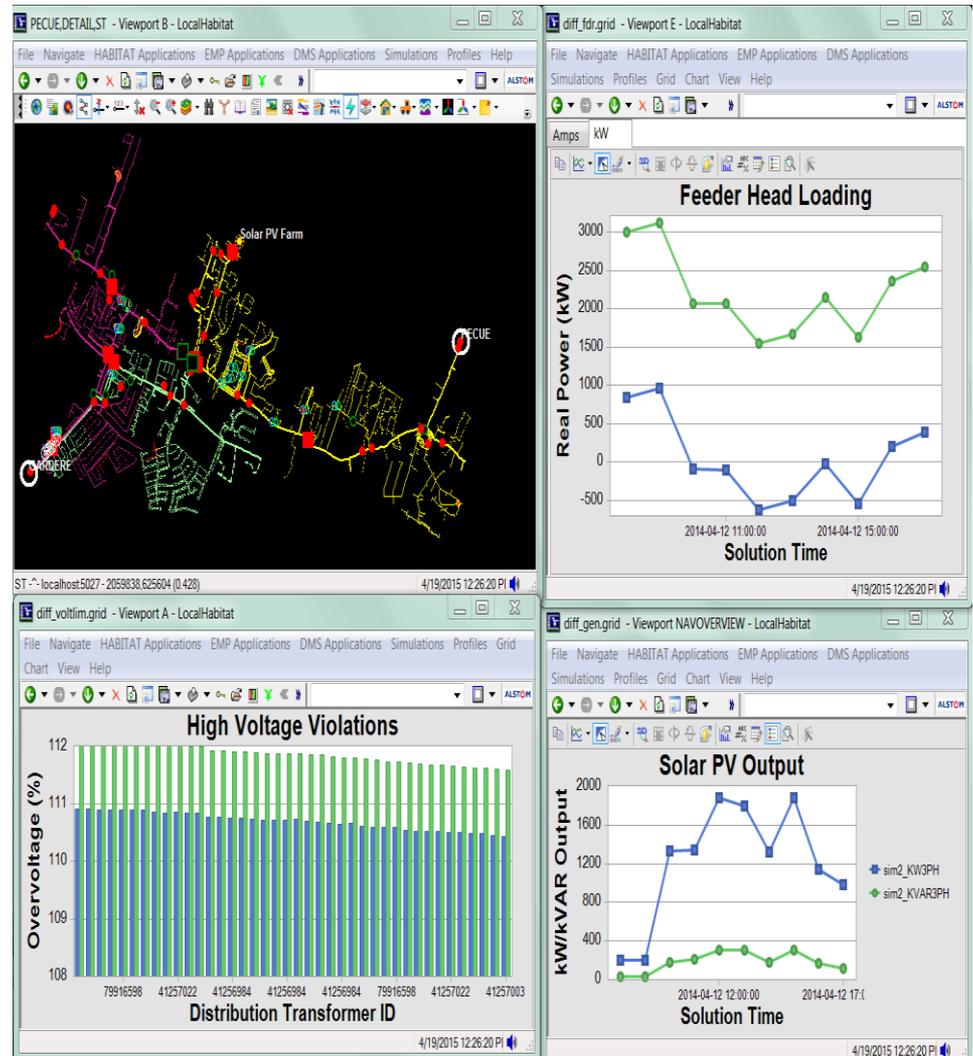


Simulator System View



DER Impact Studies with DOTS

- The Distribution Operations Training Simulator (DOTS) is used to analyze the Operational impacts of DG penetration
- A DG Modeler Tool can add hypothetical DG to the IDMS model
- Time series studies are performed with varying DG output and Load schedules
- Salient analysis results are captured and collated
- Detect operational limit violations and excess wear on automated equipment

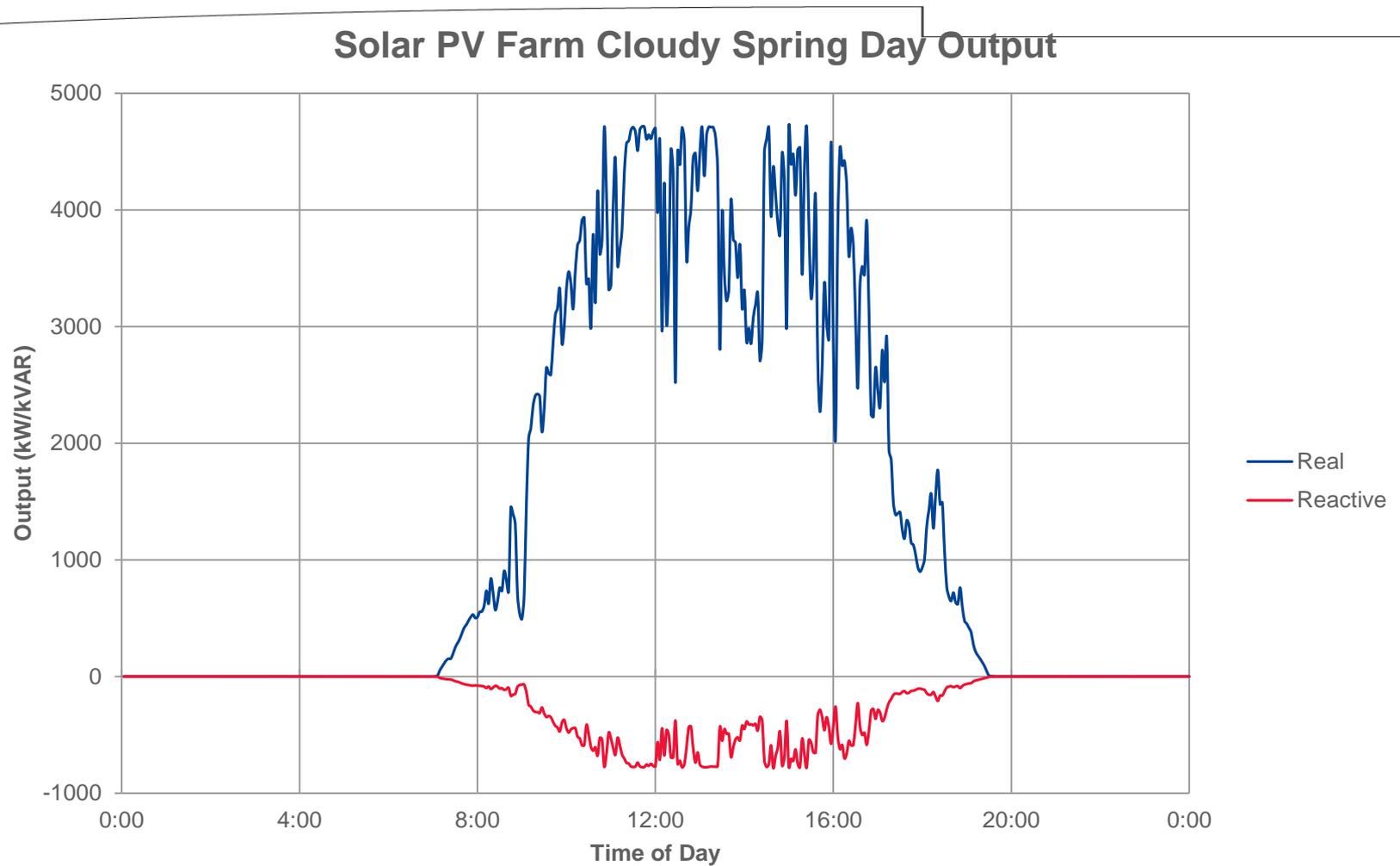


Operations Department Focus

With proper evaluation tools, Operations can:

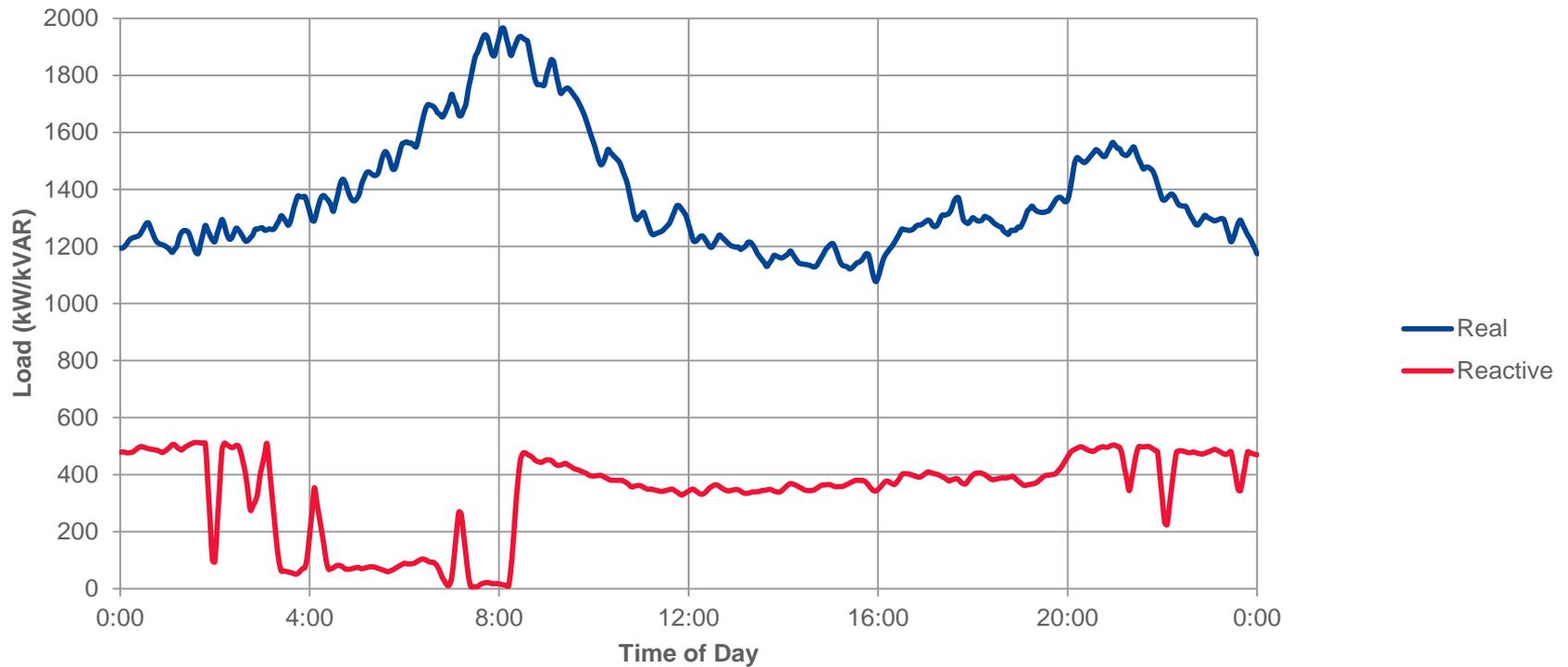
- Prepare operational mitigation procedures
- Restrict DG connection permits granted
- Request engineering design remediation
- Build regulatory cases for more operationally restrictive DG connection contracts

Study Solar Profile



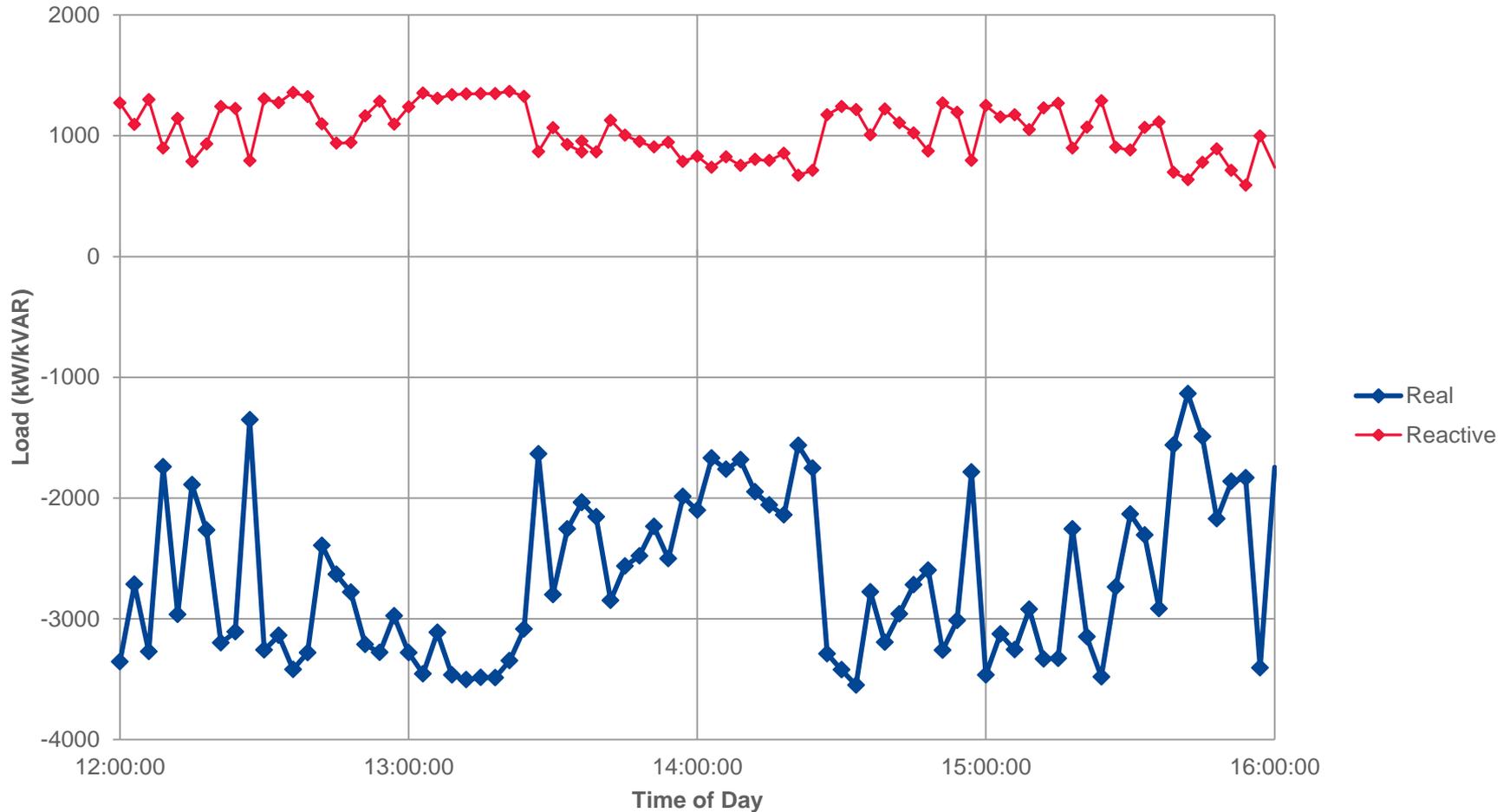
Study Circuit Load Without Solar

Study Load Profile
4/7/2012 - 3 minute interval data



Study Circuit Load with 5 MW Solar Connected

Circuit Load With Solar



Study Regulator Tap Movement (Local Control)

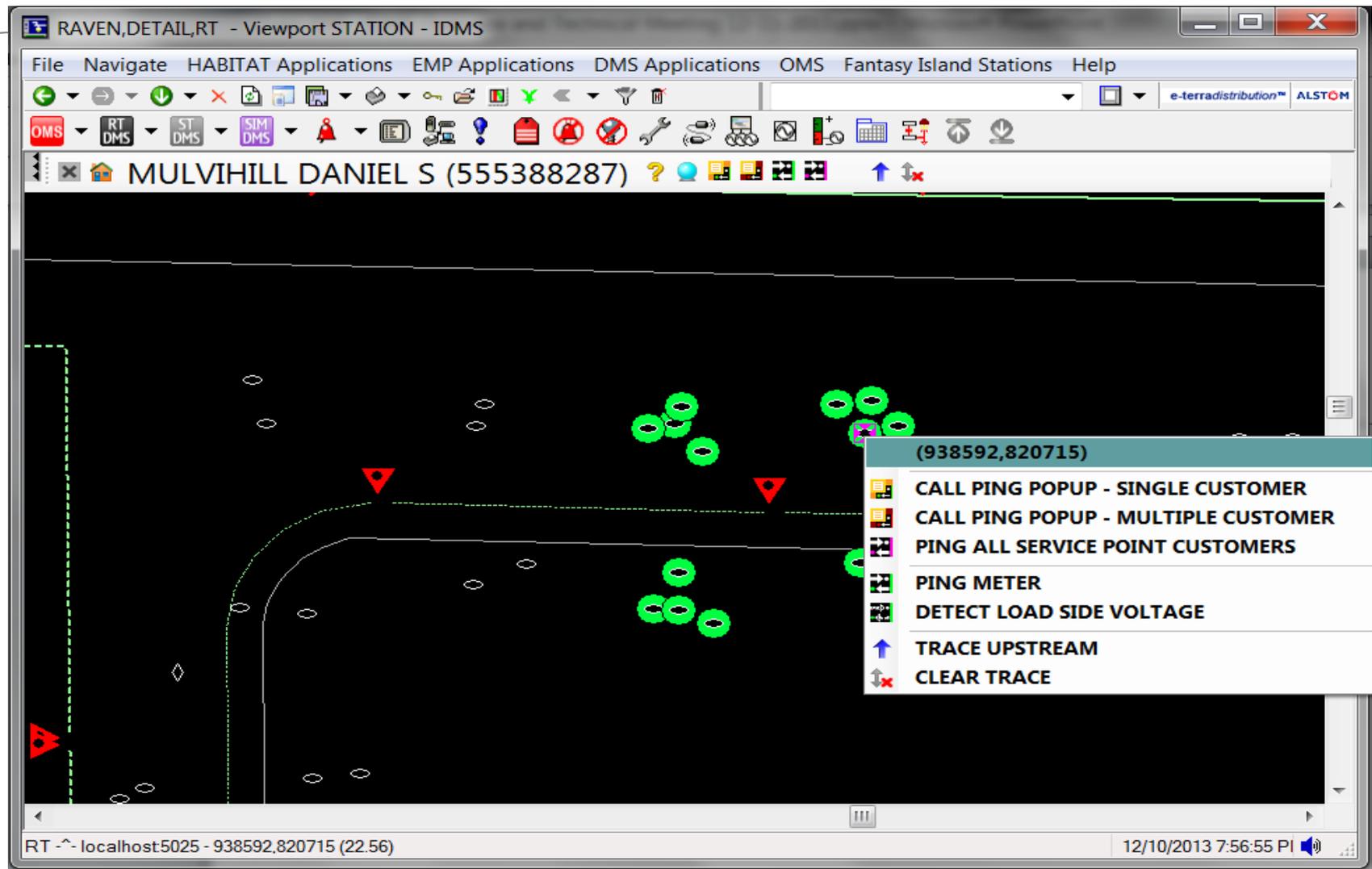
Over a 4 hour study period

Regulator	No Solar Ops	Solar Ops	No Solar Tap Range	Solar Tap Range
Reg #1 (ABC)	11	77	2	8
Reg #2 B	46	85	7	11
Reg #2 C	33	78	3	8
Reg #3 A	25	91	4	9
Reg #3 B	34	97	3	10
Reg #3 C	41	76	4	9
Reg #4 B	40	82	6	6
Reg #4 C	22	30	2	1

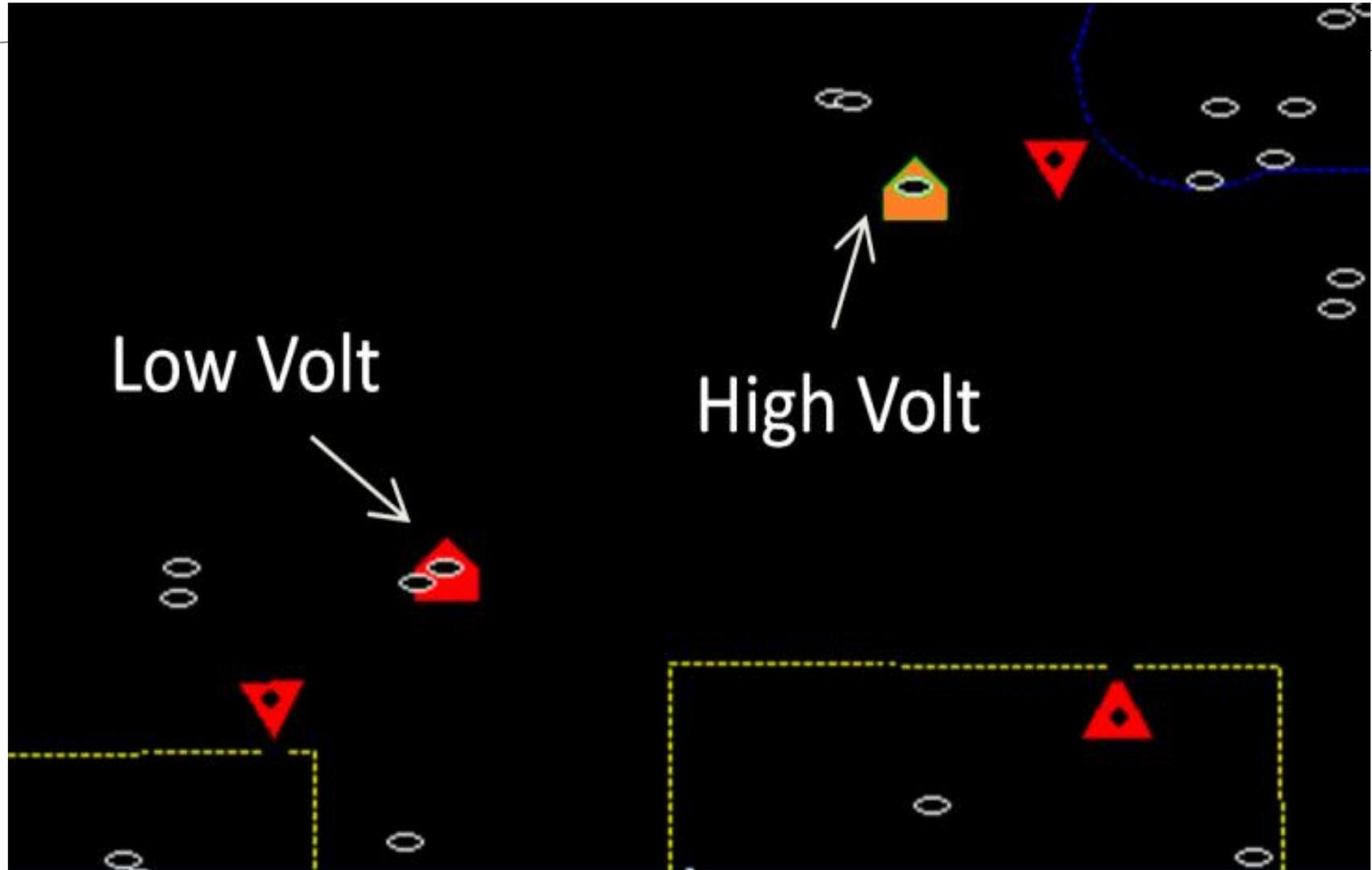
Smart Meters as Sensors for IDMS: Near Real-time ADMS/AMI Functionality

- **Meter PowerOn / PowerOff Events**
 - Outage and restoration visualization on geographic displays
- **Meter Ping**
 - For verification of outage and restoration
- **Meter Low / High Voltage Event Processing (i.e. brown-out events)**
 - Visualization of AMI voltage events on geographic displays
 - Utilization of AMI voltage events in Integrated Volt/Var Optimization (IVVO)
- **IDMS Initiated Voltage Scan**
 - Automatic voltage scan of dynamically selected bellwether meters
 - Utilization of AMI voltage scans in IVVO
- **Meter kW / kVAR measurements used in Distribution State Estimation**
 - Initially for customers with large solar DG installations or difficult to model loads
 - Telemetered load at service point overrides modeled load/generator
 - Eventually the normal source of load values for Distribution State Estimation

Meter Pings Invoked Automatically or with Right-Click Menu

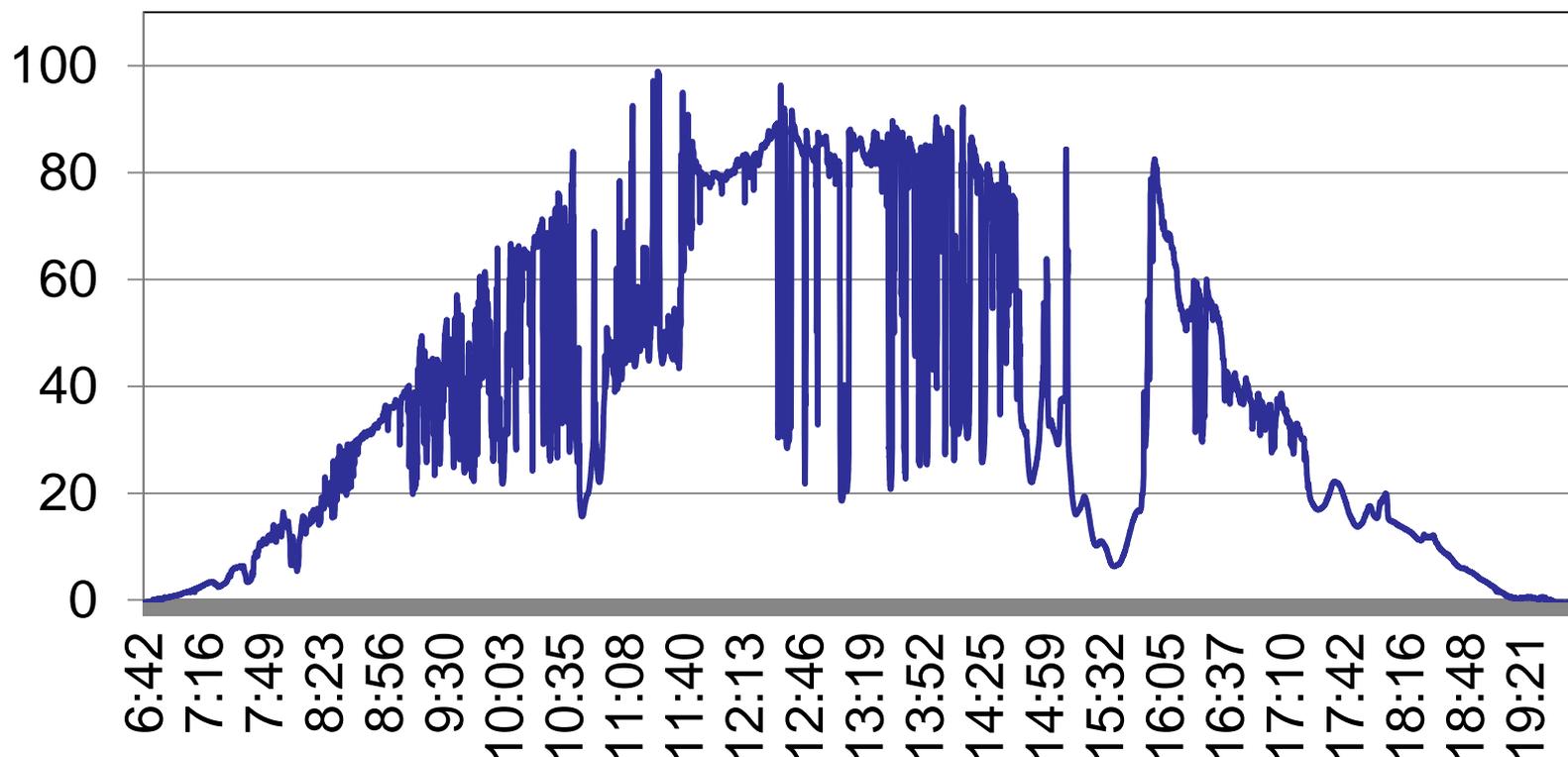


Meter Low and High Voltage Event Visualization

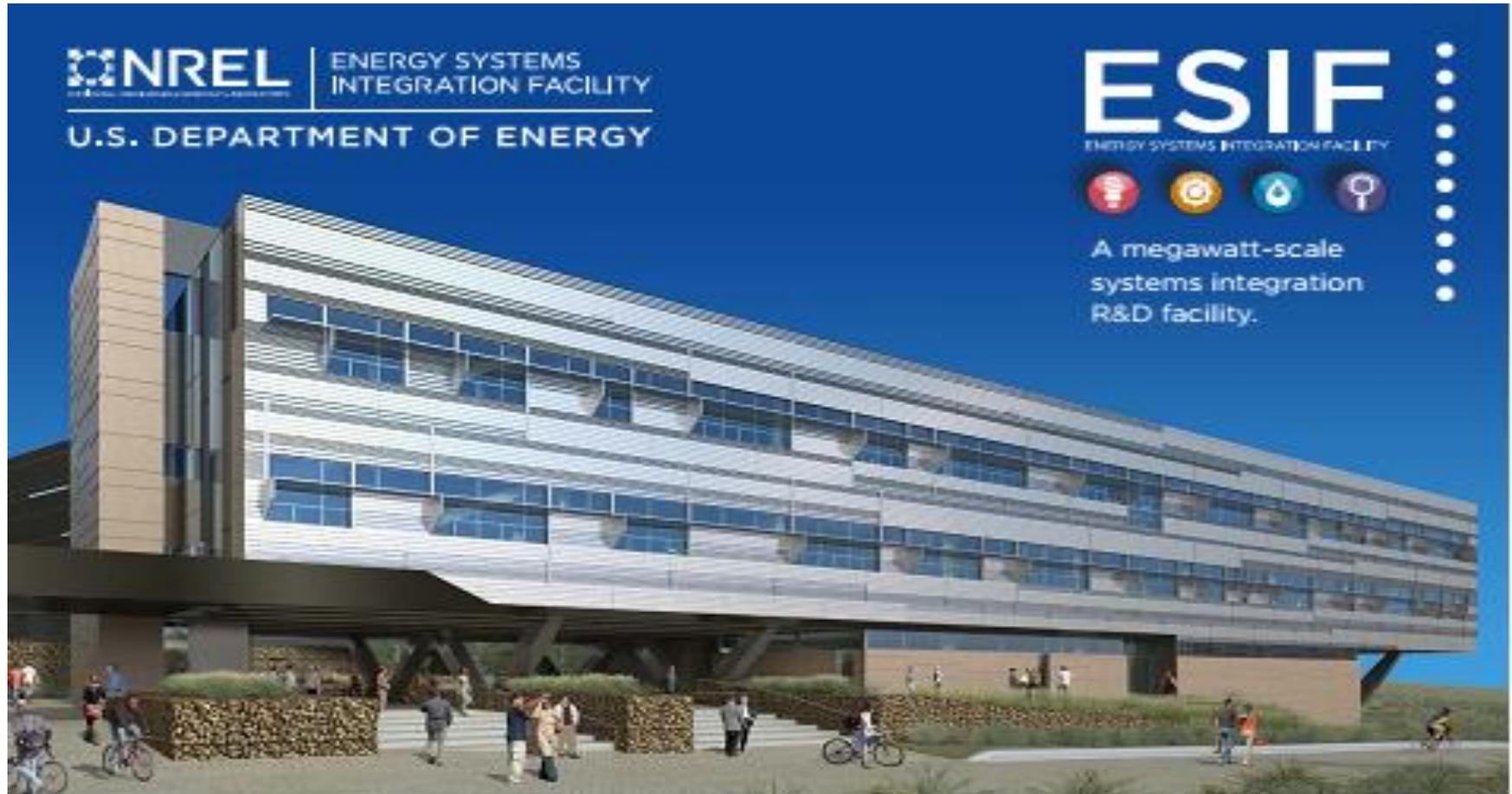


Meter kW / kVAR for Distribution State Estimation and Power Flow Calculation

- Solar DER and nonconforming loads are difficult to model
 - Smart Meters provide IDMS with the last 5-minute averaged data for power flow calculation improvements



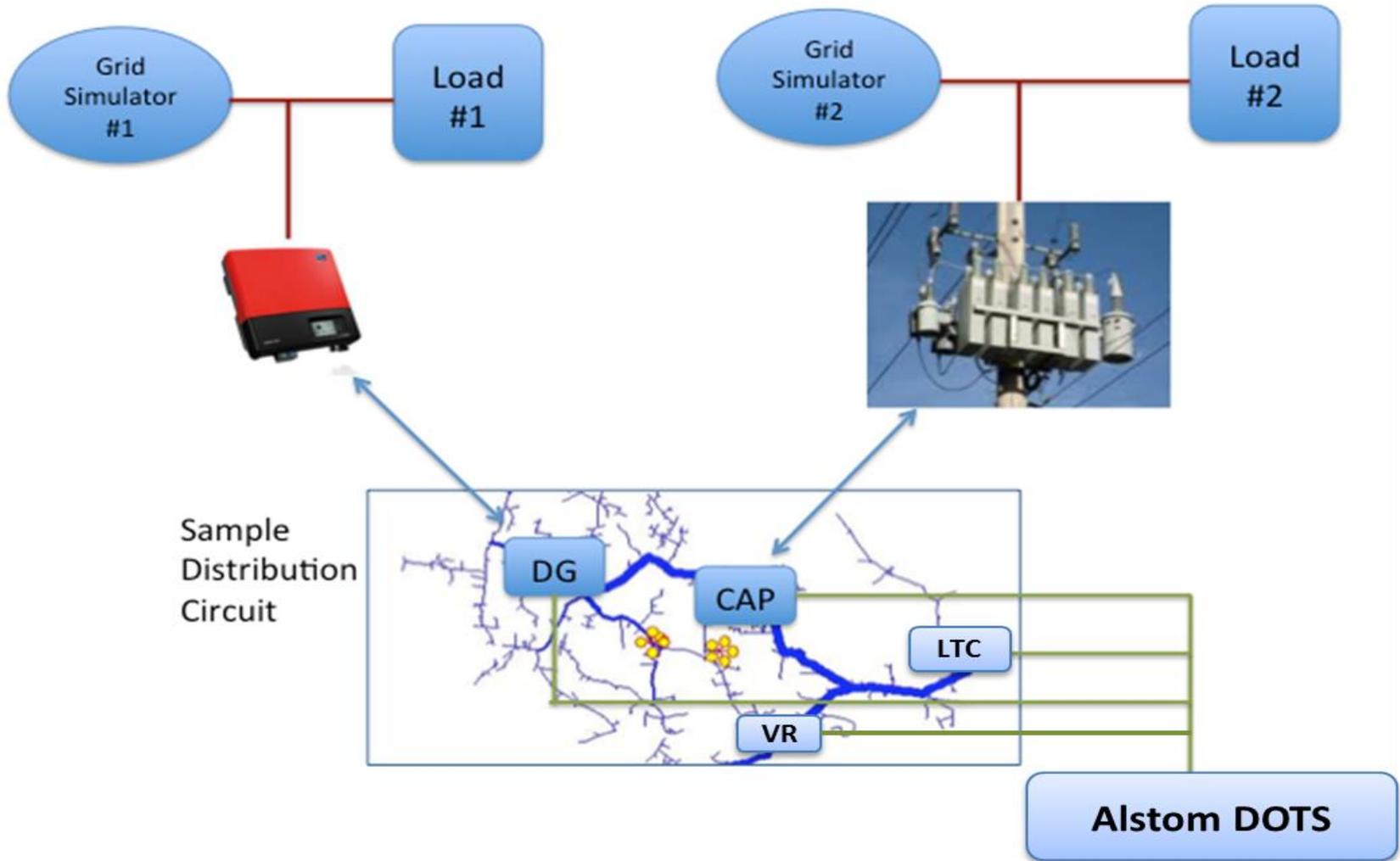
IDMS and Smart Inverters: The National Renewable Energy Laboratory



IDMS and Smart Inverters

- Ongoing DOE sponsored project with Duke Energy and NREL leveraging the ESIF
- Evaluate capabilities of commercially available “Smart” Inverters and their impact on distribution operations
- Add Smart Inverter set points as a control type within IVVO to complement taps and capacitors
- Controlling Smart Inverters is key for a DER enabled ADMS - DER voltage rise, backfeed, power factor control

Evaluation of DER Smart Inverters as a control type for IDMS



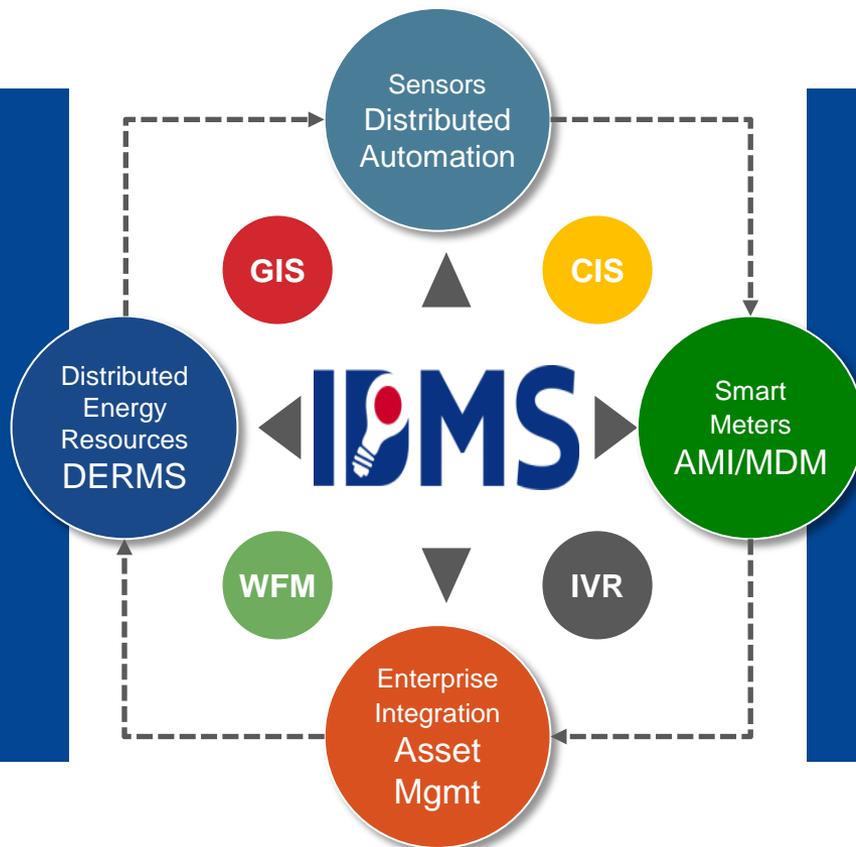
The Evolving Sophistication of Emergency Load Reduction

Utility customers are asking for a stepped approach to load reduction orchestrated through IDMS. Generally:

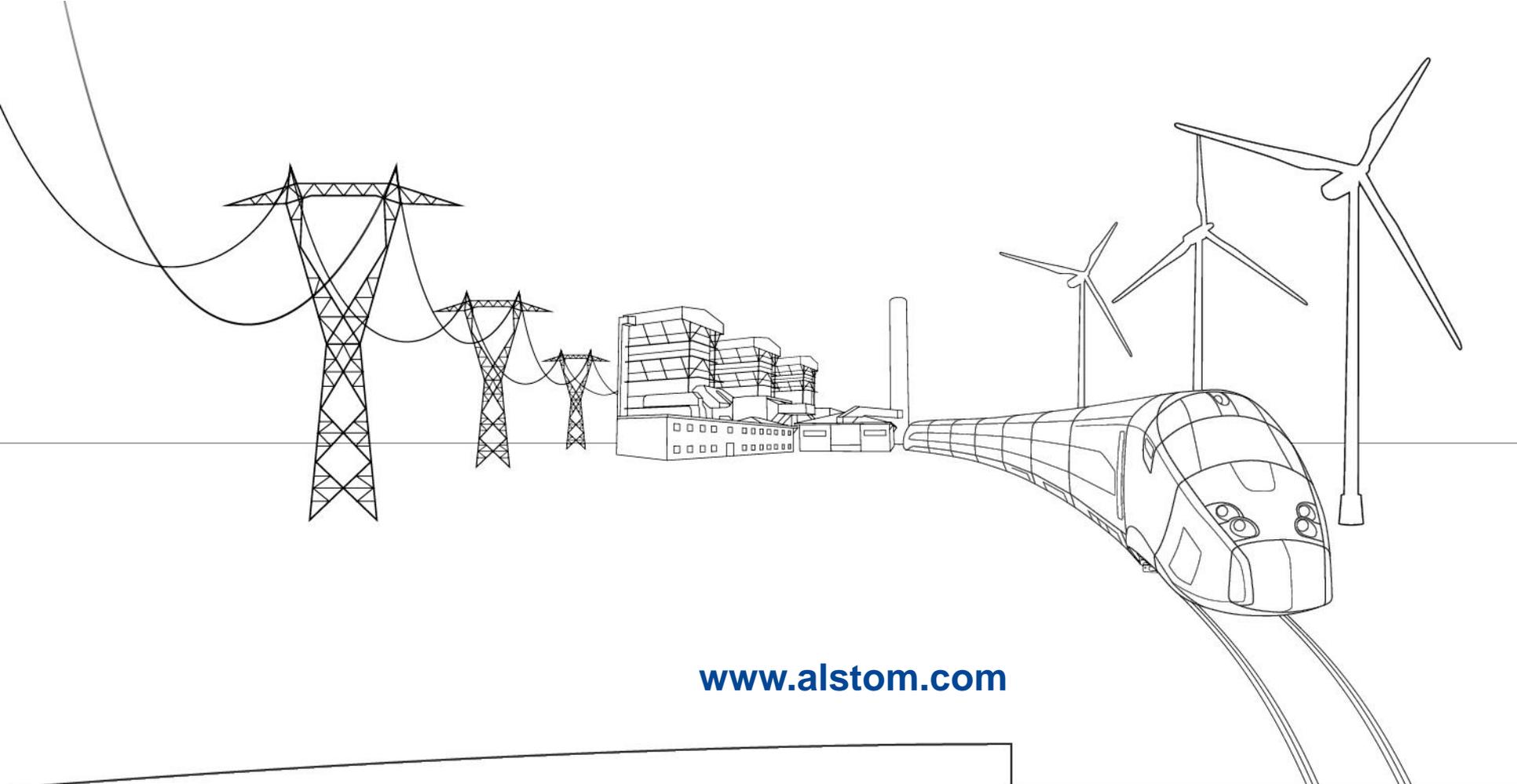
- **Demand Minimization with IVVO**
 - No customer impact – voltages moved to low end of normal ANSI range
- **Demand Response program calls**
 - Commercial and residential DR participants
- **Emergency Demand Minimization with IVVO**
 - Voltages moved to the next lower ANSI range
- **Surgical Load Reduction by network optimization function**
 - Selective load curtailment via AMI disconnects with customer type and DG awareness
- **Educated Load Reduction through circuit switching by network optimization function**
 - Based upon As-Operated network model with critical customer awareness
- **Rotational Load Shed through classic SCADA-style function**
 - With abnormal configuration and critical customer awareness
- **Traditional Block Load Shed**

IDMS

Complete Ecosystem Management



- **Grid Reliability**
- **Power Quality**
- **Field Crew Safety**
- **Operational Costs**
- **Environment Sustainability**
- **End-Customer Satisfaction**



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