SCE's Next-Generation Grid Management System
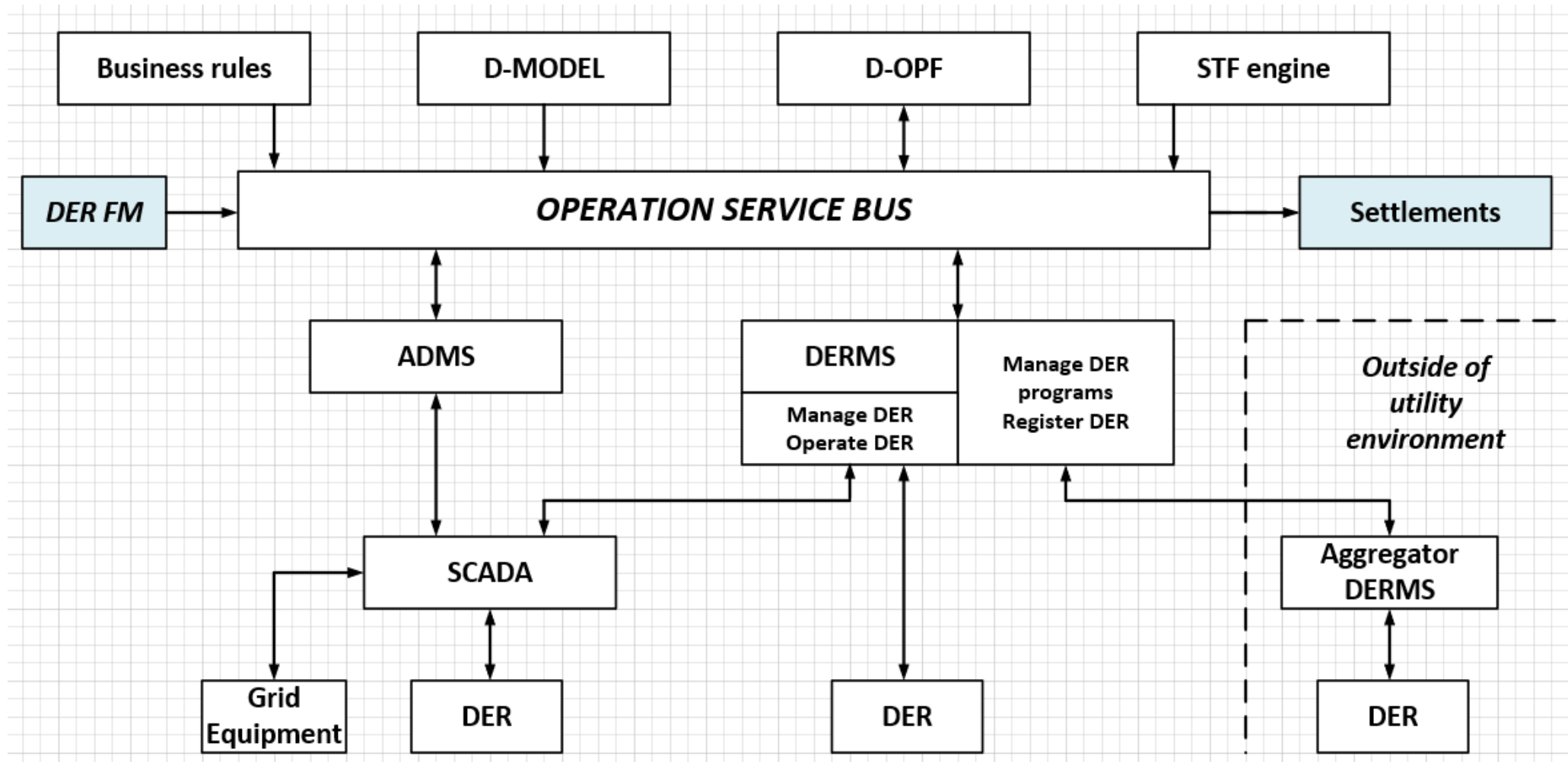
Anthony Johnson
Consulting Engineer
Southern California Edison

Grid Management System
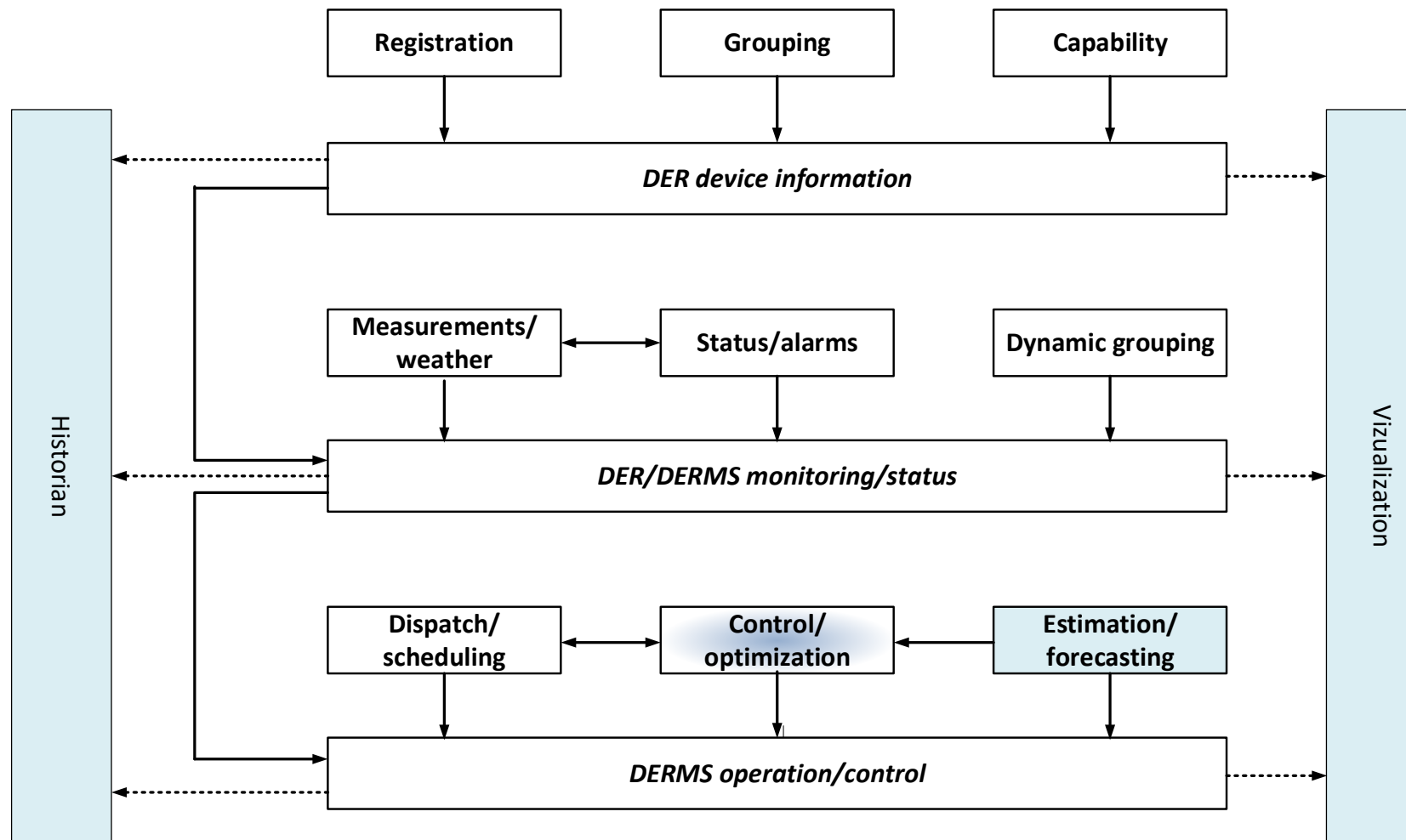
DERMS Integration with ADMS

DERMS Functional Architecture
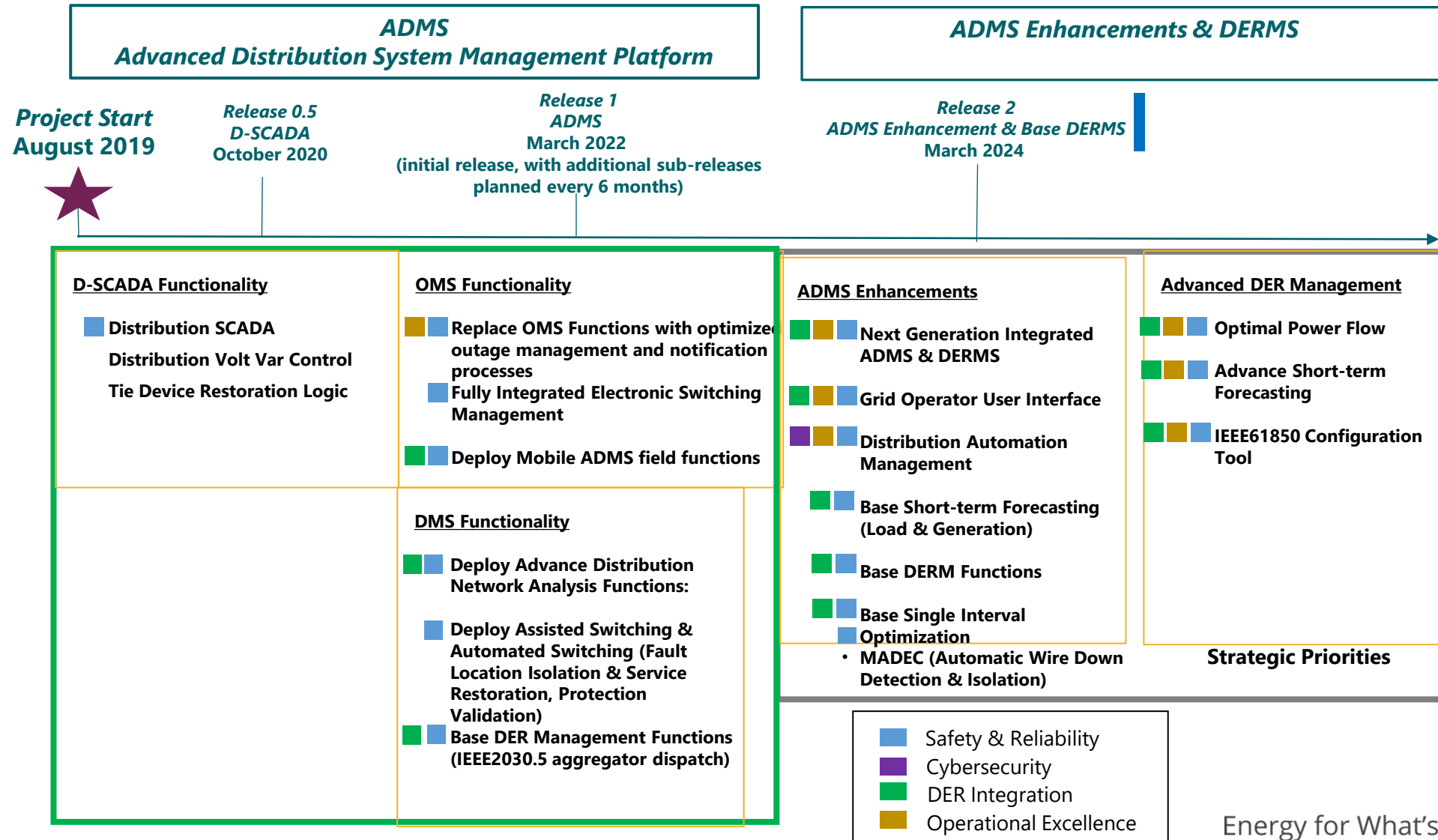
Discussion

GMS Capability RoadMap

ADMS **Advanced Distribution System Management Platform**	**ADMS Enhancements & DERMS**

Project Start
August 2019

Release 0.5
D-SCADA
October 2020

Release 1
ADMS
March 2022
(initial release, with additional sub-releases
planned every 6 months)

Release 2
ADMS Enhancement & Base DERMS
March 2024

D-SCADA Functionality

- ■ **Distribution SCADA**
- **Distribution Volt Var Control**
- **Tie Device Restoration Logic**

OMS Functionality

- ■ ■ **Replace OMS Functions with optimized outage management and notification processes**
- ■ **Fully Integrated Electronic Switching Management**
- ■ ■ **Deploy Mobile ADMS field functions**

DMS Functionality

- ■ ■ **Deploy Advance Distribution Network Analysis Functions:**
- ■ **Deploy Assisted Switching & Automated Switching (Fault Location Isolation & Service Restoration, Protection Validation)**
- ■ ■ **Base DER Management Functions (IEEE2030.5 aggregator dispatch)**

ADMS Enhancements

- ■ ■ ■ **Next Generation Integrated ADMS & DERMS**
- ■ ■ ■ **Grid Operator User Interface**
- ■ ■ ■ **Distribution Automation Management**
- ■ ■ **Base Short-term Forecasting (Load & Generation)**
- ■ ■ **Base DERM Functions**
- ■ ■ **Base Single Interval Optimization**
- ■ • **MADEC (Automatic Wire Down Detection & Isolation)**

Advanced DER Management

- ■ ■ ■ **Optimal Power Flow**
- ■ ■ ■ **Advance Short-term Forecasting**
- ■ ■ ■ **IEEE61850 Configuration Tool**

Strategic Priorities

■	Safety & Reliability
■	Cybersecurity
■	DER Integration
■	Operational Excellence

Energy for What's Ahead®

SCE is building the grid of the future to protect against the impacts of extreme weather and to support more clean energy resources.

To build the grid of the future, SCE's enhanced GMS provides a flexible and networked platform that empowers customers with options for leveraging distributed energy resources (DERs). The GMS is designed to provide the following functionality:

Distributed Energy Resource Management System (DERMS)

Advanced Distribution Management System (ADMS)

Grid Device Management Capabilities (GDM)

Grid Reliability and Economic Optimization Engine (OE)

Short-Term Forecast Engine (STFE)

And much more...

ADMS Functionality

- Advanced Distribution Management System (ADMS) capability provides analytics, electrical system optimization, reliability, reliability metrics, switching procedure management, planned and unplanned outage management, control of DERs through the DERMS, Fault Location Isolation and Service Restoration (FLISR), reporting capabilities and SCADA controls.

- It retrieves, manages and updates the electrical grid model up to the subtransmission level.

- The ADMS records, stores, analyzes and exports distribution system operational data.

- It interfaces with the SCE data historian applications.

- Mobile Grid Operations is another ADMS capability that provides field personnel access and the ability to update information such as switching procedures, maps and system statuses.

Distributed Energy Resource Management System (DERMS)

- DERMS provides bi-directional communications to a diverse fleet of SCE and 3rd-party DER, using a variety of protocols including IEEE 2030.5 and DNP 3.0.

- Through DERMS services, other GMS applications can monitor and control the behavior of individual and/or aggregated DER at the residential, commercial and industrial (C&I), and grid levels.

Grid Device Management Capabilities (GDM)

- Manages the access, configuration, maintenance, data retrieval, addition and removal of SCADA, Intelligent Electronic Devices (IEDs) and other grid devices including communications devices.

- Communications devices include NetComm radios, and components of the Field Area Network (FAN).

Grid Reliability and Economic Optimization Engine (OE)

- Optimizes distribution grid reliability and economics using inputs from the Distribution State Estimation and Optimal Power Flow (OPF) functions.

- Optimizes use of SCE and aggregator-controlled DER.

Short Term Forecast Engine (STFE)

- The Short Term Forecast Engine estimates load and generation for the distribution grid under normal, abnormal, peak and contingency conditions.

- These estimate are based off of historical measurements, weather and other environmental data inputs as well as incorporating DER forecast data provided from DERMS.

Data Historian (HIS)

- Archives grid data as well as providing data analysis capabilities. Provides historical data to the GMS and other systems.

Business Rules Engine (BRE)

- Supports system-wide consistent operation and execution of policies and operational practices by managing business rules for the ADMS and other systems.

Operational Service Bus (OSB)

- The OSB will enable integration of disparate applications using a common set of synchronous and asynchronous services referred in this document as Common Service Definitions (CSD).

- The OSB contains common services for all GMS systems including Service Orchestration and Scheduler capabilities.

Adaptive Protection (AP)

- Currently adaptive protection capabilities are out of scope for this RFP; however if adaptive protection capabilities become available, then adaptive protection may be added to the GMS scope.

Training System (DTS)

- Trains and evaluates skills of the grid control and switching center operators, distribution planners, and operational engineering staff and maintenance personnel.

- The DTS must use the same user interfaces and software as the GMS and other components.

- Includes the dispatcher training capabilities of the ADMS.

Distributed Energy Resource Management System

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Impacts on coordination and network security (Transmission and Distribution)

- The impacts of DER integration on the hierarchy balance of management/coordination of DER network security -> Aggregator -> Distribution network -> Transmission network -> Generation
  - DER are integrated into the electrical model of the ADMS
  - Aggregated to the distribution transformer level for power flow calculations
- Changes implemented or anticipated on the current operational structure (Roles: distribution operation, transmission operation, DERMS operators,...)
  - Operators need awareness of DER on the circuit to ensure correct operation of the Grid
  - Presently – we cancel approximately 2% of our switching procedures annually due to lack of this awareness (out of ~100,000)
  - Looking at applications to utilize DER to help Distribution System Operations.

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Impacts on coordination and network security (Transmission and Distribution)

- How are DERs handled during an event which pose stability issues at the transmission level?
  - Because we have so many DER that are presently unmonitored and controlled (~400,000 at this time) no action is taken.
  - In the future it may be possible to use DER to help mitigate those issues.
- How are different DER participation requests issued from different triggers/sources being prioritized and optimized?
  - Except for the control commands that go directly from the CAISO, we are looking at having the DERMS be the sole point of contact for DER. Generation Dispatch would be achieved thru the DERMS.

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DER Integration

Context surrounding DER integration to SCE's electrical network

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DER Interconnections

- Regulations are in place
    - [SCE Interconnection Process under Rule 21](#)
    - [CPUC Rule 21 Website](#)

- Who is responsible for technical verifications
    - This is identified in Rule 21.

DER Interconnections: Monitoring, Standards, and Protocols

- Monitoring
  - Smart Inverter production or consumption of active power (watts).
  - Smart Inverter consumption or production of reactive power (vars)
  - Phase measured at the AC terminals of the Smart Inverter (volts)
  - Frequency measured at the AC terminals of the Smart Inverter (Hz)
- Standards
  - IEEE 1547-2018
  - UL 1741
- Protocols
  - IEEE 2030.5 Common Smart Inverter Profile
    - Looking to have all behind the meter DER report using 2030.5
  - DNP V3.0 SA v5
    - Large in front of the meter DER preferred communication protocol
- Detailed in SCE Interconnection Process

Types of DER

- Solar PV
- Wind
- Electric Vehicle
- Battery Energy Storage System
- Demand Response

Appendix I

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Appendix A: Acronym List

Acronym	Definition
ADMS	Advanced Distribution Management System
API	Application Programming Interface
CAISO	California Independent System Operator
CPUC	California Public Utilities Commission
CSP	Communication Service Provider
DER	Distributed Energy Resources
DERMS	Distributed Energy Resources Management System
DMS	Distribution Management System
DNP	Distributed Network Protocol
DRPEP	Distribution Resources Plan External Portal
Dx	Distribution SCADA
EMS	Energy Management System
FAN	Field Area Network
FLISR	Fault Line Location Service & Restoration

Appendix A: Acronym List (continued)

Acronym	Definition
GAA	Gate All Around
GIPT	Grid Interconnection Processing Tool
GMS	Grid Management System
HMI	Human Machine Interfaces
IEEE	Institute of Electrical and Electronic Engineers
MPLS	Multiprotocol Label Switching
OMS	Outage Management System
PV	Photovoltaic
RFI	Remote Fault Indicator
RIS	Remote Intelligence
SA	System Administrator
SCADA	Supervisory Control and Data Acquisition
Tx	Transmission SCADA
UL	Underwriters Laboratories