Southern California Edison DERMS IEEE 2030.5 Aggregator Requirements

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1. Introduction & Purpose

This document describes the technical processes and requirements for aggregators to connect their IEEE 2030.5 client with SCE's Common Smart Inverter Profile (CSIP) IEEE 2030.5 server and provide services on behalf of their customers. This document is intended to apply to Behind the Meter Distributed Energy Resources. Separate requirements will be provided for Front of the Meter DERs. It is required that aggregators participating in pilots/programs that are using IEEE 2030.5-2018 communications understand and are conformant to the IEEE 2030.5-2018 standard as well as CSIP. This document is intended to be conformant to CSIP.

Specific SCE requirements related to Distributed Energy Resources Management System (DERMS) integration can be found in Section 2. CSIP and IEEE 2030.5 specific requirements can be found in Section 3. A method to support Dispatchable Aggregator Programs (aka Virtual Power Plants) can be found in Appendix A. Informative examples are provided in Appendix B.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119[1].

2. SCE DERMS Requirements

2.1. Onboarding, Registration, Provisioning and Commissioning

The following requirements and processes MUST be satisfied for an aggregator and its managed Distributed Energy Resources (DERs) to interface with SCE's CSIP Server and fulfill its obligations as defined in a pilot or program contract.

2.1.1. Aggregator Onboarding

Onboarding is the non-IEEE 2030.5 process by which an aggregator is approved to participate in a pilot or program. As part of this process, the aggregator vendor will be issued certificates by SCE and provide the initial Aggregator Information (e.g., Contact Information). The contract-specific *SCE DERMS IEEE 2030.5 Aggregator Intake Form* will be provided as part of the Onboarding Process[2].

Aggregators that need to connect to and interface with SCE's IEEE 2030.5 server MUST fulfill the following requirements:

- *CSIP SunSpec IEEE2030.5 Certified*- All aggregators that interface with SCE's IEEE 2030.5 server SHALL be tested and formally certified to the latest version of the Aggregator Profile of the SunSpec CSIP Conformance Test Procedures[3].

[1] https://tools.ietf.org/html/rfc2119
[2] Aggregator Intake Form instructions will be included with the Form
[3] https://sunspec.org/2030-5-csip/ The current final version of CSIP is v2.1

- *Contractual Agreement*- The aggregator SHALL be approved to communicate with SCE through a pilot, program, or other contract-based agreement. The specific project will collect the required Registration information as defined below, as well as other information specific to that contract.
- *Cybersecurity Compliance*- The aggregator SHALL be compliant with the required SCE cybersecurity policies and requirements as specified by the contract, program, or where stipulated.

2.1.2. Registration, Provisioning and Commissioning

The Registration, Provisioning and Commissioning (RPC) process enables and validates the DERMS and the Aggregator's ability to communicate with each other using IEEE 2030.5 as defined by CSIP.

Registration and Provisioning

Registration is the process to collect the subsequent customer and IEEE 2030.5-related Aggregator and DER information from onboarded resources. This includes IEEE 2030.5 Aggregator EndDevice Information, Virtual Power Plant (VPP) EndDevice and/or DER EndDevice and other Registration information that is used to create the IEEE 2030.5 aggregator and DER resources and map the aggregated DERs to other SCE systems that contain information related to specific customers, grid information and grid operations. This will be collected in the same Intake Form used in Section 2.1.1 to collect Aggregator information.

Provisioning is the SCE-internal IEEE 2030.5 process by which the IEEE 2030.5 aggregator and DER-related resources are created on the SCE server. Once Provisioned, SCE will notify the aggregator when the process has been completed and provide the IEEE 2030.5 Server's URL, the DeviceCapability (dcap) path, port, and determine agreed to dates for Commissioning. SCE will not allow aggregators to conduct In-Band DER Provisioning as defined by CSIP.

- Aggregators that support multiple programs/contracts SHALL implement a separate Aggregator EndDevice for each contract that complies with all associated Aggregator EndDevice requirements as described herein (i.e., each instance MUST have its own Intake Form, Public Static IP addresses, LFDI, etc.).
- All Aggregator and DER EndDevice LFDIs SHALL be provided by the aggregator and derived from the EndDevices' Certificates [4]
- Should new aggregator certificates be issued by SCE, the aggregator SHALL provide SCE with the updated LFDI and modify its EndDevice accordingly
- The aggregator SHALL provide the SCE DERMS Aggregator Intake Form with all customer and IEEE 2030.5 information 60 days prior to Commissioning date provided SCE
- The initially submitted Aggregator Intake Form SHALL be supplied for all subsequent modifications to the DER EndDevices listed in the Form at least 30 days prior to coming online

[4] See CSIP section 5.2.1.2

- There SHALL be only one aggregator managed DER EndDevice (with LFDI) per customer site[5]. A site is a SCE metered customer location

Commissioning

Commissioning entails the IEEE 2030.5 process by which the aggregator connects and interacts with the IEEE 2030.5 server to get and create the resources that are specific to that aggregator and the DERs it is managing. Additionally, with support from aggregator personnel, SCE validates the aggregator provisioning and that DER monitoring is provided correctly. The SCE DERMS operator then transitions the resources from Provisioned to Commissioned mode on SCE's DERMS[6]. SCE will not allow aggregators to conduct In-Band DER Provisioning as defined by CSIP.

The Registration, Provisioning and Commissioning process is described in the list below.

1. Aggregator provides Customer and IEEE 2030.5 information in intake form 60 days prior to DERMS Commissioning date (DERMS monitoring/control start date).
2. SCE Provisions aggregator and DER resources on the IEEE 2030.5 server
3. SCE provides DERMS connection information
4. Commissioning process (TLS Handshake, Authorization, Getting Resources, etc.). Aggregator notified of success or errors

2.2. Communication Requirements

SCE will provide a public IP address for its IEEE 2030.5 server. SCE's IEEE 2030.5 Notifications will be posted to the aggregator's notification endpoint address provided during Registration.

- The aggregator SHALL implement a public static IPv4 address for its Aggregator EndDevice client
- The aggregator SHALL implement a public static IPv4 address for the Aggregator EndDevice notification client. This must match the notificationURI in the Subscription resources.
- Aggregators SHALL comply with CSIP Section 5.2.5 and 5.3.5 related to the use and maintenance of IEEE 2030.5 Subscriptions

2.3. CSIP Grouping and Life-Cycle Management

Grouping is used by SCE to target controls to specific DER's managed by an aggregator under the aegis of a program or pilot. The requirements in this section are based on the CSIP-derived methods to create the resources on DERMS and manage the grouping through the lifecycle of the pilot or program. The methods to transfer these resources are described in CSIP. SCE will only allow out-of-band updates as described in CSIP Section 5.3.1.1

- Aggregators SHALL support CSIP group management requirements as defined in CSIP Section 5.2.3 FunctionSetAssignments (FSA) and DERPrograms

[5] The DER EndDevice is the Aggregators communication client for that site. The DER EndDevice may be a separate site/plant controller, GW or other similar system or may be integrated into the smart inverter if only one inverter is present. See the Monitoring section for DER EndDevice vs Inverter information.

[6] Note that some Provisioning-related aggregator requirements (Subscriptions, MirrorUsagePoints, etc.) are found in later sections of this document

- For SCE grouping changes, aggregators SHALL implement the FSA and DERProgram modifications made through the subscribed lists referenced in Section 3 as soon as received
- Aggregators SHALL use the *SCE DERMS IEEE 2030.5 Aggregator Intake Form* found at xxxx to provide any changes (Additions, Deletions or Modification) to the DER EndDevices and DER systems they are managing within 72 hours of changes having been made

3. IEEE 2030.5 Requirements

The information provided in this section details SCE's specific requirements related to the use of IEEE 2030.5-2018. Unless noted otherwise below, conformance to IEEE 2030.5 as defined by CSIP is required.

3.1. Time

Aggregators are responsible to ensure that their systems and managed EndDevice's are synced to SCE's IEEE 2030.5 server's Time function.

- Aggregator EndDevices SHALL support the IEEE 2030.5-2018 Time function set requirements to ensure Time is synced to SCE's IEEE 2030.5-2018 Server
- Aggregators MUST ensure that their managed DER EndDevices, smart inverters and other systems that are required to support time information remain synced to the aggregator's time or another Coordinated Universal Time (UTC) source

3.2. Monitoring

Monitoring refers to IEEE 2030.5 metering and status (nameplate, modified settings, DER status and DER availability) information. Aggregate DER metering will be required for all contracts that include DERMS. Per-DER status[7] should be provided for all program contracts that include DERMS

- Aggregators contracted to provide services (e.g., control or telemetry) to SCE via DERMS SHALL support all requirements in this section for per EndDevice/per DER monitoring and Appendix A for VPP EndDevice aggregate monitoring (if applicable)

3.2.1. Metering

As described in CSIP and the related interconnection standards, aggregators and their DER systems are required to have the capability to measure real and reactive power, voltage, and frequency and provide measurement information via IEEE 2030.5. Specific requirements for these DER measurements are as follows:

General Requirements

- As per the governing interconnection standard[8], DER metering or communication systems SHALL provide site aggregated metering data for all DERs being managed by the aggregator

[7] In most cases DER refers to a smart inverter that has associated nameplate, modified nameplate, statuses and availability information. This means there will be more than one DER in the DERList for multi-DER deployments at a site.

[8] See SCE's Rule 21 section Hh.7- "…the production or consumption of active and reactive power SHALL be communicated as an aggregate of all Smart Inverters within the Generating Facility."

- Individual meter Readings SHALL be posted to the aggregator created per-site MUP at Commissioning and at subsequent 5-minute intervals
- All metering data listed below SHALL be instantaneous data
- Meter Readings SHALL not include measurements for systems not under the aggregator's management or that are not interconnected DERs
- Readings SHALL not be sent as a MirrorReadingSet.
- If the DERs are islanded from the grid but still operational, the DER EndDevice SHOULD continue to provide Reading (see genConnectStatus)

MirrorUsagePoint

- Aggregators SHALL create a single MUP for each aggregator managed DER EndDevice and post aggregated DER measurements to it
- MUPs SHALL include a description field that describes the source(s) of the meter data
- The roleFlags SHALL be set to the appropriate roleFlagsType(s)
- The serviceCategoryKind SHALL be set to "Bit 0- electricity"
- The status value SHALL reflect the current status of the usage point (0= Off; 1= On)
- The deviceLFDI SHALL be the EndDevice LFDI provided during the Registration process (See Section 2)
- The MUP:postRate resource SHALL reflect the 5-minute required posting intervals.

MirrorMeterReading (MMR)

- MMR mRIDs SHALL be unique per the MMR's ReadingType (see below)
- The description SHALL describe the type of reading (see Reading section below)
- All other IEEE 2030.5 parameters SHOULD NOT be used

ReadingType

- accumulationBehaviour SHALL be set to "12- Instantaneous"
- commodity SHALL be set to "1- Electricity secondary metered value"
- flowDirection SHALL be provided and reflect the applicable FlowDirectionType
- kind SHALL be provided and reflect the KindType if available. If not available, it SHALL be set to "0- Not Applicable"
- phase SHALL be provided and reflect the PhaseCode. If not applicable, it SHALL be set to "0- Not Applicable"
- uom SHALL be provided and reflect the uomType. If not applicable, it SHALL be set to "0- Not Applicable"

The following uomTypes and Readings SHALL be provided:

- Real Power (Watts)
  - ReadingType uom: 38
  - PhaseCode 224

- This SHALL represent the total instantaneous measured or aggregated consumption/production of real power for all aggregator managed inverters at a site
- There SHALL be a maximum of one Real Power MMRs/ReadingType (MMR mRID) per DER EndDevice

- Reactive Power (Vars)
  - ReadingType uom: 63
  - PhaseCode: 224
  - This SHALL represent the total instantaneous measured or aggregated consumption/production of reactive power for all aggregator managed inverters at a site
  - There SHALL be a maximum of one Reactive Power MMRs/ReadingType (MMR mRID) per DER EndDevice
- Frequency (Hertz)
  - ReadingType uom: 33
  - PhaseCode: 224
  - This SHALL represent a frequency as measured at a single location at the site
  - There SHALL be a maximum of one Frequency MMR/ReadingType (MMR mRID) per DER EndDevice
- Voltage (Voltage) per Phase
  - ReadingType uom: 29
  - PhaseCodes: 128 (A), 64 (B), 32 (C)
  - This SHALL represent the average voltage as measured, per phase, for all aggregator managed inverter systems at a site
  - There SHALL be a maximum of three voltage MMRs/ReadingTypes (MMR mRID) per DER EndDevice
- powerOfTenMultiplier SHALL be provided and SHALL be applicable to the unit of measure for the ReadingType. It SHALL be 0 if not used
- The intervalLength SHOULD NOT be provided
- All other parameters in the ReadingType Resource SHOULD NOT be used

Reading

- Reading SHALL include a timePeriod to denote the dateTimeInterval of the reading. The *duration* SHOULD be 0 and *start* SHALL be the time stamp
- Reading SHALL include a value that reflects the units specified by the ReadingType
- All other parameters in the reading-related resources SHOULD NOT be used

3.2.2. Status

For every DER under its management, the aggregator SHOULD report its status (DERStatus), nameplate (DERCapability), modified settings (DERSettings) or availability (DERAvailability) to the appropriate DER's Resource found in the links of the EndDevice:DER Resource. Note that stateOfChargeStatus has differing requirements in regards to how the status will be referenced.

General Requirements:

- operationalModeStatus, inverterStatus, genConnectStatus and stateOfChargeStatus SHALL be updated by the aggregator at 5-minute intervals
    - SCE will not be using the polling rate specified in the DERList:pollRate as specified by CSIP, though aggregators implementing IEEE 2030.5 communications to their DERs may do so.
- All status updates SHALL include a readingTime representing the timestamp when the information was last updated
- For sites with micro-inverters, Status information SHALL be aggregated for all micro-inverters (i.e., the micro-inverter system is considered a single DER and reflected as such on the Intake Form and DERList)

genConnectStatus represents whether the inverter is connected to the grid or not.

- The first '0- Connected' bit SHALL be set if connected to the grid and energized. Otherwise '4- Fault/Error' SHALL be set. Other bits SHOULD NOT be used

operationalModeStatus and inverterStatus both define whether the inverter is operational (on) or not (off).

- For OperationalModeStatusType the value SHALL be set to '2- Operational Mode' if operating normally. Otherwise, the value SHALL be set to '1- Off'. Other values SHOULD NOT be used.
- Aggregators SHALL update the per-inverter inverterStatus value based on the InverterStatusType of the inverter at the time of update. The value SHALL be set to '0- N/A' if operating normally. Otherwise, the value SHALL be set to '1- Off'. No other values SHALL be used.

stateofChargeStatus represents the available Operational State of Charge (the usable amount) of the nameplate capacity of the storage DER.

- For all storage DERs (e.g., Stationary Energy Storage or Plug-in Electric Vehicles (PEVs)), the stateOfChargeStatus status SHALL be per storage device behind an inverter. This requirement is inclusive of DC-coupled PV and storage DERs
- For all storage resources, the aggregator SHALL update the StateOfChargeStatusType (%) to reflect the usable amount of storage capacity available
- For V2G-DC EVSE, if no PEV is connected to the Electric Vehicle Supply Equipment (EVSE/inverter), the stateOfChargeStatus reported SHALL be 0%

alarmStatus

Alarms are posted to the DERStatus:alarmStatus for each aggregator managed inverter. SCE will not require the use of LogEvents to report alarms.

- alarmStatus SHALL be updated by aggregators, for every aggregator managed inverter, as alarms occur

- alarmStatus bits SHALL only be set to true when the inverter has tripped offline due to the associated alarm condition
- Upon resolution of the alarm situation, the aggregator SHALL update the alarmStatus to reflect no alarms

3.2.3. DERAvailability

Aggregators MAY provide per-inverter DERAvalability. If provided, DERAvailabity updates SHOULD include the following based on its capabilities and DER type:

- An availabilityDuration that indicates the number of seconds the DER will be able to deliver active power based on the reservePercent attribute
- A maxChargeDuration indicating the number of seconds the DER will be able to receive active power based on the reserveChargePercent level
- A reserveChargePercent representing a percent of continuous received (charged) active power (based on %setMaxChargeRateW) available in reserve
- A reservePercent representing a percent of continuous delivered
- A statVarAvail that represents the estimated reserve reactive power, in var
- A statWAvail that represents the estimated reserve active power, in watts

3.2.4. DERCapability and DERSettings

DERCapabilities represents the as-manufactured nameplate ratings and other information of the inverter. DERSettings represent the modified nameplate value as configured during interconnection or at some other periods.

- Aggregators SHALL provide the data for DERCapability and DERSettings found in CSIP section 5.2.5.2.1. Aggregators SHOULD also include the following (other parameters MAY be provided):
  - modesSupported reflecting the relevant DERControlTypes
  - updatedTime reflecting the time at which the DER information was last updated
  - modesEnabled reflecting the relevant as-modified DERControlType
  - DERType reflecting the applicable type of DER supported by the inverter
- DERCapability SHALL only be sent at the time of provisioning. SCE will use this data to support validation of commissioning success
- DERSettings SHALL be sent at the time of provisioning and upon a change

3.3. DER Controls

Aggregator-managed DER systems will be managed as agreed to in pilot/program contracts or related materials. The information contained in this section provides general requirements related to the use of IEEE 2030.5-2018 DERControls and DefaultDERControls. As described in Section 3, SCE will use Subscription/Notification to notify aggregators of changes to their DER's DERProgramList, DERControlList and DefaultDERControl. SCE will be using DERProgram:primacy as defined by CSIP Section 7.10 and IEEE 2030.5-2018.

- Unless otherwise specified in pilot or program contracts, CSIP Appendix A requirements G6-G15, G22, P24-P26, P29-P33, P46-P50 SHALL be implemented by aggregators for their managed DERs with the following additional details:
  - DefaultDERControls SHALL be sent to and implemented on the aggregator managed EndDevices and inverters as soon as received by the aggregator (G7)
  - In the absence of IEEE 2030.5 DefaultDERControls or at the conclusion of a DERControl, aggregator managed inverters SHALL support the required curves and setpoints defined by the governing interconnections standards (e.g., Rule 21, IEEE 1547-2018/UL 1741 SB, etc) (G11, G12)
  - Aggregators SHALL support DERProgram:primacy and related logic to ensure correct management of conflicting DERControls for the EndDevices or inverters under its management (G13, G15)
    - In the case where avoidance of conflicting commands is not possible, the most recently created event based on creationTime SHALL have precedence (G14)
  - For DERControls to aggregator DERs, SCE will follow the *Event rules and guidelines* found in IEEE 2030.5 section 10.2.3 and 10.2.4.
    - Aggregators SHALL support the IEEE 2030.5 Event rules and guidelines found in IEEE 2030.5-2018 section 10.2.3 for the EndDevices or inverters it is managing (G22)
    - For aggregator managed EndDevices or inverters not capable of handling a scheduled dispatch (Event:interval start and duration), the aggregator SHALL ensure the DERs are dispatched according to the start and duration provided (G22)
  - Aggregators SHALL support the use of the DERControls and DefaultDERControls found in CSIP section 5.2.4 for each of the EndDevices and inverters that it is managing (G6, G8)

3.3.1. Responses

For all DERControls, SCE will provide a replyTo Uniform Resource Indicator (URI) and responseRequired= "07" (End Device SHALL indicate specific response)

- Per CSIP, the Response Function Set MUST be supported by aggregators
- All aggregators SHALL provide appropriate responses for each EndDevice they manage, including VPP EndDevices[9]

4. Virtual Power Plant (VPP) Programs

4.1. Introduction

SCE's DERMS Gateway deployment is based on the Common Smart Inverter Profile (CSIP) of IEEE 2030.5. CSIP's control-related scope covers the capabilities needed to support IEEE 1547-2018 DER management (e.g., connect/disconnect a DER, limit a DER's power to a % of nameplate, cause a DER to go to a specific Watt or % setpoint, collect DER-related information, etc.).

[9] See IEEE 2030.5-2018 section 8.8 and 10.2.3

While this functionality is important for programs that intend for SCE to manage DERs on the grid *through* aggregators, gateways, or directly, SCE has existing aggregator programs that send a single control signal to dispatch the aggregator that has been contracted to provide a certain amount of capacity on the grid. This is referred to as Virtual Power Plants (VPPs). In these types of programs, the aggregator client (as opposed to the DER client) is dispatched via an IEEE 2030.5 DERControl signal. Based on the event schedule parameters of that signal it is the aggregator that chooses, rather than SCE, which of its managed DERs can be dispatched and how to dispatch them based on the aggregator's logic and the program's contractual obligations.

4.1.1. VPP EndDevice Overview

The following requirements define the use of IEEE 2030.5/CSIP to meet the needs of the VPP Programs. This is accomplished by implementing the use of a new type of EndDevice managed by the CSIP Aggregator EndDevice, the Virtual Power Plant EndDevice (VPP EndDevice). The VPP EndDevice as used here is a virtual EndDevice that represents a group of DERs being used by the aggregator to provide grid services to SCE. This VPP EndDevice provides aggregate monitoring information from all of the DERs it is managing in the program[10]. When dispatched, the VPP EndDevice will not pass on SCE's DERControl event to the DERs used for the pilot/program. Instead, it will determine how to dispatch its resources to the meet the objectives of the DERControl event parameters.

The aggregator implementing a VPP will also be required to implement a CSIP conformant and certified Aggregator EndDevice and meet all Aggregator requirements defined in CSIP and this document to allow SCE to continue to individually monitor and manage the DERs being used by the VPP. This necessitates the completion of the SCE DERMS IEEE 2030.5 Aggregator Intake Form and related RPC process. A non-topology based DERProgram will be used for VPP Controls.

An example of the Dispatchable Aggregator Program and VPP EndDevice can be found in Appendix B

4.2. Requirements

The following requirements pertain to the Aggregator and VPP EndDevice. Where applicable, the requirements reference CSIP and specific sections of the IEEE 2030.5 Aggregator Requirements.

4.2.1. Onboarding, Registration, Provisioning and Commissioning

- Aggregators implementing VPPs for Dispatchable Aggregator Programs SHALL conform to all Aggregator Onboarding requirements (Section 2.1)
- Aggregators implementing VPP SHALL provide the SCE Aggregator Intake Form for its VPP and all DERs being used to support the program
- Aggregators implementing VPPs SHALL support the DER EndDevice and DER Monitoring requirements for its managed DER Systems as defined in Section 3.2 (See Figure 3)

[10] However, DER Monitoring as defined in Section 5.2 will still be required in addition to aggregator monitoring as defined here

4.2.2. Life Cycle Management

- Aggregators SHALL use the *SCE DERMS IEEE 2030.5 Aggregator Intake Form* found at xxxx to provide any changes (Additions, Deletions or Modification) to the VPP EndDevices, DER EndDevices and DER systems they are managing under the VPP within 72 hours of changes having been made.

4.2.3. Time

- Aggregators SHALL ensure the VPP's Time is synced to SCE's IEEE 2030.5-2018 Server Time

4.2.4. Monitoring

As SCE still requires CSIP defined DER level (DER EndDevice and inverter) monitoring data from the Aggregator EndDevice (see 5.2), only a subset of monitoring information is required to be provided by the VPP EndDevice as detailed here. Where the term "Aggregate" is used in this Appendix, this should be interpreted to mean the total (positive or negative) values collected from all DERs being managed for the Dispatchable Aggregator Program.

VPP Metering

- VPP EndDevices SHALL provide Aggregate Real Power (Watts) readings for all DERs being managed for the Program.
    - The VPP EndDevice Metering SHALL conform to Section 5.2.1 requirements with following exceptions:
        - The roleFlags SHALL be set to "Bit3- isDER"
        - PhaseCode SHALL be set to 224
        - Aggregate Real Power readings SHALL include measurements at 5 minute intervals

VPP Status

- Aggregators implementing a VPP SHALL update the genConnectStatus (ConnectStatusType) value for the VPP EndDevice based on its operational status (meaning the VPP EndDevice is available for dispatch) at the time of update. The first '0- Connected' bit shall be True if operational. Otherwise it shall be False.
- genConnectStatus SHALL be updated immediately updated upon change
    - SCE will not be using the polling rate specified in the DERList:pollRate as specified by CSIP
- All VPP status updates SHALL include a readingTime representing the timestamp when the information was last updated
- All other VPP status information (operationalModeStatus, inverterStatus, stateOfChargeStatus, and alarmStatus) SHOULD NOT be provided

VPP DERAvailability

- VPP DERAvailability SHOULD NOT be provided

VPP DERCapability and DERSettings

- The VPP SHOULD provide DERCapability:rtgMaxW and DERSettings:setMaxW reflecting the aggregate active power output capabilities of its managed DERs
- If provided, rtgMaxW SHALL be provided when first connected to SCE's DERMS
- If provided, setMaxW SHALL be provided whenever modified
- All other DERCapability and DERSettings parameters SHOULD NOT be provided

4.2.5. VPP DERControls

SCE's Dispatchable Aggregator Programs are load management programs and SCE's DERMS will use the opModTargetW DERControl to dispatch the VPP

- Aggregators implementing a VPP EndDevice SHALL support the IEEE 2030.5 Event rules and guidelines found in IEEE 2030.5-2018 section 10.2.3

VPP Responses

- Aggregators implementing a VPP EndDevice SHALL provide VPP Responses per IEEE 2030.5-2018 Section 8.8 and 10.2.3

5. Issue Resolution

Should issues occur during the life of the program/pilot, the aggregator SHALL comply with contract terms or other requirements agreed to. This includes but is not limited to:

- Aggregator and DER Communications and Operational Issues
- Planned outages
- Cybersecurity Incidents
- Missing/Invalid Monitoring Data

Appendix A- Informative Examples

This appendix provides illustrations, information, and examples for the 3 types of Aggregator-contracted services (CSIP Mode, VPP, and Monitoring Only). References to sections that contain formative information elsewhere in the document are also provided.

CSIP Model- Monitoring and Control

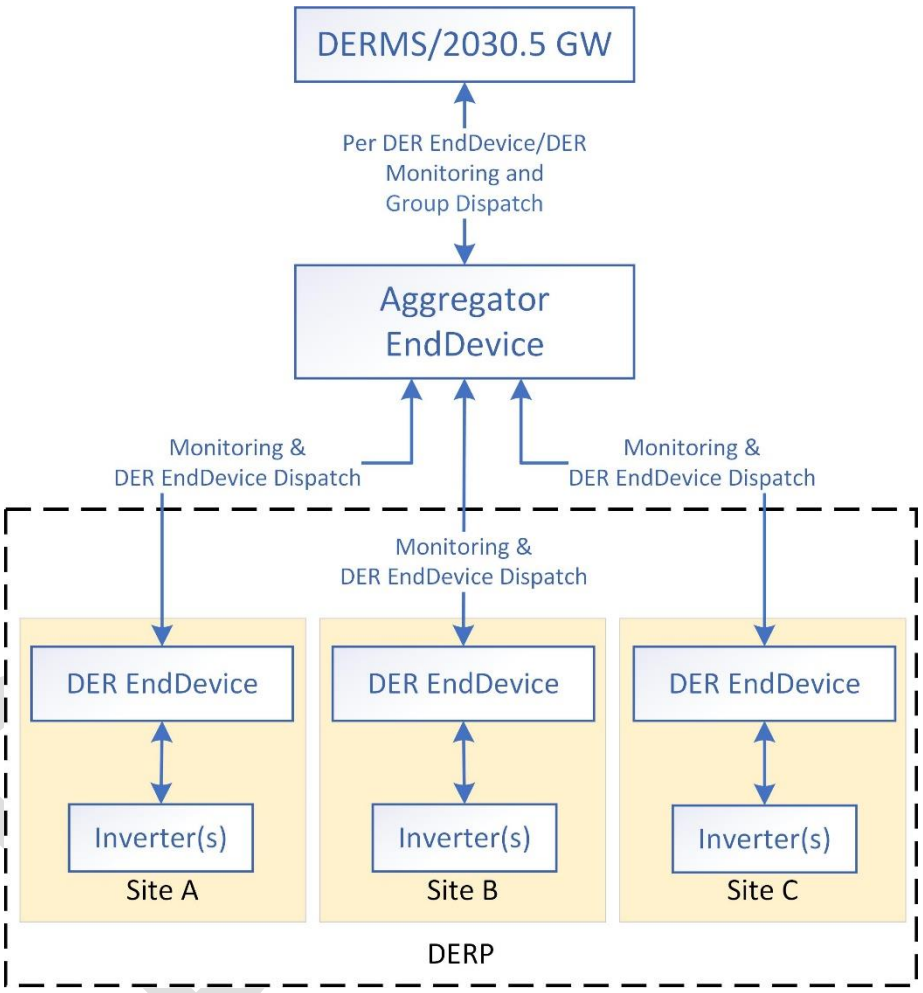

Figure 1

Figure 2 represents a standard CSIP deployment as described in CSIP and the main section of this document.

Registration, Provisioning, and Commissioning (RPC) Notes (2.1.2)

-Using the *SCE DERMS IEEE 2030.5 Aggregator Intake Form*, SCE registers and provisions (creates resources on the server) the Aggregator EndDevice, DER EndDevices, and DERs. Aggregator GETS resources from DERMS (Commissioning)

-There is only one DER EndDevice per site but may be multiple DERs in the DERList. The DER EndDevice is the communications client for the Aggregator EndDevice and could be a plant/site controller, GW, or integrated into the DER if only one DER is present at the site.

Monitoring Notes (3.2)

-The Aggregator EndDevice provides per DER nameplate/settings, status, and availability data for the DERs it is managing. SCE will create a DER in the DERList for each during Provisioning.

-The Aggregator EndDevice provides per DER EndDevice aggregate site measurements for the DERs it is managing

DER Controls (3.3)

-DERMS will create DERP(s) per contract as part of the RPC process. DERPS are used to create groupings of DER EndDevices to be controlled. It is important to note that the same originating DERMS signal is passed to all DER EndDevices by the Aggregator EndDevice

-Aggregator EndDevices track which DER EndDevices are assigned to DERPS based on the Functions Set Assignments created by DERMS

-If the site has a single Inverter, the DERMS control events (DERControls/DefaultDERControls) apply

-If the site has multiple Inverters (with one DER EndDevice), the application of the control event may depend on the capabilities of the DER EndDevice (i.e., its intelligence and logic to manage the inverters), the contract stipulations, or the type of control event. The below information attempts to provide some insight into the application of the DERMS control events:

Type of Control	DER EndDevice Behavior	Inverter[11] Behavior	Comments
Curve Control Event	Pass through to Inverter(s)	Implement curve event	Voltage and Frequency Ride-Throughs (Must Trip, May Trip and Momentary Cessation), Volt-Var, Volt-Watt, Frequency-Watt/Frequency-Droop
Connect/Disconnect	Pass through to Inverter(s)	Cease to Energize	CSIP uses opModEnergize as opposed to opModConnect. IEEE 1547-2018 refers to disabling Permit Service and Cease to Energize and Trip as separate functions but IEEE 1547.1-2019 requires only the use of IEEE 2030.5 opModEnergize. Enter Service parameters are DefaultDERControls in IEEE 2030.5
Fixed Power Factor	Pass through to Inverter(s)	Implement PF event	CSIP v2.1 does not currently require the support of opModFixedPFInjectW as defined in IEEE 1547.1-2019

[11] See Footnote 7

Real Power Output Limit	Performed at DER EndDevice level	Implement limit event	opModMaxLimW is a % and based on %setMaxW.
Set Active Power	Performed at DER EndDevice level	N/A	Applicable to storage only. CSIP includes a % and Watt setpoint control. The intent of a set active power signal is to direct the total output of the DER system to go to a certain setpoint. It may be accomplished at the inverter level but would necessitate an intelligent control system to manage inverter systems to meet objective
Set Reactive Power	Performed at DER EndDevice level	N/A	Though required by the governing interconnection standards, this was omitted by CSIP. IEEE 2030.5 DERControls as used in IEEE 1547.1-2019 include opModTargetVar and opModFixedVar. The comments in the Set Active Power row above is applicable to Set Reactive Power

CSIP Model- Monitoring Only

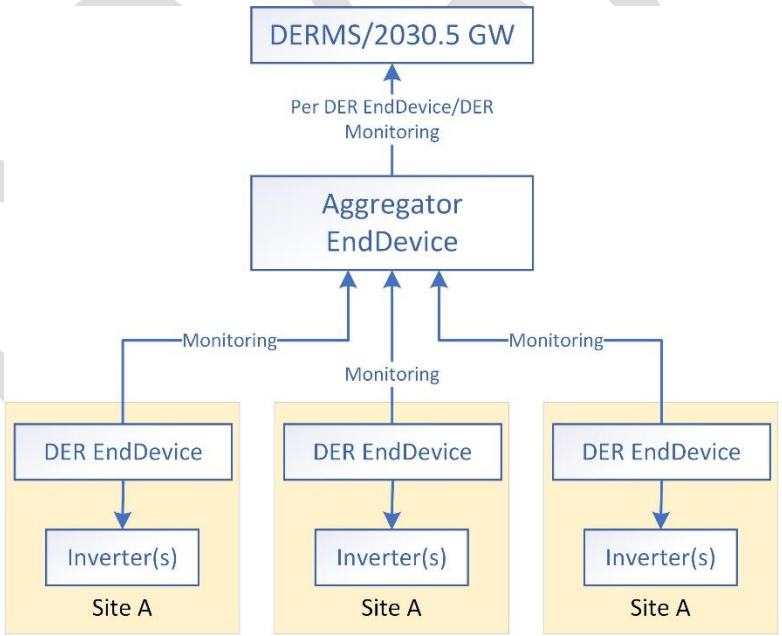

Figure 2

SCE has aggregator contracts that allow for DERMS monitoring only (3.2) but no DERMS control (3.3). There are several implications regarding this sort of implementation:

-Contracts/implementations will still require full certification to CSIP

-The Onboarding, Registration, Provisioning and Commissioning processes and requirements (2.1) remain the same

-As there are not controls, there will be no FunctionSetAssignmentsListLink (and subsequent DERPrograms, etc.) for each DER EndDevice only providing Monitoring. Aggregator's must ensure that this does not cause errors or issues

VPP EndDevice Model

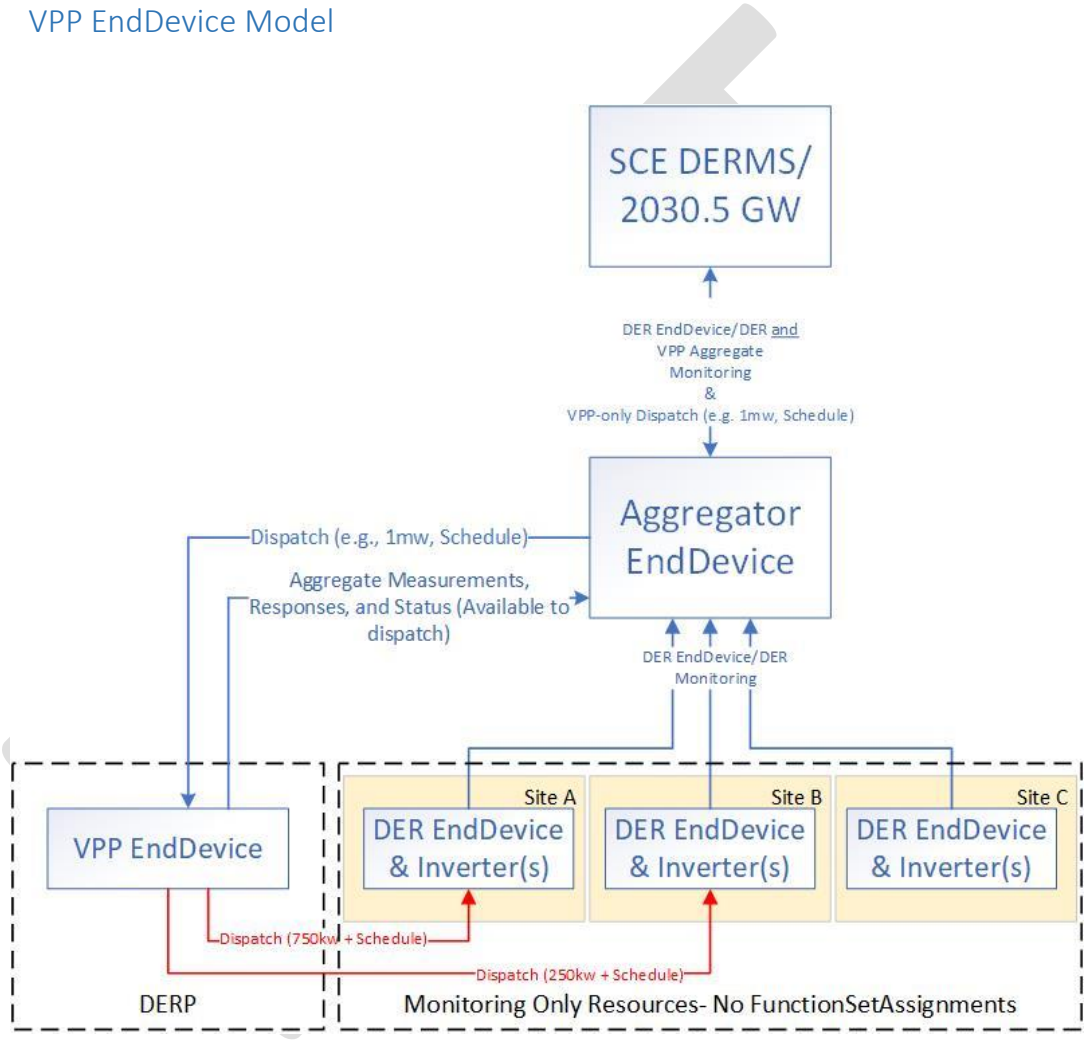

Figure 3

The VPP EndDevice model is fully described in Section 4. Figure 3 above provides an illustrative example of the VPP implementation.

-Contracts/implementations will still require full certification to CSIP

-The VPP EndDevice has the following characteristics vs a DER EndDevice:

-All Onboarding, Registration, Provisioning and Commissioning processes and requirements (2.1) remain the same with the addition of the VPP EndDevice. The *SCE DERMS IEEE 2030.5 Aggregator Intake Form* includes VPP EndDevice criteria.

-SCE will still collect all DER EndDevice information (Customer Information, LFDIs, etc.) for the VPP-managed DER EndDevices/DERs

-The VPP EndDevice is the only EndDevice that that will be assigned a DERP via FSAs.

-The VPP EndDevice provides a limited amount of monitoring data vs a DER EndDevice as described in Appendix A

-The VPP EndDevice logically has the capabilities to determine which of the Aggregator-managed systems are dispatched and by how much (see below). How this is actually accomplished (e.g., manually, through a separate process, or other) is at the discretion of the aggregator within the stipulations of the contract

-SCE will Register, Provision and Commission all VPP-managed DER EndDevices as per Section 2.1. All DER EndDevices being managed by the Aggregator/VPP for the contract must support the Monitoring-only implementation defined in the section above for Measurement and Verification (M&V) and Grid monitoring and management purposes (i.e., they will not have FunctionSetAssignments)

-Due to the use of the VPP EndDevice for controls, SCE's DERMS will not have insight into how DER EndDevices are dispatched. This is shown in Figure 3 *Dispatch* arrows. The blue arrows represent a DERMS dispatch of the VPP EndDevice at 1mw. The red lines represent the VPP EndDevice's dispatch of the aggregator's DER systems as determined by the aggregator's processes (see above bullet). The 750mw and 250mw signals and which systems are dispatched are transparent to DERMS. However, SCE should be able to determine this based on the provided DER EndDevice metering.