Jemena Electricity Networks (Vic) Ltd

Inverter OEM Validation Test Procedure

Device registration, connectivity and functional test in Jemena's Utility Server (Staging and Production)

In-band registration and connectivity tests are in development

Jemena
bringing energy to life

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Inverter OEM Validation Test Procedure

Authorisation

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History

Rev No	Date	Description of changes	Author
1.0-1.6	April-June 2024	Initial versions	Kevin Combe, Julien Fournier, Sachin Chandra, Tan Bui
2	7/08/2024	Updated end-to-end validation test procedure	Darren Michael, Kevin Combe, Sachin Chandra, Ty Chiem
2.1	20/09/2024	Provided further clarity on how LFDI should be generated (Refer Section 6.1.1.3.c) Amended Direct Device Model CSR Process Steps and Process Flow (Refer Sections 4.1.1.2, 6.1.2.3.b)	Darren Michael

Owning Functional Area

Business Function Owner:	Digital – Electricity Solutions

Review Details

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Glossary

Cloud model	The Utility Server can communicate with an Aggregator Platform which acts as the Software Communications Client. The Aggregator Platform then communicates with the various End Devices via a range of other communications technologies. The End Devices need not be located within one electrical installation and can be distributed across a large geographic area but aggregated together by a single entity.
CSIP	Common Smart Inverter profile
CSIP-AUS	The Common Smart Inverter Profile for Australia, an implementation guide for IEEE 2030.5 applicable to Australia. The CSIP-AUS can be downloaded from the ARENA DEIP interoperability steering committee website
Digicert	A company Jemena uses for PKI certificate generation
Direct Device model	The DER Device incorporates the Software Communications Client in the inverter enabling direct communications between the Utility Server and the DER.
End Device	Individual DER, often an inverter.
Gateway model	A hardware device incorporates the Software Communications Client within the device and mediates communications between the Utility Server and one or more local DERs under its control. The Gateway appears as a single IEEE 2030.5 EndDevice to the Utility Server.
IEEE 2030.5:2018	IEEE Standard for Smart Energy Profile Application Protocol
LFDI	Long Form Device Identifier as defined in CSIP. Aggregator LFDI is an identifier for Aggregator. Device LFDI is an identifier for a device.
Registration PIN	A Personal Identification Number that Jemena uses to identify its Utility Server
Software communications client	IEEE 2030.5 client to receive commands and send measurements
Jemena Utility Server	A computer server that allows orchestration of End Devices using CSIP-Aus communication protocols.

Abbreviations

CA	Certificate Authority
CEC	Clean Energy Council
CSIP	Common Smart Inverter Profile
CSIP-AUS	Common Smart Inverter Profile for Australia
CSR	Certificate Signing Request
IANA	Internet Assigned Numbers Authority
JEN CEDT	Jemena Electricity Network (JEN) Connections – Electricity Distribution Team
LFDI	Long Form Device Identifier
MCA	Manufacture Certificate Authority
MICA	Manufacture Issuing Certificate Authority
OEM	Original Equipment Manufacturer
PEN	Private Enterprise Number
PKI	Public Key Infrastructure
SERCA	Smart Energy Root Certificate Authority
SCC	Software Communication Clients
SME	Subject Matter Expert

1. Purpose and Scope

1.1 Purpose

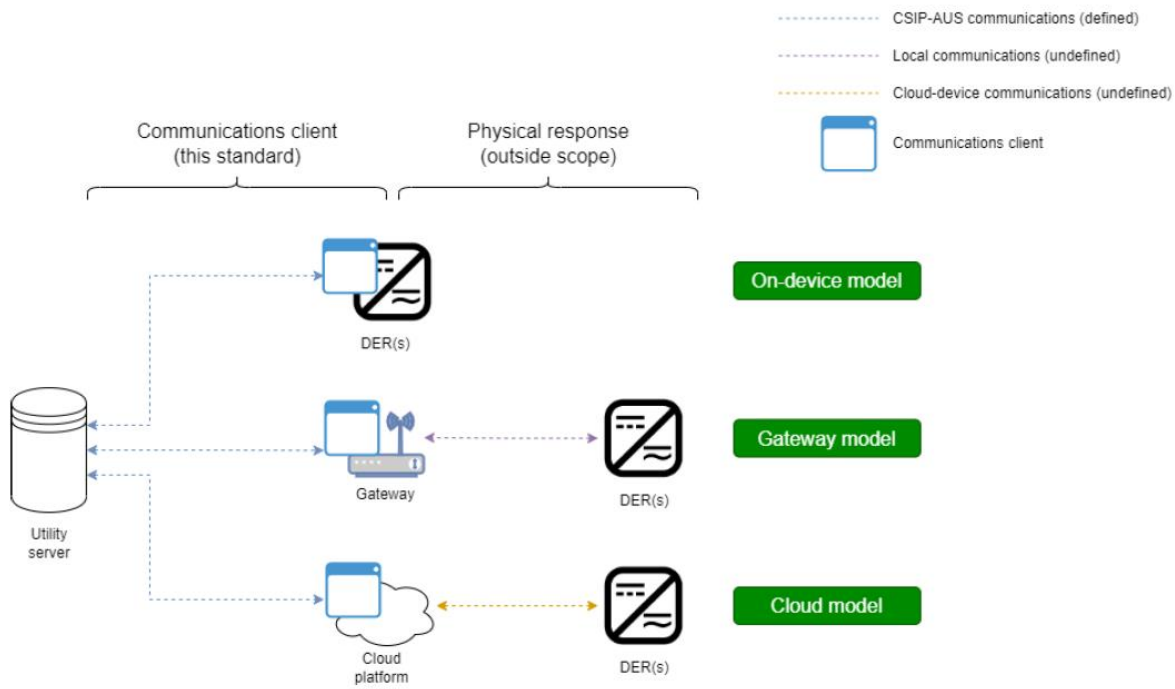
The purposes of this document are:

- to ensure there is a consistent procedure for the inverter Original Equipment Manufacturer (OEM) to test their CSIP-AUS communication software clients; and
- to validate successful interoperability between Jemena Utility Server and inverter OEM CSIP-AUS software communication clients (SCC) for inverters listed under CEC website: Inverters-with-SCC-240223.pdf (cleanenergycouncil.org.au).

This document serves as a supplementary document alongside IEEE 2030.5:2018, SA HB-218:2023, CSIP and CSIP-AUS communications client test procedures v1.0 to assist with interfacing with the Utility Server. It will be reviewed regularly and amended as required to reflect changes in standards, the application of new technologies, changes to procedures and field experience, among other things.

1.2 Scope

The scope of this document is limited to the testing of CEC listed inverters with software communication clients that are compliant to IEEE 2030.5 CSIP-Aus, either hosted locally on the inverter or a gateway device or via a certified cloud connection to Jemena's Utility Server.



2. Responsibilities

Role	Responsibility
Jemena	• Provides test Utility Server for OEM • Provides testing requirements and criteria (this document) • Witness and record test outcomes • Administer communication software clients and inverters that passes or fails the test • Technical support and resolve dispute
OEM	• Sets up any bench testing and equipment required at the OEM's laboratory to perform the validation test as documented in this document • Ensure connectivity with Utility Server established prior to execution of the tests with Jemena • Conduct test with Jemena's representative to witness and record test outcomes • Document outcomes of test for Jemena to sign off

3. Testing Activities

The following activities are required to be completed within this procedure prior to Jemena signing off successful completion of each verification. Each test step shall be recorded and filed using the forms in the Appendices.

Test Activity	Description	Responsible teams	CSIP-AUS Test
Connectivity/Discovery test in Staging Environment (out-of-band)	Connectivity test is to ensure there is a connectivity established between OEM's inverter within its test laboratory and Jemena's Utility Server in the test environment	Jemena Business SMEs Itron/ Kitu Business SMEs	Discovery – connectivity and monitoring capability
Functional Test in Staging Environment (out-of-band)	Functional test is to perform various CSIP-AUS functional tests as documented in Step 3 below and Appendix A.	Jemena Business SMEs Jemena Testers Itron/ Kitu Business SMEs	Discovery – monitoring capacity Export limit Generation limit Energize
Onboarding in Production Environment (out-of-band)	Production verification testing is non-destructive testing in the production environment and will validate the deployment correctness and recommend operational readiness.	Jemena Business SMEs Itron/ Kitu Business SMEs	Discovery – connectivity and monitoring capability
In-band registration test in Staging Environment	Automated device registration and connectivity test to ensure there is a connectivity established between OEM's inverter within its test laboratory and Jemena's Utility Server in the test environment	Jemena Business SMEs Itron/ Kitu Business SMEs	Discovery – connectivity and monitoring capability
In-band registration test in Production Environment	Automated device registration and connectivity test to ensure there is a connectivity established between OEM's inverter within its test laboratory and Jemena's Utility Server in the Production environment	Jemena Business SMEs Itron/ Kitu Business SMEs	Discovery – connectivity and monitoring capability

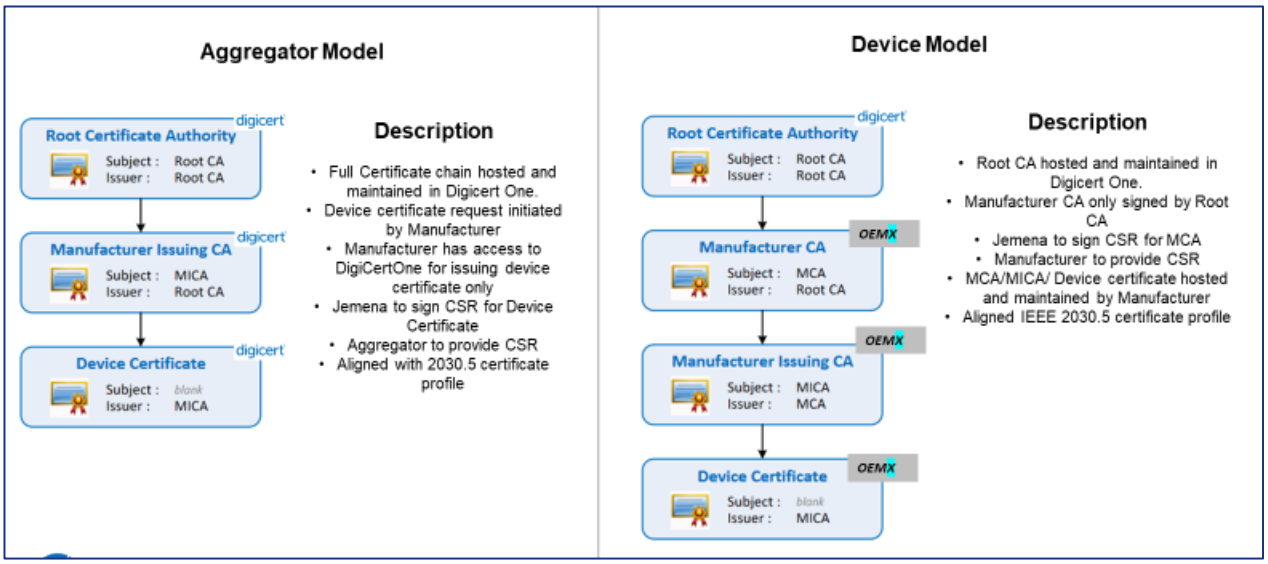
Each of these tests is further explained in the following sections.

4. Connectivity/Discovery test in Staging Environment (out-of-band)

4.1 Certificate Signing Request (CSR)

A Public Key Infrastructure (PKI) Certificate Signing Request (CSR) is a request that will be sent by an external vendor (i.e. an OEM that utilises an Aggregator Model or a Direct Device Model) to Jemena to apply for a digital identity certificate in order to connect to Jemena Utility Server. Figure 4-1 shows the high-level process for the CSR under Aggregator and Direct Device models.

Figure 4-1: High-level process of Certificate Signing Request



Processes for Aggregator and Direct Device models are further explained below.

4.1.1 Aggregator model (“cloud model”)

4.1.1.1 Prerequisites

JEN Connections – Electricity Distribution Team (JEN CEDT) must ensure the Aggregator has completed all Onboarding and Engagement Activities Form, including whitelisting of their IPs.

4.1.1.2 Process Steps

The following steps describe the CSR and registration process for an Aggregator model:

1. CSR Submission
    - Aggregator submits a Certificate Signing Request (CSR) to JEN CEDT.
    - Submission methods: Email or file share to emergency.backstop@jemena.com.au
    - Refer to Section 6.1.1.3 for CSR IEEE 2030.5 Guide
2. Connections – Electricity Distribution Team (CEDT) Processing
    - CEDT forwards the CSR to ED SCADA (Electricity Distribution SCADA Team) (via email).
    - CEDT includes:
        - Confirmation of completed Onboarding and Engagement activities.
        - Specification of CSR model (i.e. Aggregator or Direct Device Model).
        - Confirmation of CSR Request method (i.e. Email or File Share)
            - If File share, then to provide details
3. Certificate Generation in Digicert
    - ED SCADA team signs the CSR in DigiCert (Non-Production environment).

- ED SCADA team downloads the generated certificates.
- For detailed Work Instructions, refer to Section C1 – “Internal-Work Instructions_Issuing Certificate in DigiCert for Aggregator.doc”

4. Aggregator Registration in Jemena Utility Server
   - ED SCADA team registers the Aggregator in Jemena Utility Server.
   - ED SCADA inputs the following Registration details:
     - Aggregator ID (Mandatory)
     - LFDI (Mandatory)
     - Registration PIN (Optional)
   - For detailed Work Instructions, refer to Section C1” – “Internal-Work Instructions_Registering Aggregator in Utility Server.doc”
5. Certificate & Registration Details Distribution
   - ED SCADA team sends the following to the CEDT or directly to the Aggregator:
     - Aggregator’s Certificates
     - LFDI
     - Registration PIN (111115)
     - Additional Information on determining an LFDI for a Virtual End Device (Refer to section 6.1.1.3)
   - Note: ED SCADA team uses the Aggregator's original request method for sending the certificate (i.e email or file share).

4.1.1.3 Additional Information

For a detailed process flow diagram, refer to section 6.1.1.3.

4.1.2 Direct Device model (“Gateway model” and “on-device model”)

4.1.2.1 Prerequisites

JEN Connections – Electricity Distribution Team (CEDT) must ensure the OEM (Direct Device Model) to have completed all Onboarding and Engagement Activities, including whitelisting of their IPs.

4.1.2.2 Process Steps

The following steps describe the CSR and registration process for a Direct Device model:

1. CSR Submission
   - OEM submits to JEN CEDT:
     - A Manufacture Certificate Authority (MCA) Certificate Signing Request (CSR) and
     - “Manufacture Certificate Authority (MCA) - Certificate Authority (CA) Naming Form” .
   - Submission methods: Email or file share
   - See Section 0 for CSR IEEE 2030.5 Guide
   - Refer to “Non-Production Certification Authority (CA) Naming Form.doc” in section C1
2. Connections – Electricity Distribution Team (CEDT) Processing
   - CEDT forwards the MCA CSR and MCA CA Naming Form to ED SCADA team (via email).
   - CEDT includes:
     - Confirmation of completed Onboarding and Engagement activities.
     - Specification of CSR model (i.e. Aggregator or Direct Device Model).
     - Confirmation of CSR Request method (i.e. Email or File Share)
       - If File share, then to provide details
3. Certificate Generation
   - ED SCADA Lead/ Manager counter signs the MCA CA Naming Form
   - ED SCADA team emails the MCA CA Naming Form and MCA CSR to DigiCert Support Team (Riya.Michael@digicert.com) to generate an MCA certificate.

4. DigiCert (External Vendor) MCA Certificate Generation
    - DigiCert Support Team to process both MCA CA Naming Form and CSR.
    - DigiCert to email the MCA certificate back to ED SCADA team
    - *Note : This process will take 5-10 business days*
5. Certificate Distribution and Additional Certificate Request
    - ED SCADA team sends the MCA Certificate to the OEM
        - *Note: ED SCADA team uses the OEM's original request method for sending the certificate (i.e via email or fileshare).*
    - Shares Registration PIN (111115)
    - Requests Device LFDI from OEM

4.1.2.3 Additional Information

For a detailed process flow diagram, refer to Section 0.

4.2 Connectivity Test

The following steps describe the inverter connectivity process in Jemena Utility Server Staging Environment:

1. OEM sends a GET request .

   Jemena Staging/E2E URL: https://sep2-e2e.aws.jemena.com.au:8444/sep2/dcap
   Outcome:
   - If response for GET is **200 ok**. Proceed to Step 2.
   - Else, inform Jemena about failed connectivity

2. OEM shares device LFDI with Jemena and Device PIN[1] associated with the device.
   Registration PIN for Jemena Staging Environment: 111115
3. Jemena carries out below steps:
   - Confirms Device PIN shared by OEM is the same as initially shared by Jemena with OEM
   - Adds device LFDI in Jemena Utility Server
   - If it's a aggregator model, associates device with already created Aggregator in LFDI
   - Asscociates device with a node having default control: opModExpLimW = 500W
   - Request OEM's to query below endpoints:
     /tm
     /mup
     /edev
     /dderc
     /derc
     Outcome:
     - If response for above query is **Success**. Proceed to Step 4.
     - Else, inform Jemena about failed connectivity

4. OEM's powerup device and informs Jemena
5. Jemena validates below data for device in Jemena Utility Server:
   - Meter Data section is populated with lates telemetry data
   - Nameplate section is populated with relevant data
   - Derated Nameplate section is populated with latest data
   - DER Status section is populated with latest data

   Outcome:
   - If outcome is satisfactory, proceed to Step 6.
   - Else, inform OEM about failed connectivity

6. Functional Validation tests can commence on connected OEM's inverter.

[1] Device PIN is the same as the Registration PIN. Jemena prefers to use Registration PIN, however, it can be left blank if not used.

4.3 Discovery – Monitoring Capability

The following telemetry readings through the Metering Mirror functionality should be populated in Jemena Utility Server:

- Site Real Power (kW)
- Site Reactive Power (kVAr)
- Site Voltage (V)
- Gross Inverter Real Power (kW)
- Gross Inverter Reactive Power (kVAr)
- Inverter Voltage (V)

The Status Information will capture attributes under:

- DERCapability
- DERSettings
- DERStatus
- DERAvailability (Optional)

5. Functional Test in Staging Environment (out-of-band)

5.1 General

OEM to conduct the following tests with Jemena representative to witness and record outcomes of each test.

Test	Test Description	CSIP-AUS Mapping
Discovery – Monitoring Capability	This test is intended to validate the client's ability to perform discovery against the Utility Server and to establish basic IEEE 2030.5- based communications. It includes monitoring, connection status, operational mode and device capability (more details on the required attributes can be found in Appendix B1.1).	The following telemetry readings through the Metering Mirror function set: Site Real Power (kW) Site Reactive Power (kVAr) Site Voltage (V) Gross Inverter Real Power (kW) Gross Inverter Reactive Power (kVAr) Inverter Voltage (V) The Status Information will capture attributes under: DERCapability DERSettings DERStatus DERAvailability (Optional)
Export Limit	This test is intended to validate default export limit and active control export limit functions. Detailed testing requirements and use cases can be found in Appendix B1.2.	DefaultDERControl: OpModExpLimW DERControl: OpModExpLimW
Generation Limit	This test is intended to validate active control generation limit function. Detailed testing requirements and use cases can be found in Appendix B1.2.	DERControl: OpModGenLimW
Energize	This test is intended to validate the Energize control function – at this point in time both cease to energize and disconnection are acceptable to pass this test. Detailed testing requirements and use cases can be found in Appendix B1.2.	DERControl: opModEnergize
Subscription/ Notification	For aggregator-based systems, repeat above tests.	

Detailed test requirements and use cases can be found in Appendix B1.2.

5.2 Criteria used to determine pass or fails

The following criteria shall be used to determine pass or fail.

Test	Expected Result	Failure Criteria	Implementation notes
Discovery – Monitoring Capability	Client communications with the Utility Server are initialised as appropriate by the client. Utility Server captures EndDevice information. Utility Server captures monitoring as per CSIP-Aus mapping through the Metering Mirror Function. Utility Server captures Status Information: - Ratings (DERCapability) - Settings (DERSettings) - Operational Status (DERStatus) - Availability (DERAvailability) [Optional] - Alarms (DERStatus) The Client is time synced with the Utility Server.	Client does not perform discovery against the Utility Server. Client does not access the necessary function set or device capability. Client becomes unsynchronised with the Utility Server.	Required monitoring data shall be 5-minute average and the inverter must be capable of sending this every 5-minutes. Arbitrary monitoring PostRates shall be supported to a minimum interval of 60s in alignment with the CSIP-AUS. This functionality may be utilised by the Utility Server during testing and the capability test. Where a client manages multiple DER under a single device, for the Meter Mirror Function the posted values shall be an aggregation of the DER under a device. Where a client manages multiple DER under a single device, for DERCapability, the posted values shall be a summation of the total controllable capacities of the DER under a device. Where a client manages multiple DER under a single device, for DERSettings, the posted values shall be a summation of the total controllable capacities of the DER under a device.
Export Limit	The utility server configures an active DERControl: OpModExpLimW. On the next poll of the Utility Server, the client receives and starts the updated active DERControl: OpModExpLimW. Following the completion of the active DERControl, the device reverts back to the DefaultDERControl: OpModExpLimW.	The device does not change export power to the scheduled active DERControl. The device does not revert to the DefaultDERControl once the scheduled active DERControl is complete.	Where a client manages multiple DER under a single device, , the export limit control is the total site export, and the client shall portion this across the DER downstream of the controllable device to comply with the control.
Generation Limit	The utility server configures an active DERControl: OpModGenLimW. On the next poll of the Utility Server, the client receives and	The device does not change the generator power to the scheduled active DERControl. The device does not revert to the DefaultDERControl once the	Where a client manages multiple DER under a single device, the generation limit control is the aggregated generation, and the client shall portion this across the DER downstream of the controllable device.

	starts the updated active DERControl: OpModGenLimW. Following the completion of the active DERControl, the device reverts back to the DefaultDERControl: OpModExpLimW.	scheduled active DERControl is complete.	
Energize	The utility sever configures an active DERControl: opModEnergize. On the next poll of the Utility Server, the client receives and starts the updated active DERControl: opModEnergize and updates DERStatus to confirm the status of the device. Following the completion of the active DERControl the device updates the DERStatus to confirm the status of the device.	The device does not de-energise and re-energise the device. The device status is not updated. At this point in time both cease to energize and disconnection are acceptable to pass this test.	Where a client manages multiple DER under a single device, all managed DER are expected to energise / re-energise when instructed.
Subscription/ Notification	The Utility Server configures an active control (all tests above) that is 5 minutes in the future and notifies the client of this control. The client receives and commences the active control.	The device does not commence the active control.	

5.3 Multiple inverter support

This subsection outlines tests for software communications clients that intend to manage multiple downstream inverters.

A subset of the test procedure must be repeated with a multiple inverter test setup to validate a software communication client's capability to support multiple downstream devices.

Compliance to these tests will be validated with a Jemena representative to witness and record outcomes of each test.

Communication clients that intend to support management of multiple DER simultaneously shall be tested controlling at least two DERs.

The following tests must be repeated with multiple inverters present to achieve certification for multiple inverter support:

- Discovery
- Export Limit (DefaultDERControl & DERControl)
- Generation Limit (DERControl)

6. Onboarding in Production Environment (out-of-band)

6.1 Certification Signing Request

A PKI (Public Key Infrastructure) Certificate Signing Request (CSR) is a request that will be sent by an external vendor (i.e. An OEM that utilises an Aggregator Model or a Direct Device Model) to Jemena to apply for a digital identity certificate in order to connect to Jemena Utility Server.

6.1.1 Aggregator model (“cloud model”)

6.1.1.1 Prerequisites

JEN Connections – Electricity Distribution Team (CEDT) must ensure the Aggregator has completed all their required tests, onboarding and engagement activities in Non-Production.

6.1.1.2 Process Steps

The following steps describe the CSR and registration process for an Aggregator model:

1. CSR Submission
    - Aggregator submits a Certificate Signing Request (CSR) to JEN CEDT.
    - Submission methods: Email or file share
    - Refer to Section 6.1.1.3 for CSR IEEE 2030.5 Guide
2. Connections – Electricity Distribution Team (CEDT) Processing
    - CEDT forwards the CSR to ED SCADA team (via email).
    - CEDT includes:
        - Confirmation of completed Onboarding and Engagement activities.
        - Specification of CSR model (i.e. Aggregator or Direct Device Model).
        - Confirmation of CSR Request method (i.e. Email or File Share)
            - If File share, then to provide details
3. Certificate Generation in Digicert
    - ED SCADA team signs the CSR in DigiCert (Production environment).
    - ED SCADA team downloads the generated certificates.
    - For detailed Work Instructions, Refer to Section C1 – –“ Internal-Work Instructions_Issuing Certificate in DigiCert for Aggregator.doc”
4. Aggregator Registration in Jemena Utility Server
    - ED SCADA team registers the Aggregator in Jemena Utility Server.
    - ED SCADA team inputs the following Registration details:
        - Aggregator ID (Mandatory)
        - LFDI (Mandatory)
        - Registration PIN (Optional)
    - For detailed Work Instructions, Refer to Section C1 – “Internal-Work Instructions_Issuing Certificate in DigiCert for Aggregator.doc”
5. Certificate & Registration Details Distribution
    - ED SCADA team sends the following to CEDT or directly to Aggregator:
        - Aggregator’s Certificates
        - LFDI
        - Registration PIN (536367)
        - Additional Information on determining an LFDI for a Virtual End Device (Refer to section 6.1.1.3)
    - Note: ED SCADA team uses the Aggregator's original request method for sending the certificate (i.e email or file share).

6.1.1.3 Additional Information

a. **Native IEEE 2030.5 Certificate Guide :**

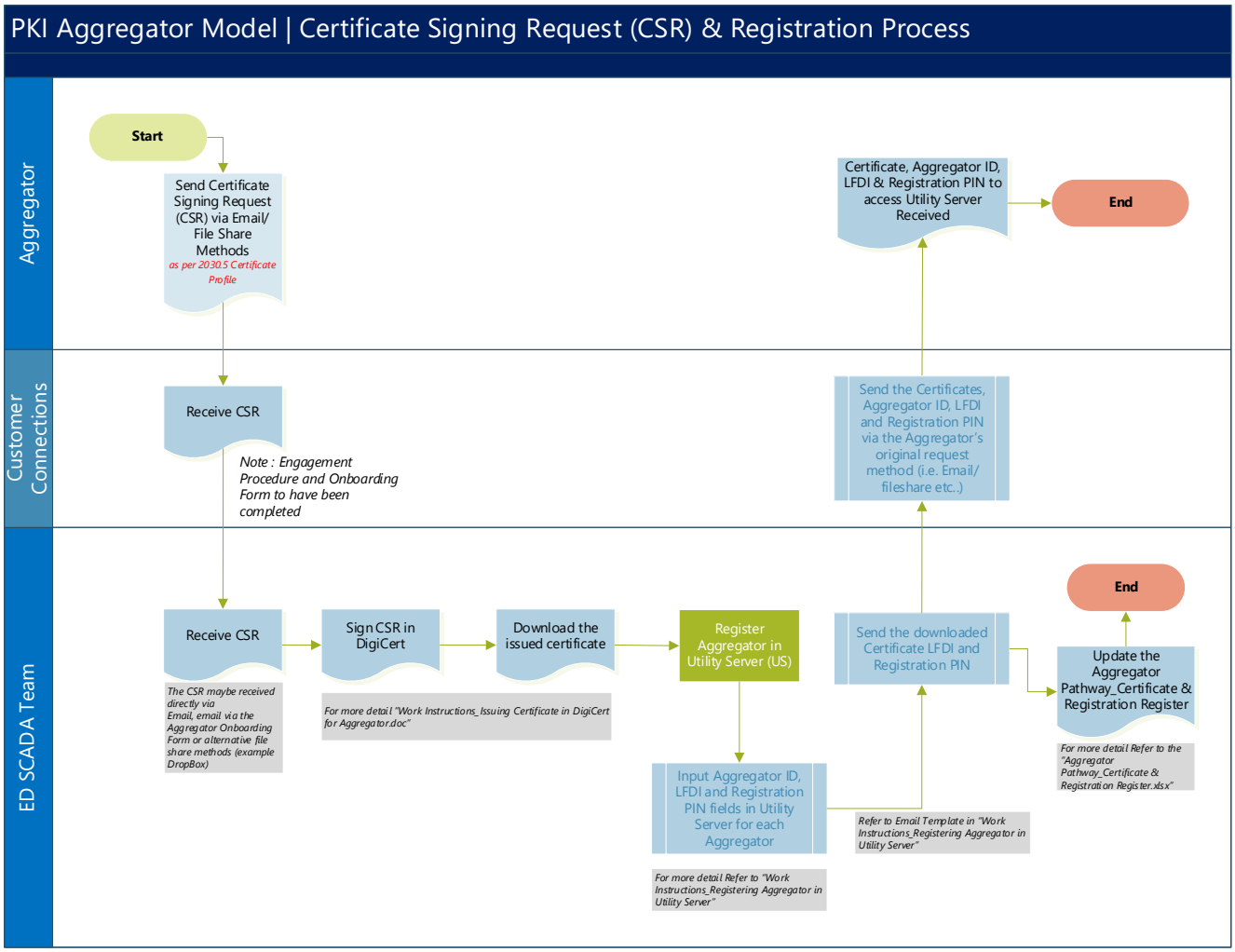
Certificate Details

Version	v3
Serial number	Unique Positive Integer assigned by the CA
Subject DN	Not Set
Issuer DN	<Issuing CA: MCA or MICA>
notBefore	<Issuing Date>
notAfter	Dec 31, 9999 23:59:59Z [99991231235959Z]
Signature Algorithm	☒ Sha256
Key size and type	ECC 256 (secp256r1)

Certificate Extensions

Extension Identifier	OID	Criticality	Value
keyUsage	{id-ce 15}	**TRUE**	
keyAgreement			Set
digitalSignature			Set
subjectKeyIdentifier	{id-ce 14}	FALSE	OPTIONAL
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
authorityKeyIdentifier	{id-ce 35}	FALSE	
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
certificatePolicies	{id-ce 32}	**TRUE**	
policyIdentifier			<Exactly One IEEE 2030.5 Device Type Identifier>
policyQualifiers			Not Set
subjectAltName	{id-ce 17}	**TRUE**	
otherName: HardwareModuleName: hwType hwSerialNum			 Set (<OID VALUE>) Set (<OCTET STRING VALUE>)

b. Process Flow :



c. Determining an LFDI For End Device:

Aggregators/Cloud proxy

Aggregators generating virtual LFDIs, **must** follow the recommended pattern for the 40 Hex digits Virtual LFDI:

- The first 32 hex digits of a unique identifier,
- Each LFDI and its associated SFDI **must** be unique and follow requirements listed in sections 6.3.2, 6.3.3, 6.3.4 under the AS 5385: 2023 ((Adoption of IEEE Std 2030.5 ™- 2018) or 2030.5-2018 - IEEE Standard for Smart Energy Profile Application Protocol)
- The last 8 hex digits **must** be the provider's Private Enterprise Number (PEN) with leading zeros (if PEN is less than 8 characters).

Example:

PEN= *18404*

So, LFDI =

a6ee92a4910236d0412bca3635a40ecd	*00018404*
32 Hex digits	*8 Hex digits*

Private Enterprise Number (PEN) are managed by Internet Assigned Numbers Authority (IANA - https://www.iana.org/), with assignment request being free of charge.

6.1.2 Direct Device model ("Gateway model" and "on-device model")

6.1.2.1 Prerequisites

JEN Connections – Electricity Distribution Team (CEDT) must ensure the OEM has completed all their required tests, onboarding and engagement activities in Non-Production.

6.1.2.2 Process Steps

1. CSR Submission
    - OEM submits to CEDT:
        - An MCA Certificate Signing Request (CSR) and
        - "Manufacture Certificate Authority (MCA) - Certificate Authority (CA) Naming Form" .
    - Submission methods: Email or file share
    - See Appendix for CSR IEEE 2030.5 Guide
    - Refer to Section C1 for Certificate Authority (CA) Naming Form – "PRODUCTION CERTIFICATION AUTHORITY (CA) NAMING FORM.doc"
2. Connections – Electricity Distribution Team (CEDT) Processing
    - CEDT forwards the MCA CSR and MCA CA Naming Form to ED SCADA team (via email).
    - CEDT includes:
        - Confirmation of completed Onboarding and Engagement activities.
        - Specification of CSR model (i.e. Aggregator or Direct Device Model).
        - Confirmation of CSR Request method (i.e. Email or File Share)
            - If File share, then to provide details
3. Certificate Generation
    - ED SCADA team Manager counter signs the MCA CA Naming Form
    - ED SCADA team emails the MCA CA Naming Form and MCA CSR to DigiCert Support Team (Riya.Michael@digicert.com) to generate an MCA certificate.
4. DigiCert (External Vendor) MCA Certificate Generation
    - DigiCert Support Team to process both MCA CA Naming Form and CSR.
    - DigiCert to email the MCA certificate back to ED SCADA team
    - *Note : This process will take 5-10 business days*
5. Certificate Distribution and Additional Information Request
    - ED SCADA team sends the MCA Certificate directly to OEM
        - *Note: ED SCADA team uses the OEM's original request method for sending the certificate (i.e via email or fileshare).*
    - Shares Registration PIN (536367)
    - Requests Device LFDI from OEM

6.1.2.3 Additional Information

a. Native IEEE 2030.5 Certificate Guide :

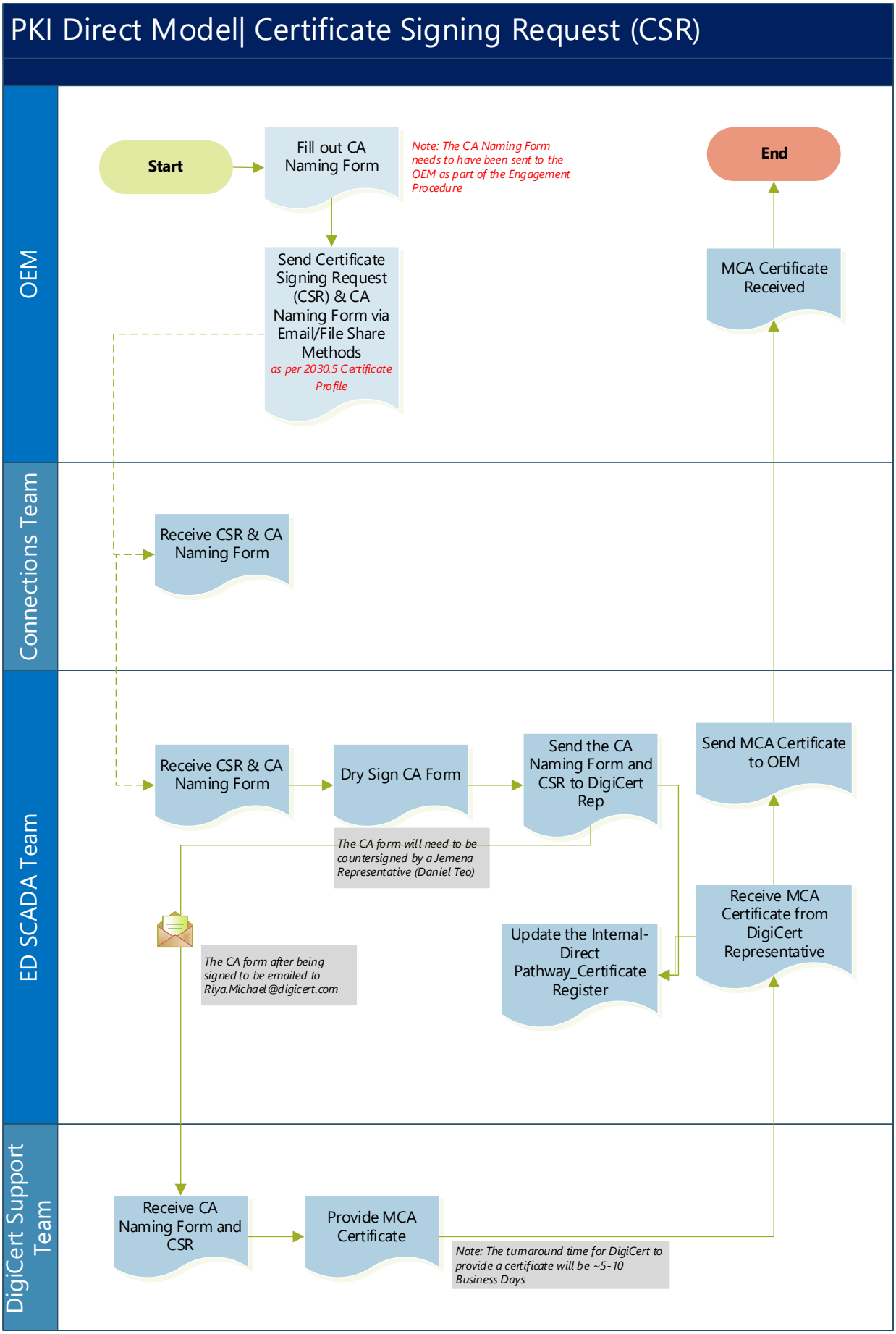
Certificate Details

Version	v3
Serial number	Unique Positive Integer assigned by the CA
Subject DN	Not Set
Issuer DN	<Issuing CA: MCA or MICA>
notBefore	<Issuing Date>
notAfter	Dec 31, 9999 23:59:59Z [99991231235959Z]
Signature Algorithm	☒ Sha256
Key size and type	ECC 256 (secp256r1)

Certificate Extensions

Extension Identifier	OID	Criticality	Value
keyUsage	{id-ce 15}	**TRUE**	
keyAgreement			Set
digitalSignature			Set
subjectKeyIdentifier	{id-ce 14}	FALSE	OPTIONAL
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
authorityKeyIdentifier	{id-ce 35}	FALSE	
keyIdentifier			Calculated per Method 2 [RFC 5280; Section 4.2.1.2]
certificatePolicies	{id-ce 32}	**TRUE**	
policyIdentifier			<Exactly One IEEE 2030.5 Device Type Identifier>
policyQualifiers			Not Set
subjectAltName	{id-ce 17}	**TRUE**	
otherName: HardwareModuleName: hwType hwSerialNum			 Set (<OID VALUE>) Set (<OCTET STRING VALUE>)

b. Process Flow :



6.2 Connectivity Test

The following steps describe the inverter connectivity process in Jemena's Production Environment:

1. OEM sends a GET request .

   Jemena Production URL: https://sep2.aws.jemena.com.au:8443/sep2/dcap

   Outcome:
   - If response for GET is **200 ok**. Proceed to Step 2.
   - Else, inform Jemena about failed connectivity

2. OEM shares device LFDI with Jemena and Device PIN[2] associated with the device.
   Registration PIN for Jemena Production Environment: 536367

3. Jemena carry's out below steps:
   - Confirms Device PIN shared by OEM is the same as initially shared by Jemena with OEM
   - Adds device LFDI in Jemena Utility Server
   - If it's a aggregator model, associates device with already created Aggregator in LFDI
   - Request OEM's to query below endpoints:
     /tm
     /mup
     /edev
     Outcome:
     - If response for above query is **Success**. Proceed to Step 4.
     - Else, inform Jemena about failed connectivity

4. OEM's powerup device and informs Jemena
5. Jemena validates below data for device in Jemena Utility Server:
   - Meter Data section is populated with lates telemetry data
   - Nameplate section is populated with relevant data
   - Derated Nameplate section is populated with latest data
   - DER Status section is populated with latest data

   Outcome:
   - If outcome is satisfactory, proceed to Step 6.
   - Else, inform OEM about failed connectivity

6. Delete device under test from Jemena Utility Server. Inform OEM about successful completion of connectivity tests .

6.3 Discovery – Monitoring Capability

The following telemetry readings through the Metering Mirror functionality should be Populated in Jemena Utility Server:

- Site Real Power (kW)
- Site Reactive Power (kVAr)
- Site Voltage (V)
- Gross Inverter Real Power (kW)
- Gross Inverter Reactive Power (kVAr)

[2] Device PIN is the same as the Registration PIN. Jemena prefers to use Registration PIN, however, it can be left blank if not used.

- Inverter Voltage (V)

The Status Information will capture attributes under:

- DERCapability
- DERSettings
- DERStatus
- DERAvailability (Optional)

6.4 Removal of device from Jemena Utility Server

Post successful connection testing, device needs to be deleted from Jemena Utility Server.

7. In-band registration test

7.1 In-band registration test in Staging Environment

Under development.

7.2 In-band registration test in Production Environment

Under development.

8. Related / Reference Documents

1. Government of South Australia, Technical Regulator Guideline. Link: 2022D066388-Technical-Regulator-Guidelines-Distributed-Energy-Resources-Version-1.5-1.pdf (energymining.sa.gov.au)
2. DEIP Interoperability Steering Committee Common Smart Inverter Profile – Australia - Test Procedures v1.0. Link: https://bsgip.com/wp-content/uploads/2023/09/CSIP-AUS-Comms-Client-Test-Procedures-v1.0-final.pdf
3. IEEE 2030.5:2018
4. SA HB-218:2023

A1 Connectivity/Discovery test in Staging Environment (out of band)

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B1 Functional Testing in Staging Environment (out of band)

B1.1 Discovery – Monitoring Capability

Further details of the monitoring and status attributes are presented below.

B1.1.1 Monitoring

Under any scenario (aggregator-mediated or otherwise), EndDevices shall be able to report the following monitoring information. This information shall be reported for the connection point. The following average readings are required through the Mirror Metering function set:

Monitoring Data	Description	Role Flags	UOM	Phase Code	Data Qualifier		Reported
Site Real (Active) Power	Site real power at the connection point	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	38 – W			2 – Average	M
						12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Site Reactive Power	Site reactive power at the connection point	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	63 – Var			2 – Average	M
						12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Real (Active) Power	Gross DER/inverter real power generation	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	38 – W			2 – Average	M
						12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Reactive Power	Gross DER/inverter reactive power generation	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	63 – Var			2 – Average	M
						12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Site Voltage (Single Phase)	Site voltage at the connection point	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	29 – V		129 – AN	2 – Average	M
						12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Site Voltage (3 phase) Line to Neutral	Site voltage at the connection point	0x03 (3) Bit 0 – isMirror Bit 1 – isPremisesAggregationPoint	29 – V		129 – AN 65 – BN 33 – CN	2 – Average	M
						12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Voltage (Single phase)	DER/inverter voltage	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	29 – V		129 – AN	2 – Average	M
						12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O
Voltage (3 phase) Line to Neutral	DER/inverter voltage	0x49 (73) Bit 0 – isMirror Bit 3 – isDER Bit 6 – isSubmeter	29 – V		129 – AN 65 – BN 33 – CN	2 – Average	M
						12 – Normal (instantaneous) 8 – Maximum 9 – Minimum	O

M – Mandatory O – Optional

Where applicable, data intervals shall be aligned to regular boundaries (for example, 1/5/30 minute boundaries). By default, EndDevices shall report monitoring information every 5 minutes (aligned to 5-minute boundaries). Devices shall support reporting intervals up to 1 minute.

B1.1.2 Status information

Aggregators acting for its DERs and DER Clients shall be able to report the following information.

B1.1.2.1 DERCapability

The required DERCapability Objects that are required:

DER Information	Nameplate Mapping	Reported	Multiple Inverter Sites Implementation
Max apparent power	rtgMaxVA	M	Total aggregated for all DERs
Max reactive power delivered by DER	rtgMaxVar	M	Total aggregated for all DERs
Max reactive power received by DER	rtgMaxVarNeg	M	Total aggregated for all DERs
Max active power output	rtgMaxW	M	Total aggregated for all DERs
Max energy storage capacity	rtgMaxWh	M – if applicable	Total aggregated for all DERs

B1.1.2.2 DERSettings

The required DERSettings Objects that are required:

DER Information	Nameplate Mapping	Reported	Multiple Inverter Sites Implementation
Max apparent power	setMaxVA	M	Total aggregated for all DERs
Max reactive power delivered by DER	setMaxVar	M	Total aggregated for all DERs
Max reactive power received by DER	setMaxVarNeg	M	Total aggregated for all DERs
Max active power output	setMaxW	M	Total aggregated for all DERs
Max energy storage capacity	rtgMaxWh	M – if applicable	Total aggregated for all DERs

B1.1.2.3 DERStatus

The required DERStatus Objects that are required:

Operational Status Information	DERStatus Mapping	Reported
Operational State	operationalModeStatus	M
Inverter State	inverterStatus	M
Connection Status	genConnectStatus	M
Alarm Status	alarmStatus	M if available
Connection Status for storage DER	storConnectStatus	Required for communications software communication clients that can control energy storage

Operational Energy Storage Capacity	stateOfChargeStatus	Required for communications software communication clients that can control energy storage

B1.1.2.4 DERAvailability

The required DERAvailability Objects that are optional and only required if the communications software communication clients can control energy storage:

Reserve Generation Status	DERStatus Mapping	Reported
Discharge duration availability	availabilityDuration	Optional if available
Charge duration availability	maxChargeDuration	Optional if available
Charge rate availability	reserveChargePercent	Optional if available
Discharge rate availability	reservePercent	Optional if available

B1.2 Functional Testing

Details of the functional test use cases are presented below.

B1.2.1 Test setup

Each DER or Device Under Test (DUT) is enrolled in 3 x DERPrograms to emulate our go-live design:

FSA	DERProgram	Primacy
1 (topology)	NMI-Level	124
1 (topology)	Top-Level	127
2 (non-topology)	Independent	127

B1.2.2 Test use cases

The following table summarises the test use cases. Detailed testing steps can be found in Appendix B1.2.3.

Test	Use case	DefaultDERControl	DERControl	Test summary
1 – Export Limit	Basic key function testing	Set @NMI-Level	Set @Top-Level	Multi-FSA: No Multi-Program: Yes Superseding control: Yes Nested control: No
1 – Generation Limit	Basic key function testing	Set @NMI-Level	Set @Top-Level	Multi-FSA: No Multi-Program: Yes Superseding control: No Nested control: No
1 – Energize	Basic key function testing	Set @NMI-Level	Set @Top-Level	Multi-FSA: No Multi-Program: Yes Superseding control: No Nested control: No
2 – BAU Export Limits	System normal BAU export limits via Independent Node	Set @NMI-Level	Set @Independent	Multi-FSA: Yes Multi-Program: No Superseding control: No Nested control: No
3 – MSL Generation Limits	MSL event generation limits via Independent Node	Set @NMI-Level	Set @Independent	Multi-FSA: Yes Multi-Program: No Superseding control: No Nested control: No
4 – MSL Generation Limits	MSL event generation limit via Top-Level topology node overriding BAU export limits	Set @NMI-Level	Set @Independent Set @Top-Level	Multi-FSA: Yes Multi-Program: Yes Superseding control: No Nested control: Yes
5 – MSL Generation Limits	MSL event generation limit via NMI-Level topology node overriding BAU export limits	Set @NMI-Level	Set @Independent	Multi-FSA: Yes Multi-Program: No

Test	Use case	DefaultDERControl	DERControl	Test summary
			Set @NMI-Level	Superseding control: No Nested control: Yes
6 – MSL Export Limits	MSL event export limit via Top-Level topology node overriding BAU export limits	Set @NMI-Level	Set @Independent Set @Top-Level	Multi-FSA: Yes Multi-Program: Yes Superseding control: Yes Nested control: Yes
7 – Export Limits	MSL event generation limit via NMI-Level topology node overriding BAU export limits	Set @NMI-Level	Set @Independent Set @NMI-Level	Multi-FSA: Yes Multi-Program: No Superseding control: Yes Nested control: Yes

The expected device response to the tests can be found in Appendix B1.2.4.

B1.2.3 Jemena's record of validation test outcomes

Date/ Time: _____

Test Activity: _____

Inverter OEM: _____

Inverter Communication Software Client version: _____

How many inverters are included in the test? _____

Inverter PollRate:_____

Inverter PostRate: _____

Overall assessment: Pass or Fail

Overall comment: _____

_____

Jemena Tester	Name:_____	Signature: _____	Date: _____
Itron Tester	Name:_____	Signature: _____	Date: _____
OEM Tester	Name:_____	Signature: _____	Date: _____
Jemena's Approver	Name:_____	Signature: _____	Date: _____

Details of individual CSIP-AUS test shall be recorded below.

1) This test looks to confirm various functions of the Client capability. Unless specified, the following test shall be conducted at the **Top-Level Topology Node** with Primacy of 127.

Test	CSIP-AUS Test Record	Comments
Discovery – Monitoring Capability	The following telemetry readings through the Metering Mirror function set: Site Real Power (kW) _____ Site Reactive Power (kVAr) _____ Site Voltage (V) _____ Gross Inverter Real Power (kW) _____ Gross Inverter Reactive Power (kVAr) _____ Inverter Voltage (V) _____	

	The Status Information will capture attributes under: DERCapability _____ DERSettings _____ DERStatus _____ DERAvailability (Optional) _____	
Export Limit	This test is intended to validate default export limit and active control export limit functions. If the DUT allows and supports posting and polling intervals up to 1 minute, update the following within the Utility Server: Requested DER Info Post Rate = 60 s Requested Meter Data Post Rate = 60 s PollRate applied: _____ PostRate applied: _____ Scheduled control duration: _____ • Set the default OpModExpLimW = 0.5kW at NMI node Confirm site active power and generation are correct _____ _____ • Set an active OpModExpLimW = 0kW Confirm site active power limit reduces to 0kW _____ _____ Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to 0.5kW _____ _____ • Set an active OpModExpLimW = 5kW	DefaultDERControl: OpModExpLimW DERControl: OpModExpLimW

	Confirm site active power limit increases to 5kW _____ _____ Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to 0.5kW _____ _____ Note: Depending on pollRate and postRate, the scheduled control time shall be set to at least 4 times to demonstrate each test. E.g. if the pollRate and postRate is set to 1 minute, then the scheduled control time shall be set to a duration of 4 minutes. **Overlap of two control commands test** This test is intended to understand whether the first control command will be cancelled when the second control command initiates. • Set 1st active OpModExpLimW = 0.25kW for Tstart=0 and Tend = 20 minutes • Set 2nd active OpModExpLimW = 1.0kW for Tstart=14 and Tend = 27 minutes (event needs to be created once 1st active control has started) • Confirm at end of scheduled control that site export limit returns to 0.5 kW. • Record observation below: _____ _____	
Generation Limit	PollRate applied: _____ PostRate applied: _____ Scheduled control duration: _____ This test is intended to validate active control generation limit function. • Set an active OpModGenLimW = 0kW Confirm inverter active power limit reduces to 0kW _____ _____ Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit	DERControl: OpModGenLimW

	returns to 0.5kW _____ _____ • Set an active OpModGenLimW = 5kW Confirm inverter active power limit increases to 5kW _____ _____ Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to 0.5kW _____ _____ Note: Depending on pollRate and postRate, the scheduled control time shall be set to at least 4 times to demonstrate each test. E.g. if the pollRate and postRate is set to 1 minute, then the scheduled control time shall be set to a duration of 4 minutes.	
Energize	Confirm connection status of device Send OpModEnergize = True Confirm connection status _____ _____ Send OpModEnergize = False Confirm connection status _____ _____ At this point in time both cease to energize and disconnection are acceptable to pass this test.	DERControl: opModEnergize

2) This test looks to represent the use case of Ongoing Site Export Control via an Independent Node. Repeat with one Active Export Limit test, with the control set at the **Independent Node** as follows:

- Assign the device to an Independent Node **"Testing Node"** with Primacy set to 127 (i.e., the same as the Top-Level Topology Node)
- Set control time to 2 times the pollRate or postRate (whichever is the longest time)
- Set an active OpModExpLimW = 5kW on Independent Node

  Confirm site active power limit increases to 5kW

  _____

  _____

  Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to 0.5kW

  _____

  _____

3) This test looks to represent the use case of Ongoing Generation Limit Control via an Independent Node. Repeat with one Active Generation Limit test, with the control set at the **Independent Node** as follows:

- Assign the device to an Independent Node **"Testing Node"** with Primacy set to 127 (i.e., the same as the Top-Level Topology Node)
- Set control time to 2 times the pollRate or postRate (whichever is the longest time)
- Set an active OpModGenLimW = 0kW on Independent Node

  Confirm inverter active power limit reduces to 0kW

  _____

  _____

  Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to 0.5kW

  _____

  _____

4) This test looks to represent the use case of Ongoing Site Export Control via an Independent Node and Overriding by the MSL event at the Top-Level Topology Node.

- Assign the device to an Independent Node **"Testing Node"** with Primacy set to 127 (i.e., the same as the Top-Level Topology Node).
- Set an **Independent Node** active OpModExpLimW = 5 kW on **"Testing Node"** for 30 Minutes or (6x poll rate)

  Confirm site active power limit increases to 5 kW

  _____

  _____

- After10 minutes or (1x poll rate)

Set an active OpModGenLimW on **Top-Level Topology Node** = 0 kW for 10 minutes or (2x poll rate)

Confirm inverter active power limit decreases to 0 kW

Record whether **Independent Node** active OpModExpLimW control has been aborted?

_____

_____

Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to 0.5kW

_____

_____

[Note that control responses are subject to the rules within IEEE 2030.5:2018 Section 10.2.3.3 Rules and Guidelines]

5) This test looks to represent the use case of Ongoing Site Export Control via an Independent Node (with Primacy set to 127) and Overriding by a Lower Primacy at the NMI Topology Node.

- Assign the device to an Independent Node **"Testing Node"** with Primacy set to 127 (i.e., the same as the Top-Level Topology Node).
- Set an **Independent Node** active OpModExpLimW = 5 kW on **"Testing Node"** for 30 Minutes or (6x poll rate)

  Confirm site active power limit increases to 5 kW

  _____

  _____

- After 10 minutes or (1x poll rate)

  Set an active OpModGenLimW on **NMI Topology Node** = 0 kW for 10 minutes or (2x poll rate)

  Confirm inverter active power limit decreases to 0 kW

  Record whether **Independent Node** active OpModExpLimW control has been aborted?.

  _____

  _____

  Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to 0.5kW.

  _____

  _____

[Note that control responses are subject to the rules within IEEE 2030.5:2018 Section 10.2.3.3 Rules and Guidelines]

6) This test looks to represent the use case of Ongoing Site Export Control via an Independent Node and Overriding by the MSL event at the Top-Level Topology Node for active control OpModExpLimW.

- Assign the device to an Independent Node **"Testing Node"** with Primacy set to 127 (i.e., the same as the Top-Level Topology Node).

- Set an **Independent Node** active OpModExpLimW = 5 kW on **"Testing Node"** for 30 Minutes or (6x poll rate)

  Confirm site active power limit increases to 5 kW

  _____

  _____

- After 10 minutes or (1x poll rate)

  Set an active OpModExpLimW on **Top-Level Topology Node** = 0 kW for 10 minutes or (2x poll rate)

  Confirm inverter active power limit decreases to 0 kW

  Record whether **Independent Node** active OpModExpLimW control has been aborted?

  _____

  _____

  Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to 0.5kW

  _____

  _____

[Note that control responses are subject to the rules within IEEE 2030.5:2018 Section 10.2.3.3 Rules and Guidelines]

7) This test looks to represent the use case of Ongoing Site Generation Control via an Independent Node (with Primacy set to 127) and Overriding by a Lower Primacy at the NMI Topology Node for active control OpModGenLimW.

- Assign the device to an Independent Node **"Testing Node"** with Primacy set to 127 (i.e., the same as the Top-Level Topology Node).
- Set an **Independent Node** active OpModGenLimW = 5 kW on **"Testing Node"** for 30 Minutes or (6x poll rate)

  Confirm site active power limit increases to 5 kW

  _____

  _____

- After 10 minutes or (2x poll rate)

  Set an active OpModGenLimW on **NMI Topology Node** = 0 kW for 10 minutes or (2x poll rate)

  Confirm inverter active power limit decreases to 0 kW

  Record whether **Independent Node** active OpModGenLimW control has been aborted?.

  _____

  _____

  Confirm at end of scheduled control that site export limit returns to 0.5kW. Observe and record failsafe response time, that is, the duration from end of scheduled control to when the site export limit returns to

0.5kW.

_____

_____

[Note that control responses are subject to the rules within IEEE 2030.5:2018 Section 10.2.3.3 Rules and Guidelines]

Following completion of the testing, update the following within the Utility Server:

Requested DER Info Post Rate = 300 s

Requested Meter Data Post Rate = 300 s

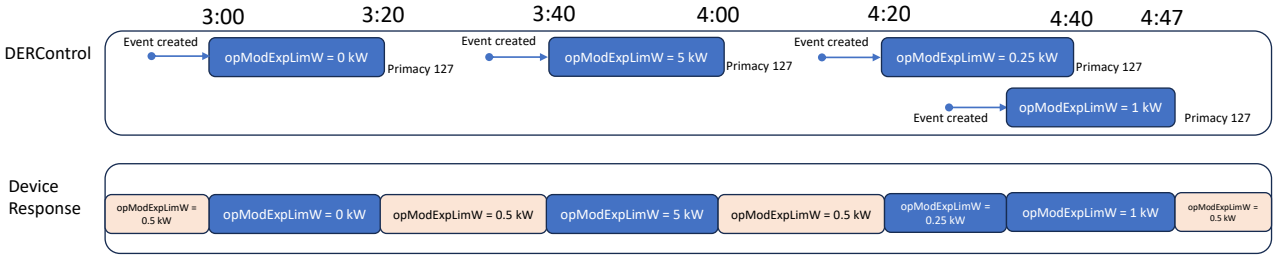
B1.2.4 Jemena's expected device response to tests

Expected device response to the tests

Test 1: Export Limit Test (Multi-Program)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

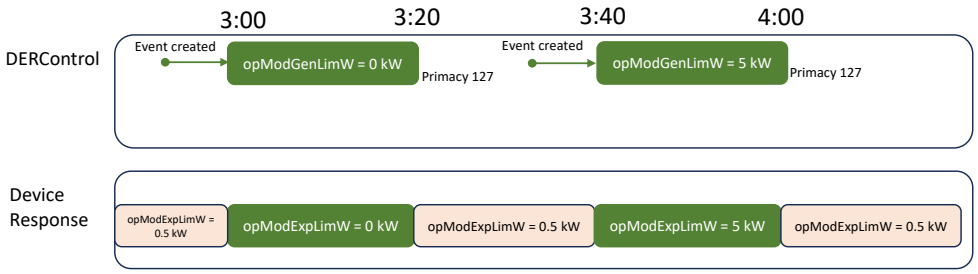
FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	Top-Level Topology	127		opModExpLimW
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	



Test 1: Generation Limit Test (Multi-Program)

DefaultDERControl: opModExpLim = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	Top-Level Topology	127		opModGenLimW
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	

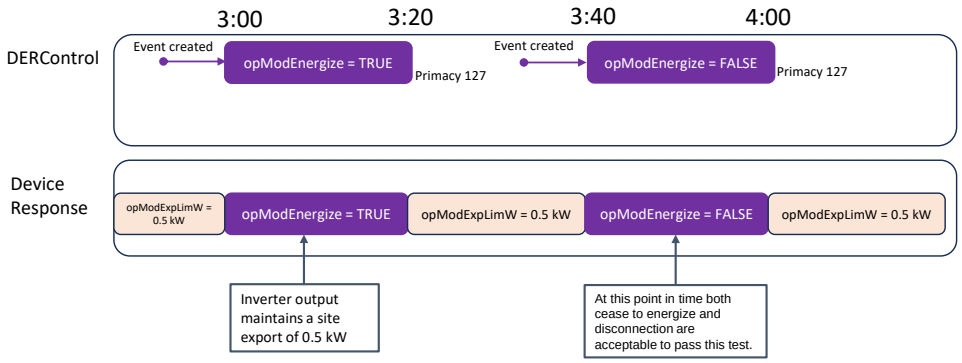


Expected device response to the tests

Test 1: Energize Test (Multi-Program)

DefaultDERControl: opModExpLim = 0.5 kW Primacy 124

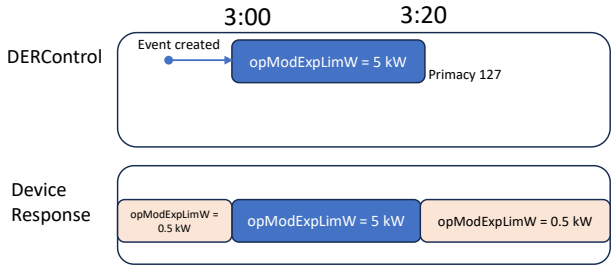
FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	Top-Level Topology	127		opModEnergize
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	



Test 2 (Multi-FSA)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

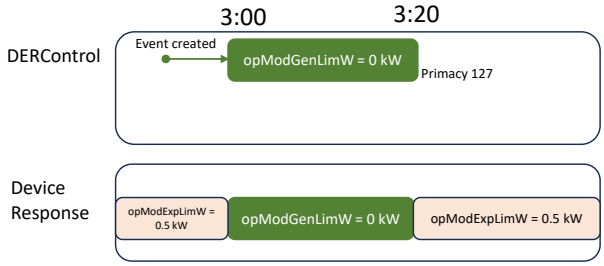
FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA2	Non-Topology	127		opModExpLimW



Test 3 (Multi-FSA)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA2	Non-Topology	127		opModGenLimW

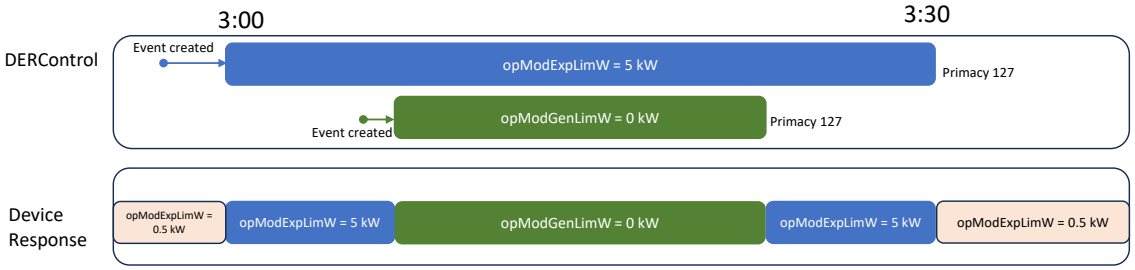


Expected device response to the tests

Test 4 (Multi-FSA, Multi-Program, Multi-Controls)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA1	Top-Level Topology	127		opModGenLimW
FSA2	Non-Topology	127		opModExpLimW

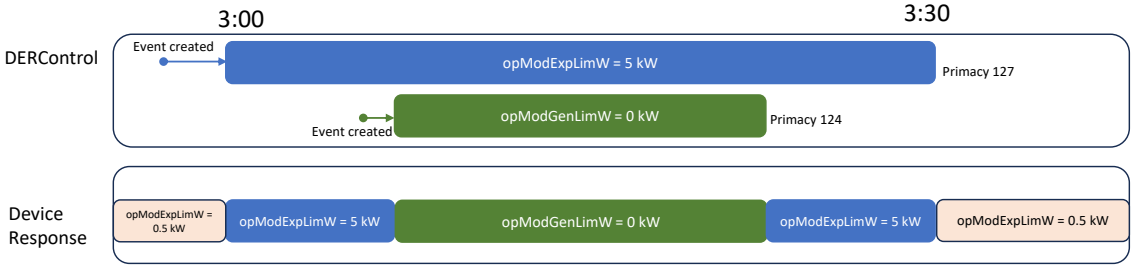


t) For DERControls, differing controls (e.g., opModTargetVar, opModTargetW) within DERControl *Events* are independent and are allowed to overlap or nest without superseding. If multiple controls are identified for a DERControl *Event*, future DERControl *Events* for an individual control (or a subset of the original *Event*) that cause an *Overlapping Event* will supersede the original *Event* strictly for that control (or a subset of the original *Event*). Note: Rule f) applies to all *Overlapping Events*.

Test 5 (Multi-FSA, Multi-Controls)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	opModGenLimW
FSA2	Non-Topology	127		opModExpLimW



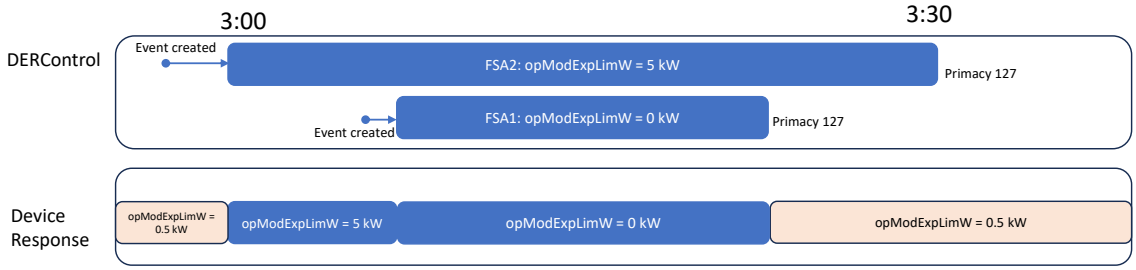
t) For DERControls, differing controls (e.g., opModTargetVar, opModTargetW) within DERControl *Events* are independent and are allowed to overlap or nest without superseding. If multiple controls are identified for a DERControl *Event*, future DERControl *Events* for an individual control (or a subset of the original *Event*) that cause an *Overlapping Event* will supersede the original *Event* strictly for that control (or a subset of the original *Event*). Note: Rule f) applies to all *Overlapping Events*.

Expected device response to the tests

Test 6 (Multi-FSA, Multi-Program, Same Control)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	
FSA1	Top-Level Topology	127		opModExpLimW
FSA2	Non-Topology	127		opModExpLimW



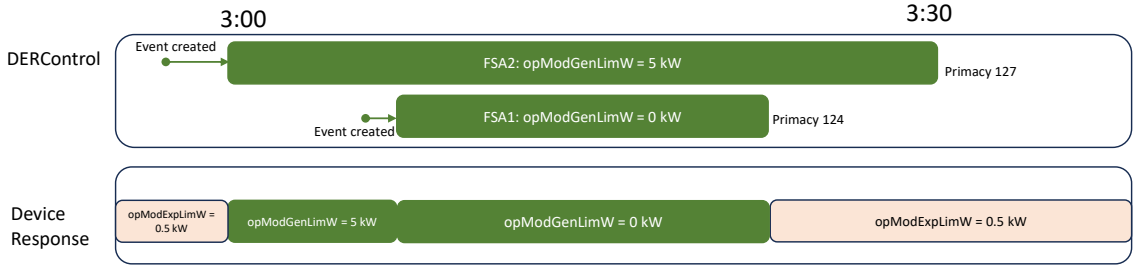
e) A client SHALL consider the current *Event* complete if a superseding *Event* is started.

f) When comparing two *Nested Events* or *Overlapping Events* from servers with the same primacy, the creationTime element SHALL be used to determine which *Event* is newer and therefore supersedes the older. The *Event* with the larger (e.g., more recent) creationTime is the newer *Event*.

Test 7 (Multi-FSA, Same Control)

DefaultDERControl: opModExpLimW = 0.5 kW Primacy 124

FSA	DERProgram	Primacy	DefaultDERControl	DERControl
FSA1	NMI Topology	124	opModExpLim = 0.5 kW	opModGenLimW
FSA2	Non-Topology	127		opModGenLimW



e) A client SHALL consider the current *Event* complete if a superseding *Event* is started.

f) When comparing two *Nested Events* or *Overlapping Events* from servers with the same primacy, the creationTime element SHALL be used to determine which *Event* is newer and therefore supersedes the older. The *Event* with the larger (e.g., more recent) creationTime is the newer *Event*.

Clients SHALL determine the primacy of DRLC and DER Control based on the following in order of precedence:

a) Servers SHALL indicate their primacy in the primacy element of the function set instance. See schema (IEEE Std 2030.5 supplemental material) definition of PrimacyType for possible values.

b) Clients SHALL prioritize execution of DRLC and DER function set *Events* with different PrimacyType attributes using the following guidelines:

1) 0 supersedes 1
2) 1 supersedes 2
3) 2 supersedes 3
4) If two instances are received with the same priority, then normal Event Rules and Guidelines apply (e.g., superseding based on scheduling).

C1 Onboarding in Production Environment (out-of-band)

Document Type	Document Description	Document
Work Instructions	Detailed Work Instructions for Internal JEN team on how Sign a CSR and Download a Certificate for an Aggregator in DigiCert	Internal-Work Instructions_Issuing
Work Instructions	Detailed Work Instructions for Internal JEN team on how to Register an Aggregator in Kitu (Utility Server)	Internal-Work Instructions_Registe
Work Instructions	Detailed Work Instructions for Internal JEN team on how to download the Root Certificate (SERCA) from DigiCert Platform. This is for the Direct Model OEM's certificates to be configured in Kitu (Utility Server) (if required)	Internal- Work Instructions_Downlo
Production : CA Naming Form	Production Environment's CA Naming Form to be sent to Direct Model OEM's	PRODUCTION CERTIFICATION AUT
Non-Production : CA Naming Form	Non-Production Environment's CA Naming Form to be sent to Direct Model OEM's	NON-PRODUCTION CERTIFICATION AUT