Pacific Gas and Electric Company (PG&E)
Southern California Edison Company (SCE)
San Diego Gas and Electric Company (SDG&E)

Instruction Sheet for Standards and Required Tests for Equipment to Be Certified for Interconnection under Rule 21

Version 6/5/2025

Disclaimer: PG&E, SCE and SDG&E (Utilities or IOUs) provide this Instruction Sheet for developers, industry organizations, equipment manufacturers and interconnection customers as a reference for understanding the certification requirements of equipment used for generating facilities connected to the Utilities' electrical grids. This Instruction Sheet does not supersede or replace any requirement in the Utilities' Rule 21 tariffs or other interconnection requirements from the hosting Utility.

Unless otherwise noted, all references to standards, Rule 21, applicable Interconnection Handbooks, and other governing documents are to documentation published as of the date of this version of the Instruction Sheet.

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Main References

PG&E:

- *PG&E's Electric Rule 21 Tariff*
- *Transmission and Distribution Interconnection Handbooks*
- *Greenbook Manual*
- *UL 1741 SB CSIP Requirements*
- *Advice Letters*
- *For more information, visit PG&E's Interconnections page*

SCE:

- *SCE's Electric Rule 21 Tariff*
- *Electric Service Requirements*
- *Interconnection Handbook*
- *NEM/NBT Interconnection Handbook*
- *Advice Letters*
- *For more information, visit SCE's Interconnections page*

SDG&E:

- *SDGE's Electric Rule 21 Tariff*
- *Transmission Interconnection Handbook*
- *Distribution Interconnection Handbook*
- *Advice Letters*

List of Acronyms:

Acronyms and Abbreviations	
AC	Alternating Current
ATL	Authorized Test Laboratory
CALSSA	California Solar and Storage Association
CEC	California Energy Commission
CPUC	California Public Utilities Commission
CRD	Certification Requirements Decision
CSIP	Common Smart Inverter Profile (a.k.a. *IEEE 2030.5 Implementation Guide for Smart Inverters*)
DC	Direct Current
DER	Distributed Energy Resource(s)
ESS	Energy Storage System
EVSE	Electric Vehicle Supply Equipment
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ILAC	International Laboratory Accreditation Cooperation
ISO	International Organization for Standardization
MASH	Multifamily Affordable Solar Housing
MOLRT	Maximum Open Loop Response Time
MRA	Mutual Recognition Arrangement
NEM/NBT	Net Energy Metering / Net Billing Tariff
NEMFC	Net Energy Metering – Fuel Cell
NEMV / NBTV	Net Energy Metering Virtual / Net Billing Tariff Virtual
NRTL	Nationally Recognized Testing Laboratory
OEM	Original Equipment Manufacturer(s)
OSHA	Occupational Safety and Health Administration
PCS	Power Control System(s)
PG&E	Pacific Gas and Electric
PKI	Public Key Infrastructure
PTO	Permission To Operate
PV	Photovoltaic System
RES-BCT	Renewable Energy Self-Generation Bill Credit Transfer
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric

Acronyms and Abbreviations	
SRD	Source Requirement Document(s)
SOMAH	Solar on Multifamily Affordable Housing
UL	Underwriters Laboratories
V1G	Unidirectional Vehicle Charging
V2G	Vehicle-to-Grid (bidirectional charging/discharging)
VGI	Vehicle Grid Integration

Section 1. Rule 21 Certification and Testing Standards

Standard (Testing)	Applicable Rule 21 Topic / Interconnection Option	Comments
UL 1741 or UL 1741 SA	• Section Mm. Inadvertent Export • Section Hh. Smart Inverter (requires UL 1741 – SB, see below)	UL 1741 or UL 1741 Supplement A (UL 1741 SA) are required for all applications using inverter-based technology. *Note: Refer to Section 2.6 for an exemption currently provided for V2G DC electric vehicle supply equipment (EVSE).*
UL 1741 SB	• Section Hh. Smart Inverter Generating Facility Design and Operation Requirements	Required for all applications using *Smart Inverter* based technology. The inverter requirements are intended to be consistent with UL 1741 Supplement B (UL 1741 SB) using as the source requirement document ANSI/IEEE 1547-2018 and IEEE1547.1-2020 standards. *Note: Refer to Section 2.6 for an exemption currently provided for V2G DC electric vehicle supply equipment (EVSE).*
IEEE 2030.5	• Section Hh. Communications requirements for Smart Inverters	Required for all applications using *Smart Inverter* based technology. The default application-level protocol shall be IEEE 2030.5 as defined in the latest version of the Common Smart Inverter Profile (CSIP, a.k.a *IEEE 2030.5 Implementation Guide for Smart Inverters*). Inverters can be certified directly with CSIP or shown to be compatible with a CSIP certified gateway (refer to *IEEE 2030.5 Implementation Guide for Smart Inverters*). **Note**. As of the date of this Instruction Sheet, IEEE is leading updates to the *IEEE 2030.5 Implementation Guide for Smart Inverters*. The SunSpec Alliance is leading updates to the CSIP Test Procedures.
UL PCS Certification Requirements Decision (CRD) issued on March 8, 2019	• Section Mm1, Option 8: Non-Export • Section Mm2, Option 9: Limited Export using certified PCS • Section Mm3, Option 10: Non-Export with Inadvertent Export using PCS • Section Mm4, Option 11: Limited Export with Inadvertent Export using PCS	Currently required for all proposed power control systems (PCS) to provide the functionality required under the Rule 21 sections listed. **Note**. The CRD for PCS contains tests to assess a set of PCS functionalities not previously addressed in UL 1741. * Refer to the footnote below this table for additional information.

Standard (Testing)	Applicable Rule 21 Topic / Interconnection Option	Comments
UL 3141 Issue 2 published on October 9, 2024 *	• Section Mm5, Option 12: Limited Export with Limited Generation Profile Utilizing Certified Power Control Systems	**Note**. Section Mm5 Option 12 is required for Limited Generation Profile projects (per Resolution E-5296). Section Mm5 Option 12 is provided in Joint Advice Letter SCE 5424-E-A, PG&E 7435-E-A and SDG&E 4554-E-A, dated 2/28/2025, and was approved by CPUC Energy Division on March 26, 2025. An upcoming Advice Letter process will formalize this language in Rule 21.
Non-Inverter Technologies and Non-certified Equipment	• Section H – Non-Inverter technologies	The applicable Interconnection Handbook (as available from the hosting utility for the specific type of project) describes the requirements for equipment for which standards are not applicable or not published yet (Non-Inverter based).
Section L of Rule 21 contains more standards related to testing and certifying interconnection equipment, such as those for surge protection, testing, and withstand capability.		

*** Note on UL PCS CRD**:

UL PCS CRD now points to UL 3141. UL 3141 Issue 2 has incorporated the guidance of the UL PCS CRD. Rule 21 Sections Mm1 through Mm4 still refer to the UL PCS CRD. A future Rule 21 filing is expected to update Sections Mm1 through Mm4 to refer directly to UL 3141 rather than indirectly via the existing UL PCS CRD reference.

PCS equipment is expected to be certified to the applicable UL PCS standard available at the time of certification. Devices certified to the UL PCS CRD do not need to recertify to UL 3141, unless a use case specifically requires UL 3141 compliance (i.e., some use cases can still employ the CRD, some use cases must now use PCS certified to UL 3141 Issue 1, and some use cases, such as integrated scheduling for LGP, must now use PCS certified to UL 3141 Issue 2).

Section 2. Certification Process

Section 2.1. Certification Requirements for Grid Support Solar Inverters, Grid Support Battery Inverters, and Energy Storage Systems

For solar and battery inverters (external) and energy storage systems (inverter-incorporated), in accordance with California Public Utilities Commission (CPUC) Resolutions E-5000[1] and E-5036[2], the Utilities require interconnection applicants to use UL 1741 Supplemental B (UL 1741 SB) certified inverters as well as support conformance with the Common Smart Inverter Profile (CSIP, a.k.a. *IEEE 2030.5 Implementation Guide for Smart Inverters*)[3].

UL 1741 SB Tests

UL 1741 SB[4] is a supplement to the UL 1741 safety standard and includes testing for grid support utility-interactive inverters and converters. UL 1741 SB is the product testing standard that is used to evaluate compliance with the IEEE 1547-2018 and the IEEE 1547.1-2020 standards. UL 1741 SB includes type testing and interoperability testing requirements. For the interoperability testing, UL 1741 SB is used to validate conformance to IEEE 1547-2018 interoperability requirements (managing and monitoring) with one of the three defined protocols (IEEE 2030.5, SunSpec Modbus, IEEE 1815 DNP3).

Rule 21 Table L.1 lists the test criteria requirements (with generator type or inverter technology as applicable to each test) as well as the relevant testing or certification standard that each test needs to be conducted under. While UL 1741 and UL 1741 Supplement A (UL 1741 SA) were written specifically for inverters, the requirements are readily adaptable to synchronous generators, induction generators, as well as single/multi-function controllers and protection relays.

Required Documentation:

- UL 1741 Certification:
  - Certification to UL 1741 (3rd Edition) standard including UL1741 SB, issued by a NRTL.

CSIP Tests

On December 5, 2019, the Commission issued Resolution E-5036 to clarify the testing requirements for smart inverter Phase 2 communications. Appendix D of Resolution E-5036 laid out a revised version of CSIP testing requirements. In the "Approved Testing Pathway," Resolution E-5036 notes that a Nationally Recognized Testing Laboratory (NRTL) "should test conformance gateways to IEEE 2030.5 in accordance with the [SunSpec CSIP Test Procedures]."[5] The Approved Testing Pathway defines which specific SunSpec CSIP Test

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1 Resolution E-5000: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M309/K713/309713654.PDF

2 Resolution E-5036: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M321/K596/321596742.PDF

3 CSIP ver. 2.1: https://sunspec.org/wp-content/uploads/2019/08/CSIPImplementationGuidev2.103-15-2018.pdf

4 https://www.shopulstandards.com/ProductDetail.aspx?productId=UL1741_3_S_20210928

5 Resolution E-5036 at 22.

Procedures[6] should be performed. Please refer to the Approved Testing Pathway attached as Appendix B to this Instruction Sheet for more information.

Note: Per Resolution E-5357[7], the IEEE is now the agency responsible for future updates to the CSIP and SunSpec will continue to steward its CSIP Test Procedures (which were originally published in 2018).

Required Documentation:

- Phase 2 Communications (CSIP) Certification via one of the following methods:
  - When using an aggregator or a CSIP certified gateway for communications with Utility: Attestation of an inverter communicating with a CSIP certified aggregator/gateway[8] from a NRTL.
    - For inverters that are not certified to IEEE 2030.5 at the level of the inverter, each inverter model or family of models will demonstrate compliance with the Phase 2 communication requirements via compatibility testing in conjunction with a CSIP-certified aggregator/gateway as established in Resolution E-5000 and as modified in Resolution E-5036 (see Appendix B "Approved Testing Pathway" to this Instruction Sheet).
    - Inverters must be tested and attested to receive commands from a gateway, aggregator, or energy management system that conforms to IEEE 2030.5 and CSIP.
    - The language between the inverter and the aggregator/gateway can be proprietary as long as the aggregator/gateway meets CSIP requirements.
    - Attestation may be provided by the UL 1741 SB Certification if the inverter is tested and attested to receive commands from a gateway, aggregator, or energy management system that conforms to IEEE 2030.5 and CSIP as part of the process.
  - When using direct communication between Utility and inverter:
    - Inverter-level CSIP Certification provided by one of the following:
      - A NRTL, which can certify testing results from itself or another NRTL.[9]
      - The Sunspec Alliance, which can certify testing results from a SunSpec Alliance Authorized Test Laboratory (ATL).

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6 SunSpec CSIP Test Procedures: https://sunspec.org/ieee-2030-5-csip-certification/

7 Resolution E-5357: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M551/K523/551523428.PDF

8 A "gateway" is anything other than the Distributed Energy Resource (DER) that provides a communications interface to the hosting utility for the purposes of exchanging the content contained in the communications with one or more DERs.

9 Having a SunSpec CSIP Certification is required to get onto the SunSpec 2030.5 Public Key Infrastructure (PKI). This may be required for certain programs and is optional for others. If an entity opts for an alternative PKI solution, they must ensure it meets the security standards outlined by the Utility's interconnection requirements and the CSIP guidelines. For questions related to this, reach out to the specific Utility's contact information provided in Section 4.

Section 2.2. Power Control System (PCS) Certification (UL CRD, UL 3141 Issue 2, or latest UL PCS Standard)

As stated in the footnote of the Rule 21 Certification and Testing Standards listed in Section 1 above, as of the date of this Instruction Sheet, Rule 21 Sections Mm1 through Mm4 refer to Underwriters Laboratories (UL) PCS Certification Requirements Decision (CRD) issued on March 8, 2019. It is expected that in a future update of Rule 21, the Utilities will clarify the applicability of UL PCS CRD, UL 3141 Issue 2, or a later UL PCS standard. Rule 21 Section Mm5 (OPTION 12: Limited Export with Limited Generation Profile Utilizing Certified Power Control Systems)[10] refers only to UL 3141 Issue 2 which is required for Limited Generation Profile projects (per Resolution E-5296[11]).

For power control systems, the following are required:

Required Documentation:

- Certificate of Compliance with UL PCS CRD, UL 3141 Issue 2, or the latest UL PCS Standard, as applicable, issued by a NRTL.
- Manufacturer's Equipment Information and Instructions Document (as required by the UL PCS CRD, UL 3141 Issue 2, or latest UL PCS standard, as applicable).

Information Needed in the UL PCS CRD, UL 3141 Issue 2, or latest UL PCS Standard (as applicable) Test Report:

- Signed or stamped and dated by NRTL whose OSHA Scope of Recognition includes UL PCS CRD, UL 3141 Issue 2, or latest UL PCS standard, as applicable.
- Indicates the applicable standard (UL PCS CRD issued on March 8, 2019, UL 3141 Issue 1 published on January 11, 2024, UL 3141 Issue 2 published on October 9, 2024, or later UL PCS standard).
- Specifies the requested model number(s), if applicable.
- Defines all the wildcards in the requested model number(s).
- Specifies all the additional devices required and tested for PCS functionality
  - Accepted PCS equipment includes the "Additional Required PCS Devices" column information added to the model entry.
- Defines all wildcards in the model number of any required additional devices.
- Specifies all the ESS or PV Operating Modes that were tested and certified.
- Specifies the maximum open loop response time for each certified mode **.
  - Measured by Max Open Loop Response Time (MOLRT). To comply with NEM Integrity and Options Mm1 through Mm4 in Rule 21, the following modes are analyzed:

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[10] Section Mm5 is a new Rule 21 section introduced by Resolution E-5296. As of the date of this Instruction Sheet, Section Mm5 is expected to be incorporated into Rule 21 with an effective date of July 9, 2025. See Joint Advice Letter SCE 5424-E-A, PG&E 7435-E-A and SDG&E 4554-E-A, dated 2/28/2025, for text of Section Mm5.

[11] Resolution E-5296: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M527/K981/527981713.PDF
Resolution E-5296 Appendices: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M527/K964/527964265.pdf

- Unrestricted Mode: 10 seconds or less in MOLRT
- Export Only Mode: 10 seconds or less in MOLRT (CRD - NEM)
- Import Only Mode: 10 seconds or less in MOLRT (CRD - Limited Export); or 2 second or less in MOLRT (CRD - Non-Export)
- No Exchange Mode: 10 seconds or less in MOLRT

Information Needed in the "Manufacturer's Equipment Information and Instructions Document":

- Issued by the inverter or ESS manufacturer.
- Submitted on company letterhead.
- Includes all the requested model number(s).
- Identifies the equipment's "current measurement reference point."
- Includes all the required information specified in the UL CRD, UL 3141 Issue 2, or latest UL PCS standard, as applicable.

Note: Refer to UL 3141 for information on required physical markings of the PCS device to demonstrate certification, details needed to be included in the PCS installation instructions, and other specifics.

Section 2.3. PV Modules

Required Documentation:

- NRTL safety certification to UL 61730 from a NRTL whose OSHA Scope of Recognition includes the UL 61730 standard.
  - Signed or stamped and dated by the testing lab. A current list of NRTLs approved by OSHA, along with their recognized scopes, can be found on the OSHA website.
  - Refer to the CEC's Listing Request Instructions Page 3 of 8 Revised 11/3/2023: https://www.energy.ca.gov/sites/default/files/2023-05/PV_Module_Listing_Request_Instructions_ADA.pdf
  - Refers to subsections 10.2, 10.4, 10.5, 10.6, and 10.7 of IEC 61215:2005 (crystalline) or IEC 61646:2008 (thin film) and includes data for:
    1. NOCT
    2. Temperature coefficients (αIsc, βVoc, γPmax)
    3. Performance at STC
    4. Performance at Low Irradiance
    5. Performance at NOCT
  - Specifies the model number(s) tested.
  - Specifies all the model numbers that the test results can be applied to.
  - Reports test data without the impact of any integrated optimizer
- International Laboratory Accreditation Cooperation (ILAC) accredited lab's test report(s) for IEC 61215:2005 (Crystalline) or IEC 61646:2008 (Thin Film).

Note: Do not submit any proprietary or confidential information. (Optional)

Minimum Criteria for Safety Certification:

The safety certification(s) document must meet the requirements outlined below.

a) Signed or stamped and dated by NRTL whose OSHA Scope of Recognition includes the UL 61730 standard (both –1 and –2 sections).
b) Indicates the UL 61730 standard (both –1 and –2 sections) and Source Requirement Documents (SRDs) for the test.
c) Specifies the requested model number(s) certified.
d) Defines all the wildcards in model number(s).

Minimum Criteria for Performance Data Test Report(s):
The testing lab must meet the following qualifications:

a) The laboratory is accredited to ISO/IEC 17025.
b) The accreditation must be from an accreditation body that is a signatory to the ILAC Mutual Recognition Arrangement (MRA).
c) The scope of accreditation must include IEC 61215 or IEC 61646, whichever is applicable. The performance test report must meet the requirements outlined below.

Section 2.4. Batteries: Only electrochemical batteries

Required Documentation:

- NRTL certification(s) to UL 1973.
- Manufacturer's spec sheet(s) for all the requested model number(s).

Note: Do not submit any proprietary or confidential information.

Minimum Criteria for Safety Certification:
The certification(s) must meet the requirements outlined below.

a) Signed or stamped and dated by NRTL.
b) Indicates the UL 1973 standard and Source Requirement Documents (SRDs) for the test.
c) Specifies the requested model number(s) certified.
d) Defines all the wildcards in model number(s).

Section 2.5. AC Disconnect

Required Documentation:

- Manufacturer's spec sheet(s) for all the requested model number(s).

Note: Do not submit any proprietary or confidential information.

Section 2.6. Special Certification Requirements for V2G DC Equipment

Certification for Vehicle to Grid (V2G) equipment is not explicitly stated in Rule 21; however, the underlying requirements for V2G equipment using smart inverters to connect to a customer's site and operate in parallel with the Utilities' grid generally follows the certification requirements listed in Section 1 of this Instruction Sheet.

In anticipation for potential extreme weather events in the summers of 2022 and 2023, on December 6, 2021, the CPUC issued Decision (D.) 21-12-015 which expanded the Emergency Load Reduction Program (ELRP) created by the Commission on D.21-03-056 (issued March 26, 2021). D.21-12-015 expanded the ELRP on electrical vehicle participation by allowing aggregation of V2G managed charging and discharging to support the grid at net peak. The Vehicle-Grid-Integration (VGI) aggregation consists of any combination of electric vehicles and charging stations – including those that are capable of managed one-way charging (V1G) and bi-directional charging and discharging (V2G) deployed with residential or non-residential customers that meets certain criteria.

To support electric vehicle participation in the ELRP, D.21-12-015 provided for an exemption for any direct current (DC) V2G electric vehicle supply equipment (EVSE) that has UL 1741 certification (but not UL 1741 SA certification, any subsequent UL 1741 supplement certification required in Rule 21, or Smart Inverter Working Group-recommended smart inverter functions) to interconnect initially for the purpose of participating in the ELRP, subject to all other Rule 21 interconnection requirements.

For more information about the ELRP, as well as each Utility's implementation of the ELRP and their requirements for participation, please visit the following pages:

CPUC: *https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-costs/demand-response-dr/emergency-load-reduction-program*

PG&E: *https://elrp.olivineinc.com/*

SCE: *https://elrp.sce.com/*

SDG&E: *https://www.sdge.com/businesses/savings-center/energy-management-programs/demand-response/emergency-load-reduction*

Further details on V2G direct current (DC) (set to unidirectional mode) are available in Advice Letter 6500-E (PG&E), Advice Letter 3955-E (SDG&E), Advice Letter 4718-E (SCE) dated February 11, 2022, submitted in response to Resolution E-5165.

Section 2.7. Non-Inverter Technologies

The applicable Interconnection Handbook (as available from the hosting Utility for the specific type of project) describes the requirements for equipment for which standards are not applicable or are not published yet (non-inverter based).

Section L of Rule 21 contains more standards related to testing and certifying interconnection equipment, such as those for surge protection, testing, and withstand capability.

Section 2.8. Testing and Certification Resources:

The list of approved NRTLs to perform certification for some or all the standards is listed at the *OSHA's Nationally Recognized Testing Laboratory (NRTL) Program*:

https://www.osha.gov/nationally-recognized-testing-laboratory-program
https://www.osha.gov/nationally-recognized-testing-laboratory-program/current-list-of-nrtls

Other links:

- List of Recognized Testing Standards: https://www.osha.gov/nationally-recognized-testing-laboratory-program/list-standards
- IEEE Standards Association: https://www.ieee.org/
- SunSpec Alliance: https://sunspec.org/

Section 3. Utilities' Lists of Certified Equipment

Once the equipment is tested and certified, certified equipment needs to be added to each utility's list of certified equipment so that it can be selected by the applicant for the initial and subsequent submittal of their interconnection request.

Interconnection equipment that is certified will be added to the Utilities' list of certified equipment in 1 of 2 ways, as outlined below:

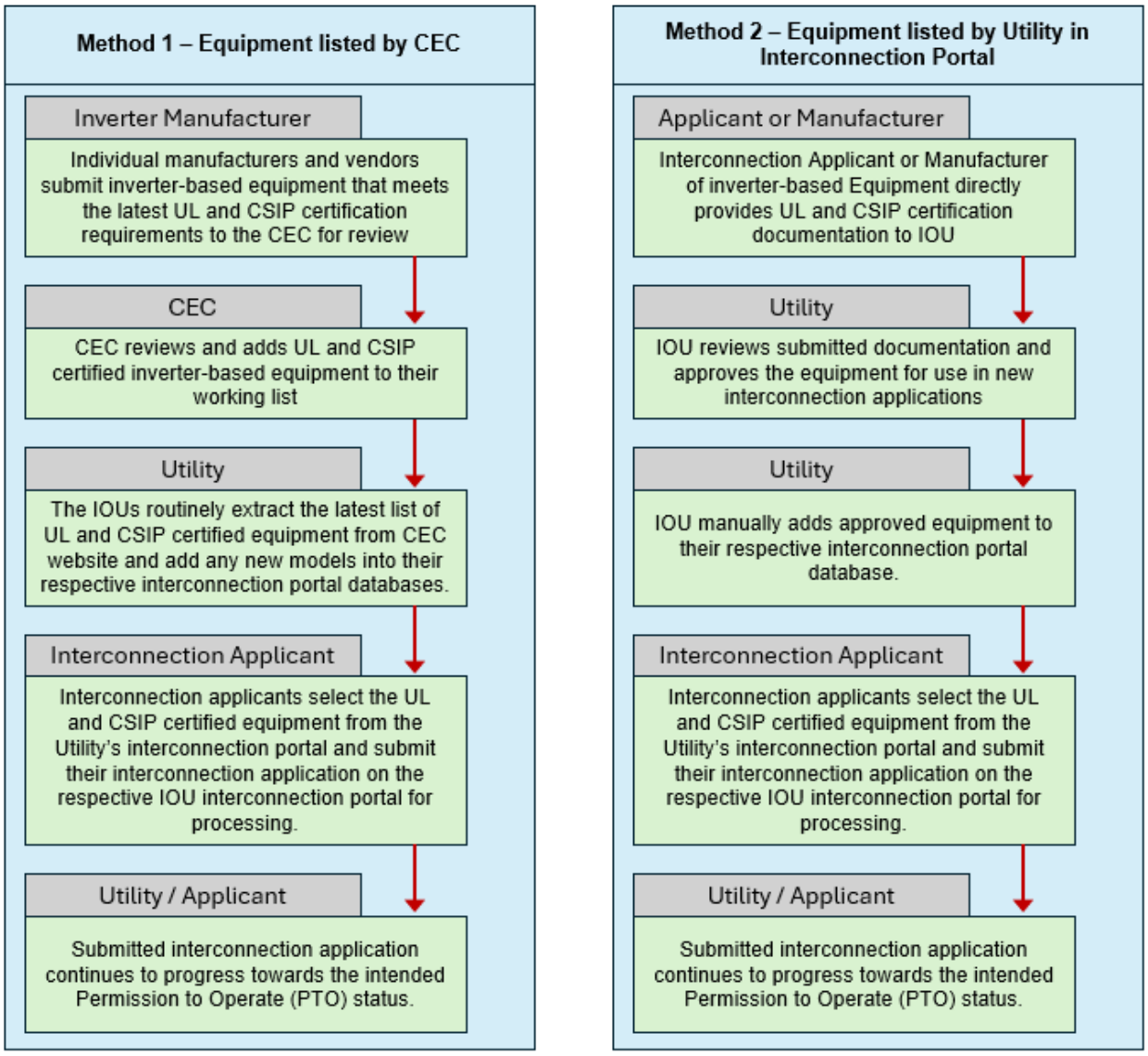
1. Importing inverter-based equipment from the CEC website
   a) Individual manufacturers and vendors submit inverter-based equipment that meets the latest UL and CSIP certification requirements to the CEC for review.
   b) CEC reviews and adds UL and CSIP certified inverter-based equipment to their working list.
   c) The Utilities routinely extract the latest list of UL and CSIP certified equipment from CEC website and add any new models into their respective list of certified equipment.
      Note: Only equipment indicating a "Y" in the "UL 1741 SB Certification, 3rd Edition" column, and either a "Y" or "Y*" in the "Common Smart Inverter Profile Conformance, CSIP" column will be added to the Utilities' list.
   d) Interconnection applicants select any UL and CSIP certified equipment (from the applicable Utility list of certified equipment) and submit their interconnection application on the applicable Utility interconnection portal for processing.[12]
   e) Submitted interconnection application continues to progress towards the intended Permission to Operate (PTO) status.

2. Manually adding inverter-based equipment currently not on CEC website
   a) Interconnection applicant or manufacturer of inverter-based Equipment directly provides UL and CSIP certification documentation of inverter-based equipment to hosting Utility.
   b) The applicable Utility reviews submitted UL and CSIP certification documentation and approves the equipment for addition to their respective list of certified equipment moving forward.

[12] For interconnection applicants wishing to use a UL 1741 or UL 1741 SA certified inverter intending to participate in the Electric Load Reduction Program (ELRP) , contact the utility directly using the information provided in Section 4.

c) The Utility manually adds approved equipment to their respective list of certified equipment.
d) Interconnection applicants select any UL and CSIP certified equipment (from the applicable Utility list of certified equipment) and submit their interconnection application on the applicable Utility interconnection portal for processing.
e) Submitted interconnection application continues to progress towards the intended Permission to Operate (PTO) status.

A chart demonstrating this process is provided below.



For Energy Storage Systems follow the same processes and requirements as above. If using the CEC listing method, only applications indicating a "Y" in the "UL 1741 SB Certification, 3rd Edition" column, and either a "Y" or "Y*" in the "Common Smart Inverter Profile Conformance, CSIP" column will be accepted.

For PV Modules: UL 61730 standard column indicated.

For Batteries: (The Battery List only includes electrochemical batteries): UL 1973 standard column indicated.

Further Documentation:

The CEC as well as the Utilities provide instructions on the documentation required to be submitted for their certification review.

- CEC:
  - Solar Equipment Lists Program https://www.energy.ca.gov/programs-and-topics/programs/solar-equipment-lists
  - Inverter Listing Request Instructions https://www.energy.ca.gov/sites/default/files/2022-03/Inverter_Listing_Request_Instructions_ADA.pdf

- PG&E
  - PG&E Interconnection website
  - PG&E Instructions for Inverter Information Submittal
  - PG&E Inverter Information Form

- SCE:
  - Interconnecting Generation under Rule 21
  - Instructions Sheet
  - Inverter Information Submittal

- SDG&E
  - SDG&E Rule 21 Interconnection website

Section 4. Utilities' Contact Info

Section 4.1. Certified Equipment Lists and Other Standards Questions

For information regarding Rule 21 standards requirements and certified equipment lists, please refer to the following:

- PG&E

  Please contact EGIEquipmentCertification@pge.com for any questions related to Rule 21 equipment standard requirements.

  Inquiries and certification submissions are reviewed and responded to in order of receipt. Certification submissions lacking complete documentation will not be reviewed and will be returned to the sender for revision. PG&E aims to review packages and provide approval within 30 business days of receiving a complete package. This time frame may vary based on request volume.

- SCE:

  Please send all documentation for review/listing of certified equipment to VerifyInverters@sce.com. Requests for review of certified equipment will be processed in the order they are received.

  For questions regarding applicability of standards to Rule 21, standards development or new proposed alternate standards, please contact Roger Salas (roger.salas@sce.com).

- SDG&E

  For any questions relating to Rule 21 standards requirements, please contact the lead engineer for Customer Generation, who can be contacted at the following contact email address: Netmetering@sdge.com

  Inquiries and certification submittals will be processed in the order in which they are received. Those submittals which are deemed incomplete by Customer Generation will be sent back to the sender for follow up, as required to satisfy all requirements. The timing for a completed request will vary on other competing requests.

Section 4.2. Other Relevant Contact Information Regarding Interconnections

Each utility maintains various email addresses or web content with useful information on interconnection processes or program information. The following are some additional useful contact information (not intended to be exhaustive):

- PG&E

  For questions about your application, please contact the relevant email address and or visit the PG&E Interconnection website: PG&E Interconnections

Project Type	Description	Mailbox
Standard NEM	Solar, wind, or hybrid (solar and wind) generators ≤ 30 kW	NEMfollowups@pge.com
Standard NEM Paired Storage	Solar, wind, or hybrid (solar and wind) generators ≤ 30 kW with Energy Storage ≤ 10 kW	SNEMPairedStorage@pge.com
Complex Rule 21	All other Rule 21 Interconnection Programs	Rule21Gen@pge.com

- SCE:

  For all non-NEM/NBT applications, SCE assigns a project manager who should be the primary point of contact to address questions about your project. For NEM/NBT projects (including virtual networks), please refer to the contact information provided in the PowerClerk Interconnection portal or email SolarBillingPlan@sce.com.

- SDG&E

  For more information or assistance with your application, email our Customer Generation team at DGInquiries@sdge.com.

  Inquiries and certification submittals will be processed in the order in which they are received. Those submittals which are deemed incomplete by Customer Generation will be sent back to the sender for follow up, as required to satisfy all requirements. The timing for a completed request will vary on other competing requests.

  To address any disputes regarding Rule 21 missed timelines, please contact SDG&E's appointed ombudsman at rule21.ombudsman@semprautilities.com.

Section 5. Rule 21 Testing Requirements

Rule 21, Section L (Certification and Testing Criteria) describes the test procedures and requirements for equipment used for the interconnection of generating facilities to the Utilities' transmission or distribution system. This section provides information about some of these tests (Type Testing, Production Testing, Commissioning Testing, and Periodic Testing). Please refer to Rule 21 for the complete set of requirements for each of these tests.

Section 5.1. Type Testing

Type Testing refers to a one-time test performed on a sample of a particular model of a device to verify specific aspects of its design, construction and performance and its conformance with intended standards. The complete set of requirements for Type Testing is described in Rule 21 Section L.3.

The guidelines provided in Appendix A (*Guidelines for Rule 21 Section L.7 - "Type Testing Procedures Not Defined in Other Standards*) were developed during 2024 to clarify helpful and efficient practices for qualifying equipment as "Certified Equipment," as defined under Rule 21 Section L.2.a, for which certification national standards have not been published for such piece of equipment. These guidelines also appear on each utility web site along with utility contact person information for equipment manufacturers seeking to communicate with a utility about Rule 21 Section L.7 type testing.

The Energy Division maintains a public list of contact persons for equipment manufacturers, who are points of contact for type testing, should a utility or interconnection customer need to contact a manufacturer about their equipment.

List of OEM Contacts for Type Testing Purposes

Any manufacturer whose equipment may be subject to type testing can submit an email request be added to the list or update an existing entry. Email IxDE@cpuc.ca.gov with company name, contact person name, title/role, and email.

Section 5.2. Production Testing

Production Test is a test performed on each device coming off the production line to verify certain aspects of its performance. Production Tests are not conducted by the Utilities as these are only done during the manufacturing stage of the devices.

Requirements for Production Testing are described in Rule 21 Section L.4.

Section 5.3. Commissioning Testing

Commissiong Test is a test performed during the commissioning of all or part of a generating facility to achieve one or more of the following: (a) verify specific aspects of its performance; (b) calibrate its instrumentation; or (c) establish instrument or protective function set-points.

Requirements for Production Testing are described in Rule 21 Section L.5.

Commissioning Tests are always required but the Utilities may waive attendance to the test for non-complex projects.

The processes for completing Commissioning Tests are described in the applicable Utility's Interconnection Handbook:

- For projects in PG&E's service area, Commissioning Tests are outlined in PG&E's (Rule 21 tariff, Section F.5 and L.5) and Section G5.1 of the PG&E Transmission Interconnection Handbook.
- For NEM projects in SCE's service area, please refer to SCE's NEM Interconnection Handbook, 2022 edition, Section 3.2.
- For project in SDGE's service area, Commissioning Tests are outlined in SDG&E's Distribution Interconnection Handbook, May 2018 edition, Section 6.3.

Section 5.4. Periodic Testing

Testing of interconnection-related protective functions and equipment (whose purpose is to protect against unsafe operating conditions) should be performed as specified by the manufacturer's operating instructions, and at least every four (4) years.

Requirements for Periodic Testing are described in Rule 21 Section L.6.

The Utilities normally do not witness periodic testing but may require information about periodic testing (such as testing logs).

Section 6. List of Interconnection Programs and Applicable Technology

The table below is a non-exhaustive list of the available interconnection programs. It outlines the technologies able to participate in the programs, as well as further requirements. Both inverter-based (smart inverters, when applicable) and non-inverter-based technologies can participate in all of the below programs.

Program	Description
Standard NEM/NBT	Solar, wind, or hybrid (solar and wind) generators ≤ 30 kW
Standard NEM/NBT Paired Storage	Solar, wind, or hybrid (solar and wind) generators ≤ 30 kW with Energy Storage ≤ 10 kW
Expanded NEM	Solar, wind, or hybrid generators ≤1MW
NEM Paired Storage	Solar, wind, or hybrid generators ≤1MW with Energy Storage > 10kW and ≤ 150% of NEM system size
NEM/NBT Aggregation	An eligible NEM/NBT system intended for multiple electric accounts on the same property as the renewable generator and/or on property contiguous or adjacent to that property where those properties are solely owned, leased, or rented by the same customer.
NEM/NBT Virtual	Solar, wind or hybrid generators with multiple Utility customers that are located on a cluster of multi-tenant and multi-meter buildings, facilities or structures that are under the control of a single Owner or Operator built to serve a common function, such as a housing complex or a multi-tenant complex, on an integral parcel of land undivided.
NEMV MASH	Same as NEM/NBT Virtual but only available to income-qualified housing projects with proof of MASH, NSHP, or LIWP program participation. Although MASH incentives are discontinued, interconnection of otherwise eligible systems is still available.
NEMV SOMAH	Same as NEM/NBT Virtual but only available to income-qualified housing projects with proof of SOMAH participation
Non-Export	All types of generator technologies and sizes where energy will not be exported to the Utilities' electric system
NEM Fuel Cell[1] (NEMFC)	Fuel cell generators ≤5MW. (discontinued for new projects)
NEM/NBT Multiple Tariff	Solar, wind, or hybrid generators ≤1MW with Energy Storage > 10kW and >150% of NEM system size or a combination of generating technologies with different tariff treatments
RES-BCT	Solar, wind, or hybrid generators ≤5MW for Local Government only

Section 7. Instruction Sheet Version History

Version	Publication Date	Description of Revision	SIWG Review	Other Comments
001	06/05/2025	First publication	06/05/2025	
002		□ Updates xxx □ Additions xxx □ Etc. xxx	xx/xx/xx	

Appendix A - Guidelines for Rule 21 Section L.7
"Type Testing Procedures Not Defined in Other Standards"

The following guidelines are relevant to Rule 21 Section L.7 to be used for qualifying equipment as "Certified Equipment," as defined under Rule 21 Section L.2.a, for which certification national standards have not been published for such piece of equipment.

1. A public-facing directory of primary Points of Contact at utilities and a list of Original Equipment Manufacturers (OEMs) should be published specifically for the purpose of facilitating engagement and communications pertaining to Type Testing[13]. Each utility should designate, and differentiate, if necessary, their Points of Contact for (i) Type Testing for equipment for which an interconnection application using the equipment has not been submitted, and (ii) Type Testing for equipment for which one or more interconnection applications using the equipment have already been submitted to the respective utility.

2. OEMs should seek to proactively enroll in the publicly available list of OEMs, via a subscription/un-subscription form managed by a single entity, to update their contact information and to include pending release of new products, product variants, use cases, or configurations. OEMs should be encouraged to maintain their information updated and to reach out to the utility contacts up to three to six months in anticipation of any upcoming interconnection requests proposing to use their products as to provide sufficient time for review, testing, and certification of new equipment or systems, as may be applicable.

3. OEMs should be proactive at reaching out to IOUs when they believe Type Testing will be required on any of their products. In any proactive outreach to utilities, OEMs should strive to provide relevant documentation regarding the new product, configuration, or use case to inform the utilities' review and testing determinations. Such documentation could include technical specifications; narrative descriptions of the role and function of the new product, configuration, or use case; suggested features or functionality that utilities might wish to test; and the OEM's anticipated or target dates for 1) NRTL testing and certification, 2) utility Type Testing, if needed, and 3) commercial availability. Utilities should acknowledge receipt of an OEM's outreach within 10 business days.

4. Utilities may at their discretion require Type Testing to test system-level functionality of non-certified equipment or for certified system for which individual system components may have been tested and certified by a NRTL to applicable standards (such as inverters), but system-level functionality may not have been explicitly tested and certified by a NRTL due to non-existence of applicable standards to test and certify the required system-level functionality.

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[13] The Energy Division maintains a public list of contact persons for equipment manufacturers, who are points of contact for type testing should a utility or interconnection customer need to contact a manufacturer about their equipment: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/rule21/list-of-oem-contacts-for-type-testing-purposes-03212025.xlsx

5. If a utility determines Type Testing is needed, either based on its own initiative, upon review of an interconnection application, or following OEM's outreach, the utility should make personnel available to engage the relevant OEM to communicate, discuss and determine the planning, development and execution of the Type Testing required. If the OEM proves incommunicative or cannot otherwise be engaged, the utility has the discretion to conduct the Type Testing requirements through coordination with the applicant customer or the installer. Completion of the Type Testing is required prior to approval of any interconnection application using the equipment (or the applicable functionality) that is the subject of the Type Testing.

6. If a utility determines Type Testing is required, the utility should inform the other utilities and offer them the opportunity to participate in the Type Testing activities, as to avoid redundant efforts, when permitted or allowed by the OEM, the installer, or the customer, as applicable.

7. Upon determination that Type Testing is required, the designated lead utility will schedule a "scoping meeting" with the OEM, installer, customer and other utilities, as applicable, to discuss and agree on Type Testing objectives, agree to test procedures, and coordinate the date, time, and location of the Type Test. The utility and OEM (or applicable parties) should develop and reach a consensus on finalized testing procedures prior to the scheduled date of testing in order establish transparency on how the certified equipment will be evaluated, and what the passing criteria will be during testing.

8. It is highly preferred to conduct Type Testing in the OEM's laboratory facilities (or laboratory arranged by the OEM) given the complex testing for normal and abnormal configuration/operations.

9. If field testing is required, or if laboratory testing is not possible, OEMs, in tandem with relevant third parties (installers, developers, contractors, etc.), should be responsible for identifying optimal field sites and/or host customers for testing. OEMs should then work in tandem with utilities and third parties to communicate test schedules and procedures with the host and oversee test activities.

10. Nothing in these guidelines inhibits the discretion of utilities to require new or additional Type Testing for similar or related products or features, or to adjust testing plans as new information arises.

11. Type Testing experience with new products could be brought by utilities to the attention of CPUC Energy Division staff if, in the opinion of the utility, discussion with stakeholders on any specific categories of products, configurations, or system-level functionalities that are not covered by existing standards could bring value on Type Testing procedures to be performed in the future.

Appendix B – Approved Testing Pathway For Phase 2 Communications Requirements

***NOTE**: Originally this "Testing Pathway" was introduced in Resolution E-5000, issued July 12, 2019. In Resolution E-5036, issued December 6, 2019, the Commission made minor changes to the original "Testing Pathway". This Appendix B is the clean version of the Testing Pathway as approved in Resolution E5036 Appendix D.*

In order to make the direction of the Commission explicit, we detail the approved testing pathway for the Phase 2 communications requirements below. The IOUs shall implement the smart inverter Phase 2 requirements as described by CALSSA in the Petition[14] and as reiterated herein.

This appendix is intended for use in conjunction with the testing specifications proposed in the Petition. However, where any discrepancies arise, this appendix governs. Where this language allows for multiple interpretations, it should be read in the manner most consistent with the interoperability requirements put forth in IEEE 1547 and 1547.1.

Testing Pathway:
Inverters that are certified to IEEE 2030.5 at the inverter level will be considered compliant with the Phase 2 communications requirements and will not be required to pass the following compatibility testing.

For inverters that are not certified to IEEE 2030.5 at the level of the inverter, each inverter model or family of models[15] will demonstrate compliance with the Phase 2 communications requirements via compatibility testing in conjunction with a CSIP-certified gateway[16], [17]. In this

[14] In a February 11, 2019, Petition for Modification of Resolution E-4832 and E-4898 ("the Petition"), the California Solar and Storage Association (CALSSA) requests that the Commission clarify and modify the smart inverter Phase 2 and 3 requirements. The Petition makes four primary assertions: (1) IEEE 2030.51 should not be required at the inverter level, (2) undefined utility testing should not be required and utilities should rely on attestations for Phase 3 Functions 1 (Monitor Key Data) and 8 (Scheduling), (3) compatibility testing should satisfy compliance with Phase 2 without active aggregator agreements or installed gateway devices, and (4) further extension of the effective date for certain inverter capabilities may be needed.

[15] For inverter product families that use the same communications protocols, physical communications layers, firmware, and communication circuit design, the NRTL may use engineering judgement to determine whether a single verification will suffice for the product family or whether model-by-model verification is necessary. For example, if a 5 kW inverter and a 10 kW inverter have different model numbers but utilize the same communications interface, the NRTL may determine that a compatibility test of the 5 kW inverter may be applied to the 10 kW model and vice versa. (Footnote included from Resolution E-5000).

[16] A "gateway" is anything other than the DER that provides a communications interface (CSIP/IEEE 2030.5) to the utility for the purposes of exchanging the content contained in the communications messages with one or more DERs.

[17] The gateway may have been previously CSIP certified and need not be tested concurrently with the inverter.

testing, a NRTL[18] should perform the following SunSpec CSIP test procedures on the gateway while it is connected to the inverter or inverter control unit:

- Inverter Status (BASIC-028)
- Inverter Meter Reading (BASIC-029)
- Basic Inverter Control – Volt/Var (BASIC-006)
- Basic Inverter Control – Fixed Power Factor (BASIC-008)
- Basic Inverter Control – Volt-Watt (BASIC-011)

The NRTL need not witness the inverter-level result of these commands. Instead, the inverter or gateway manufacturer must attest that the inverter communicates with the NRTL server and executes the commands. The NRTL should then state in the inverter test report that the manufacturer attested to performance of the commands during the test.

The NRTL should test conformance gateways to IEEE 2030.5 in accordance with the SunSpec CSIP Test Protocols. This testing may be carried out without regard to what is connected to the far end of the gateway. However, the entity under test may connect a specific inverter model to the gateway. If a specific inverter model is used, the testing lab may note the inverter model in the test results or in a letter associated with the test results.

Following the above tests, the NRTL should produce two reports. The test report should state that the gateway conformed to IEEE 2030.5 and CSIP. This may be certified by the SunSpec Alliance. A separate letter should state the inverter models that were connected to the gateway for compatibility testing, as outlined above. The CEC or another list-maintaining entity will receive that letter and use these documents as the basis for a list of compliant inverter models. The IOUs shall draw from that list to populate the list of eligible inverters in their interconnection application portals.[19]

[18] The term “Nationally Recognize Testing Lab (NRTL)”, as used throughout this Appendix B, refers to both (1) those testing labs that have been recognized by the Occupational Safety and Health Administration (OSHA) as providing evaluation, testing, and certification of electrical products and (2) SunSpec Authorized Testing Laboratories (SunSpec ATLs).

[19] If a non-IOU party maintains the list and excludes any categories of inverter for reasons not related to Rule 21 compliance, the IOUs shall nonetheless ensure the inclusion of those inverters that have undergone all relevant testing among the eligible inverters.