

Inverter Advancements in UL1741 and UL 62109



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Distributed Energy Resources
Equipment

UL LLC

Renewable Energy Standards for safety of Power Conversion Equipment

USA

- UL1741
- UL62109
 - UL62109-1 General Published
 - UL62109-2 Inverter specific in process (Late 2015)

Canada

- CSA C22.2 No. 107.1 (present)
- CSA 62109 (future)
 - Allows for use of IEEE 1547 and 1547.1

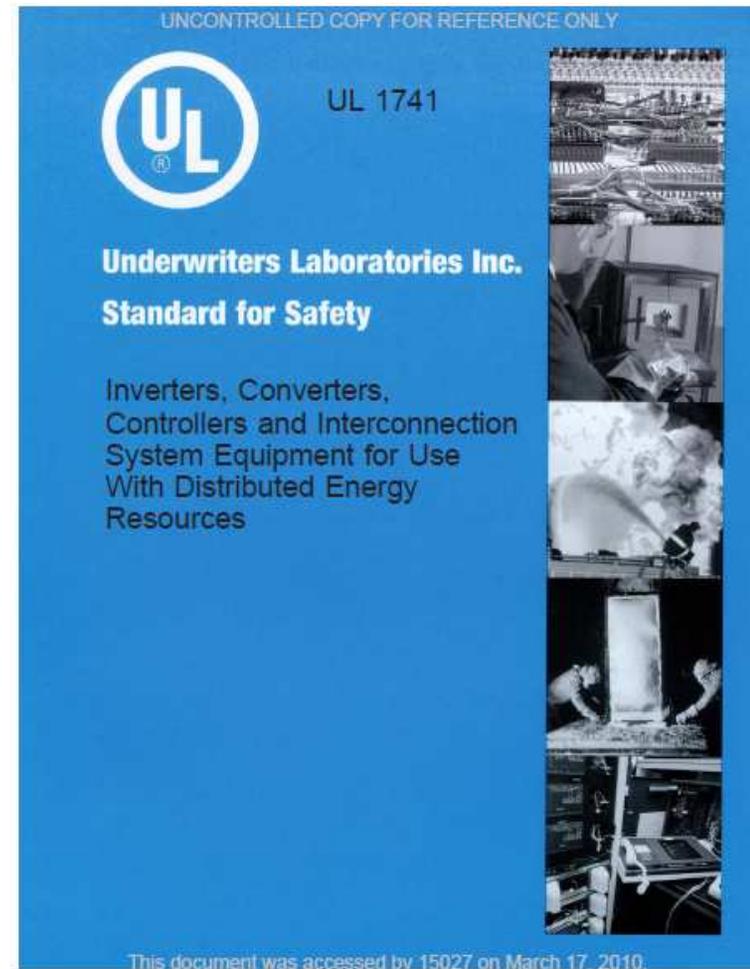
International:

- IEC 62109-1
- IEC 62109-2



UL 1741 Covers Power Conversion and Protection Equipment for the Following Types of DR products:

Photovoltaics, PV
Fuel Cells
Micro-turbines
Wind and Hydro Turbines
Engine Generator Set
Utility Interactive Inverters
Stand Alone Inverters
Multi-Mode Inverters
AC Modules
Charge Controllers
PV Balance of Systems,
Combiner Boxes, GFDIs, etc



USA Grid Interconnection Standards

IEEE 1547

Interconnection System Requirements

- Voltage Regulation
- Grounding
- Disconnects
- Monitoring
- Islanding

IEEE 1547.1

Interconnection System Testing

- Temperature Stability
- Response to Abnormal Voltage
- Response to Abnormal Frequency
- Synchronization
- Protection from EMI
- Surge Withstand
- Paralleling Device
- DC Injection
- Unintentional Islanding
- Reverse Power
- Open Phase
- Reconnect after disturbance
- Harmonics

UL 1741

Power Conversion and Interconnection Equip

- Construction
- Testing normal and abnormal
- Protection against risks of injury to persons and connected equipment.
- Ratings, Markings and Instructions
- Specific DR Tests for specific technologies
- Production line testing
- Certifications address NEC and electric utility interconnection needs.

This linkage between UL1741 and IEEE 1547 established a set of standardized interconnection requirements and procedures that are being used to evaluate utility interconnected DG products for both electrical safety and utility grid interconnection to address the needs of Electrical AHJs and Utility Interconnection Engineers.

Note - These products work well for lower percentages of grid penetration.



IEC 62109 and UL1741



The scope of UL 1741 includes sections that are not yet published in IEC 62109, such as:

- PV charge controllers
- Combiner boxes
- Requirements for other renewable energy sources like fuel cells, rotating machines, etc,
- Grid interconnection systems equipment.
- We will have both standards and the STP will determine the best way to address interactions and overlaps of both.



IEC 62109-2 PV Inverter Specific Requirements

IEC 62109-2 addresses the requirements for inverter specific safety functions:

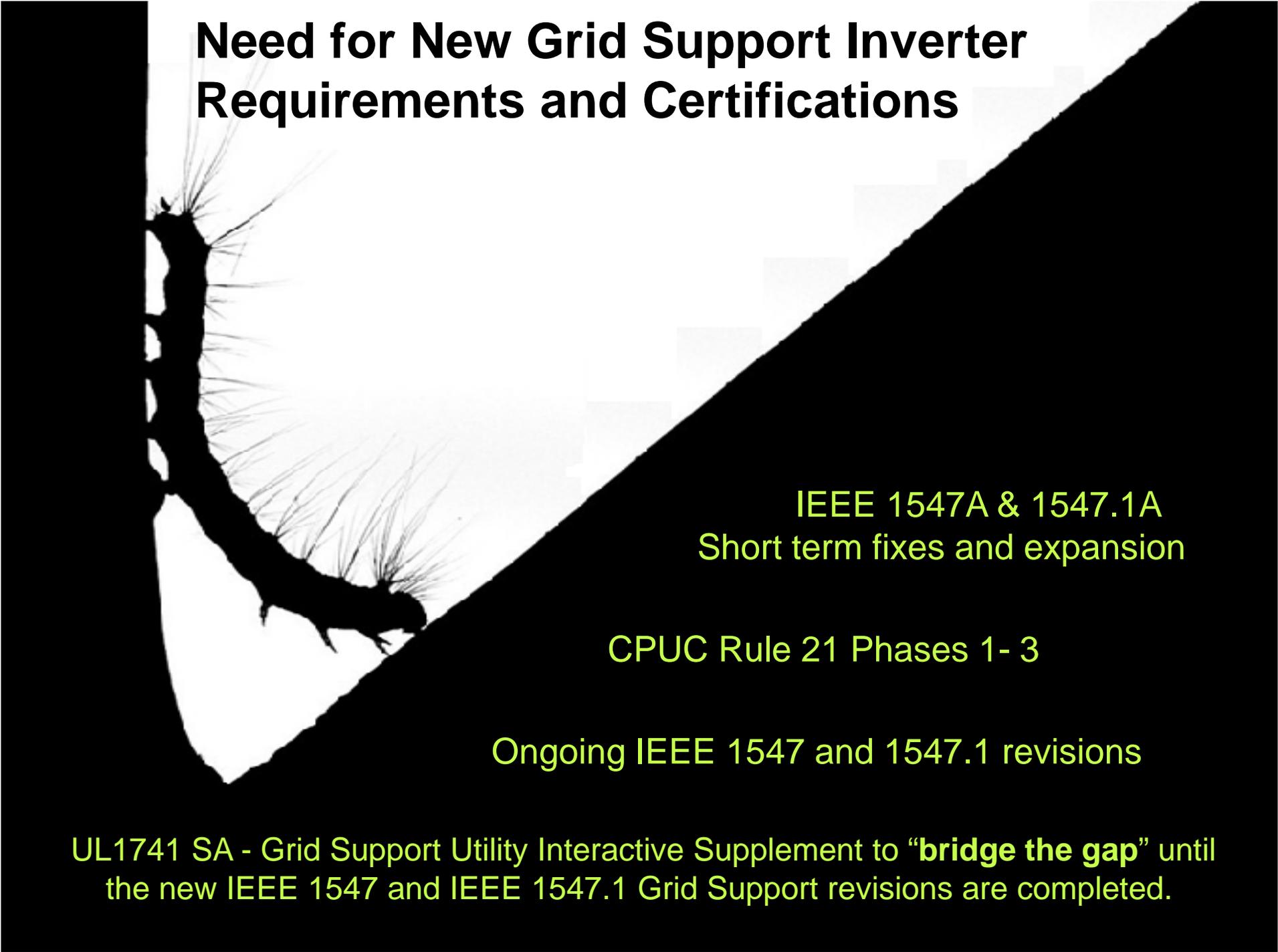
- Power Quality THD, DC injection,
- Voltage and frequency control
- Array and system isolation protection
- Markings
- Documentation



US Harmonization Committee is Developing US National Differences for the Adoption of IEC 62109-2 as UL 62109-2

- References to UL1741 for grid interconnection requirements
- Enhanced multi-mode requirements
- Updated ground fault protection requirements
 - Address NEC requirements
 - Share PV AFCI energy based fire hazard limits
 - Clarify GFDI protection does not provide electric shock protection.
- Pushing to develop comment draft in early Q4





Need for New Grid Support Inverter Requirements and Certifications

IEEE 1547A & 1547.1A
Short term fixes and expansion

CPUC Rule 21 Phases 1- 3

Ongoing IEEE 1547 and 1547.1 revisions

UL1741 SA - Grid Support Utility Interactive Supplement to “**bridge the gap**” until the new IEEE 1547 and IEEE 1547.1 Grid Support revisions are completed.

UL1741 New Supplement for Grid Support Utility Interactive Inverters

Excellent Task Group! – weekly meetings to develop the UL1741 Supplement including:

- Inverter Industry
- Electric Utilities – CA, HI and AZ
- National Labs – SANDIA and NREL
- EPRI
- NRTLs / Test Labs

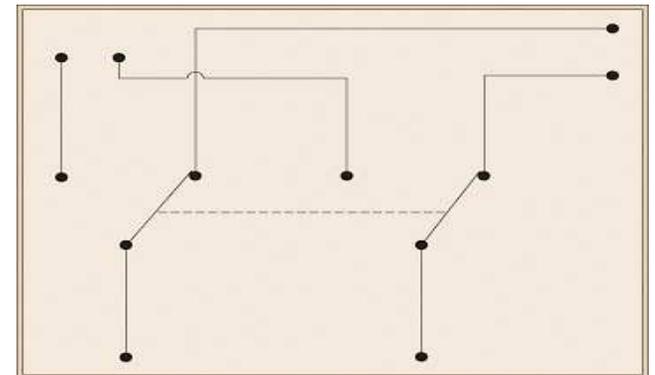


The task group is addressing UL1741 STP comments and is preparing the ballot draft. Pushing to complete ballot draft by mid October.



UL1741 Multi-Mode Task Group and Upcoming Microgrid Task Group

- UL is working with industry and California electric utilities to enhance the UL1741 and UL62109-2 requirements for multi-mode inverters.
- Make use of the IEEE 1547.1 Synchronization Tests.
- Need to better define how and when multi-mode products transition from grid support / ride through functionality to stand alone operation.
- A Microgrid task group is being formed to develop microgrid equipment requirements.



UL1741 New Supplement for Grid Support Utility Interactive Inverters

- Anti-Islanding
- L/HVRT
- L/HFRT
- Must Trip Test
- Normal Ramp Rate
- Soft-Start Ramp Rate
- Fixed Power Factor
- Volt/Var Mode
- Other / Optional
- Communications Interface
- Data Model
- Monitor Alarms
- Monitor DER Status and Output
- Frequency Watt



Need to Clearly Differentiate

The differences between utility interactive generation products:

- Utility Interactive
- Grid Support Utility Interactive
- Special Purpose Utility Interactive products

Clearly define product functions, ratings and requirement compliance within the product markings, ratings, manual, certification documentation and new certification categories.



Certification for the Purpose

NEC moving toward equipment certified for the purpose.
Field failures related to incorrect applications for equipment.

- Reprogrammed motor drives used a utility interactive inverters
- UPS used as dynamic Var compensator
- Industrial control equipment used for power generation applications
 - Electrical Spacings (Creepage and clearances)
 - Overvoltage category
 - Pollution degree
 - Operating temp range
 - Environmental ratings
 - Electrical ratings and markings for the application and sources



Ultimate Goal

Increase renewable energy safety with the help of the renewable energy industries, thought leaders, AHJs, Utilities and other interested parties, develop and maintain appropriate installation codes, standards and certifications.

This will permit easier entry for mfrs into their target markets.

Facilitate a streamlined process where renewable energy equipment and systems may be designed, produced, evaluated, certified, sold, installed and operated in a smooth and agreeable manner for all parties.





you for your time!

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