UL3001, UL2200A and UL3741 Update Tim Zgonena UL LLC Sept 19, 2018 UL and the UL Logo are trademarks of UL LLC © 2017. All rights reserved. No portion of this material may be reprinted in any form without the express written permission of UL LLC. or as otherwise provided in writing.

UL Energy Partnerships

To address the needs of national and international energy stakeholders, UL works closely with;

- Manufacturers
- Regulators
- Government agencies
- Industry experts
- Test labs
- Other certification agencies
- Other standards and code writing agencies



UL's relationships and partnerships with key Energy industry stakeholders is a foundation upon which we write relevant safety and performance standards for cutting edge products and systems.



We Have Many Existing Standard for DERs



Tailored specifically to the needs of product mfrs, developers and renewable energy project owners/operators.

UL3001 is intended to coordinate these DERs interoperation

UL3001 Distributed Energy Resource Systems

Draft Scope

This standard covers the safety and performance of distributed energy resource systems. These systems may be comprised of distributed energy sources such as photovoltaic arrays or wind turbines in homogenous or hybrid configurations, energy storage systems, grid interface equipment and related equipment to accomplish functionality of the distributed energy system.

These requirements address the safety of system design, integration and operation. They also cover the performance of these systems as it relates to grid operability, interface with premises wiring systems, and

performance of the equipment in the various modes of system operation.



STATUS: Task Groups are developing the seed document into a draft for STP review comment and ballot.

UL3001 Standards Technical Panel (STP)

- Manufacturers
 - System
 - Equipment
 - Components
- AHJs
- Utilities
- PUCs
- National Labs
- Consultants
- Testing Orgs

These members are from both the US and Canada



Standards covered by this STP:

UL 3001, Standard for Safety for Distributed Energy Generation and Storage Systems

STP Balance Summary

Total Number of Voting Members: 44

Interest Category	Number of members	Percentage (%)	
AHJ	8	18	
Commercial/Industrial User	5	11	
Consumer	0	0	
General	8	18	
Government	2	5	
International Delegate	0	0	
Producer	11	25	
Supply Chain	5	11	
Testing & Standards	5	11	

UL3001 Task Groups



- TG1 Chair Task Groups (two chairs for each task group) TG2 Scope and Title
- TG3 Definitions and Standards References TG4 Critical System Components







- TG5 DERS Interoperability Communications (inside the DERS)
 - TG6 DERS Protective Functions TG7 Grid Interconnection, Coordination and Interoperability

Islanded operation voltage frequency distortion performance



Need to include - EMI radiated, conducted both into equipment and out of equipment immunity etc.



- TG9 Ratings, Markings and Instructions TG10 Grounding
- G11 System Safety related requirements and tests outside of the equipment standards.
- TG12 Electrical interaction between sources





Coordination of DERS Equipment

- System components need to operate safely under normal and foreseeable abnormal system conditions
- Differentiate between system faults to which equipment need to respond to vs single fault failures within a piece of equipment
- Interaction between energy sources and power conversion equipment
- Operation ranges of system equipment
- Protection from system faults
- Source parameters



Protection of Mixed System Sources

Renewable power sources have specific installation and protection requirements to maintain them within their safe operating parameters and limits to prevent electric shock, fire and mechanical hazards.

Photovoltaics (PV) Wind turbines Hydro turbines Fuel Cells Batteries EVs Generators – Others –







Maximum system voltage Maximum normal current Charge discharge current Maximum fault current **Reverse current** Ground faults Arc faults **Overload Overspeed Thermal limits**



- UL3001 task groups are writing the draft standard
- Align with new 2020 NEC code
- Make use of existing standards from UL, IEEE, IEC, etc.
- Send draft to STP for comment
- Follow UL / ANSI STP Process to develop a DERS standard for both the US and Canada



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





New Grid Support Utility Grid Compatibility and Interconnection



Many of the performance issues associated with the grid interactive operation and off grid operation of Distributed Generation (DG) systems are important Safety Issues.



UL 9540 - Scope

Safety of energy storage systems:

- Includes energy storage systems that are:
 - Standalone to provide energy for local loads
 - For use in utility-interactive applications in compliance with UL1741, IEEE 1547 and IEEE 1547.1 or
 - Other applications intended to provide grid support functionality,
 - Able to perform multiple operational modes
 - May include balance of plant and other ancillary equipment of the system







NFPA 70 NEC 2017

Article 625 EV Charging Systems

- Article 690 Photovoltaics (PV)
- Article 691 Large Scale (PV)
- Article 692 Fuelcells
- Article 694 Wind Turbines
- Article 705 Interconnected Electric Power Production Sources. The above articles reference 705 for electric utility interactive systems.
- Note: 705 requires UL1741 Listed utility interactive.
- Article 706 Energy Storage
- Article 710 Standalone Systems (Islanded) Article 712 DC Microgrids

Future state to address overlap with traditional generator applications.

700 Emergency Systems701 Legally Required Standby Systems702 Optional Standby Systems





NEC Articles covering renewable energy continue to expand and change.

NEC 2017 Article 705 Relative to Microgrids

Part IV. Microgrid Systems

- **705.150 System Operation.** Microgrid systems shall be permitted to disconnect from the primary source of power or other interconnected electric power production sources and operate as a separate microgrid system.
- **705.160 Primary Power Source Connection.** Connections to primary power sources that are external to the microgrid system shall comply with the requirements of 705.12.
- **705.165 Reconnection to Primary Power Source.** Microgrid systems that reconnect to primary power sources shall be provided with the necessary equipment to establish a synchronous transition.
- **705.170 Microgrid Interconnect Devices (MID).** Microgrid interconnect devices shall comply with the following:
- (1) Be required for any connection between a microgrid system and a primary power source
- (2) Be listed or field labeled for the application
- (3) Have sufficient number of overcurrent devices located to provide overcurrent protection from all sources

Informational Note: MID functionality is often incorporated in an interactive or multimode (U) inverter, energy storage system, or similar device identified for interactive operation.

UL 2200A

UL 2200A

Outline of Investigation for Fire Containment Testing of Stationary Engine

Generator Enclosures

Issue No. 1

May 31, 2019

UL2200A is intended to:

 Be a consensus standard for the US.
 Provide a defined test method for the NFPA 37 full scale fire test.
 Provide a defined compliance criteria for the NFPA 37 full scale fire test.

3. Allow for engine generator installations closer than 5ft from combustible building surfaces.

UL2200A Acceptance Criteria

10.1 A product is in compliance with this test if all of the following criteria are met:

 a) Surface temperature measurements along instrumented wall surfaces shall not exceed 150
 ° C

(302° F) maximum temperature;
b) The fuel system shall not leak more than as specified in Table 7.1; and
c) Walls adjacent to the generator shall not ignite.



UL3741 PV Hazard Control

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Development of PVRS Standard for Compliance with the 2017 NEC 690.12



1) Listed PV array level protection system. 2) 80V, 30 Second Limit for controlled conductors internal to the array. 3) PV arrays with no exposed wiring methods, no exposed conductive parts, and installed more than 8ft from exposed grounded conductive parts or ground.



New science based research and leverage existing technology where we can.

UL Developing New Standard & STP for PV Rapid Shutdown Systems PV Hazard Control

PV module mfrs (UL1703)

Electronics (UL1741)

PV rack mfrs (UL2703)

Harness mfrs (UL9703)

PV wire, connector and harnesses (9703, 6703,etc)

Fire Fighting Community AHJs Functional safety and risk assessment experts National labs Industry experts Others



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UL3741 Photovoltaic Hazard Control

- Existing product safety standards and NFPA 70, the National Electrical Code (NEC) include requirements for PV systems that provide practical safeguarding against common hazards in normal use.
- Firefighting operations present a potentially severe set of conditions that are outside of those evaluated as part of a typical product safety certification evaluation.
- This Photovoltaic Hazard Control standard evaluates for specific, defined abnormal conditions and fault tolerance related to anticipated firefighter operations that exceed the criteria of existing PV product safety standards



UL3741 DOE (Sandia and UL) Supporting Research

This new research project expands on original UL Fire Research project. <u>We needed science based data to replace the 80V</u> guesstimate that is better than.....

- 1. Evaluate different configurations of PV
- 2. Define safe states for PV systems operation under emergency conditions
- 3. Determine body impedance model for Fire Fighters including PPE and tools.
- 4. Determine risk of electrical shock in ungrounded, isolated PV arrays
- 5. Evaluate electrical enclosure protection from firefighting liquids
- 6. Harmonize safety standards and committee work

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UL3741 PV Hazard Control System(s) Functional Diagram



NOTE: Examples of systems, equipment and components include: PVHCS: e.g. Combination of specific morning system (6), use of switching and array segmenting devices (5), and inverter control (3)(4). PVHCE: e.g. Array combiner box with internal switching (2) PVHCC/ MPLE: e.g. Switching component located mid string (5)

UL3741 Figure 7 Source Circuit Resistance

Figure 7, Source circuit impedances





Timing for UL3741

- Align with 2020 NEC code proposals where possible (ongoing)
- Develop and publish the UL3741 Standard (ongoing)
- Develop educational material Do's and Don'ts (future)



• UL3741 STP just provided comments and suggestions to the draft put on CSDS. The Task Groups will fast track the draft update in preparation of the ballot draft. If all goes UL3741 should be published in early 2020.



UL ANSI Standards Development Consensus Process





Proposal	Preliminary Review	Submitter's Review of Comments	Ballot	Comment Resolution	Re-ballot	Adoption or Failure
• Anyone • UL CSDS system	•STP •Standard Subscribers	 Considers comments May revise proposal 	•STP votes •Standard subscribers review •Public review	•STP resolves all comments	 Changes to proposal based on comments STP confirms or changes vote 	 Consensus needed to adopt Proposal fails if consensus is not achieved

Ultimate Goal

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

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

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



Thank you!

Tim Zgonena UL LLC

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