

**Benefits of IEEE 1547-2018 Adoption
&
Advanced Inverter Settings**

2024 Stakeholder Forum

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Highlights/Overview

- APS plans to adopt advanced inverter settings found within IEEE 1547-2018 for grid-support functions that align with best industry practices.
- These settings have the potential to minimize the negative effects that high penetrations of Distributed Energy Resources (DERs) can have on the grid and allow more customers the opportunity to interconnect.

Advanced Inverters & Grid-Support Functions

- Advanced (smart) inverters have the capability to monitor and respond to information (e.g., voltage, frequency) to maintain grid stability
 - Adjust output to achieve longer operational time vs. reaching threshold and ceasing operation
 - Ride through abnormal conditions

IEEE 1547 & UL 1741-SB Certification

- UL 1741 is the industry standard for Inverter Safety
 - The tests which advanced inverters must pass to receive UL 1741 certification were designed to meet or exceed the requirements set forth by IEEE 1547-2018
- UL1741-SB introduced interoperability conformance testing in accordance with IEEE 1547.1-2020, which established testing procedures for advanced inverter capabilities



UL 1741-SA & -SB Certification Differences

- Supplement SB references IEEE Std. 1547.1-2020 to standardize certification and ensure testing covers the full range of allowable settings required by IEEE 1547-2018
 - SA-compliant devices are more narrowly certified to non-uniform performance requirements



UL 1741-SB

Over/Undervoltage Trip
Watt/VAR Mode
Constant VAR Mode
Tests

UL 1741-SA

Low/High Volt. Ride
Through
Low/High Freq. Ride
Through
Power Factor
Volt/VAR Mode
Frequency-Watt
Volt-Watt

IEEE 1547 & UL 1741-SB Certification (cont.)



- Per the APS Interconnection Requirements Manual (IRM) revision that was approved Nov. 2022, APS had planned to require UL 1741-SB certified inverters alongside recommended settings.
 - However, until SB-Certified inverters are widely available, APS will continue to work with industry partners and manufacturers to continue to approve UL 1741-SA certified inverters
- Stakeholder Communication will be sent ahead of adoption/requirement changes

Arizona Administrative Code (AAC) & Implementation of

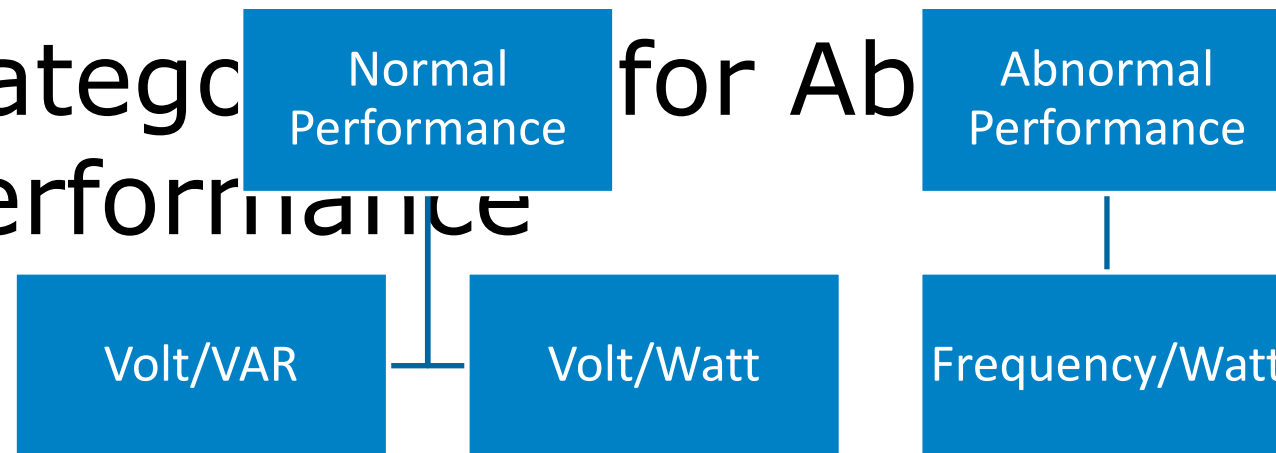
- [AAC Title 14, Chapter 2, Article 26, Section R14-2-2625 C.](#) **Advanced Settings** allows for grid-support features to be implemented via Advanced Inverters upon mutual consent between customers and utilities
 - Volt/VAR
 - Volt/Watt
 - Fixed Power Factor
 - Soft-Start Reconnection
 - Frequency/Watt

APS Grid-Support Features

- Where we are:
 - Minimum Power Factor capabilities have been a long-standing requirement of the APS IRM, and Fixed Power Factor has been employed on a case-by-case basis.
- Where we're going:
 - With APS' adoption of IEEE 1547-2018, Volt/VAR will replace the Fixed Power Factor mode of operation.

APS Adoption of IEEE 1547-2018 Advanced Inverter Settings

- Adoption of default setting values found within Category B for Normal Performance & Category III for Abnormal Performance



* Category III includes the IEEE 1547A-2020 Amendment

APS Adoption of IEEE 1547-2018 Advanced Inverter Settings (cont.)

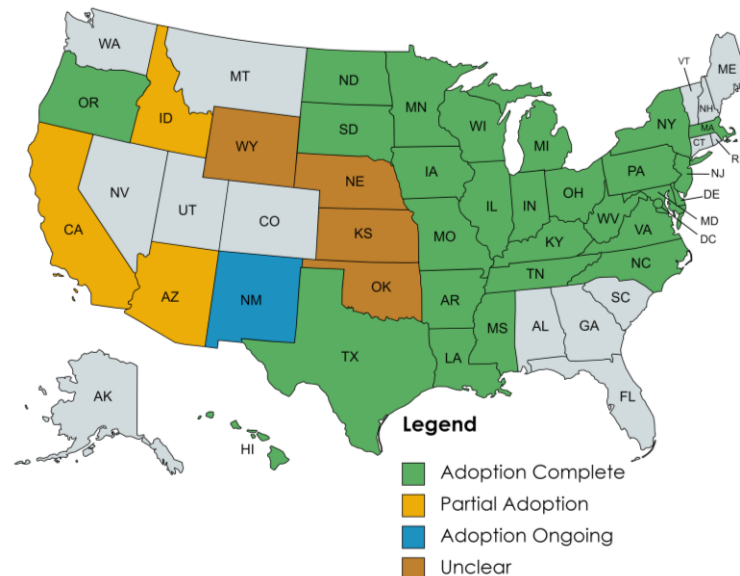
- Proposed settings & documentation align with what is stated within AAC section R-14-2-2625, including a section for new customers with a checkbox for customers to agree with the proposed settings.



Benefits of implementing Advanced Inverter settings

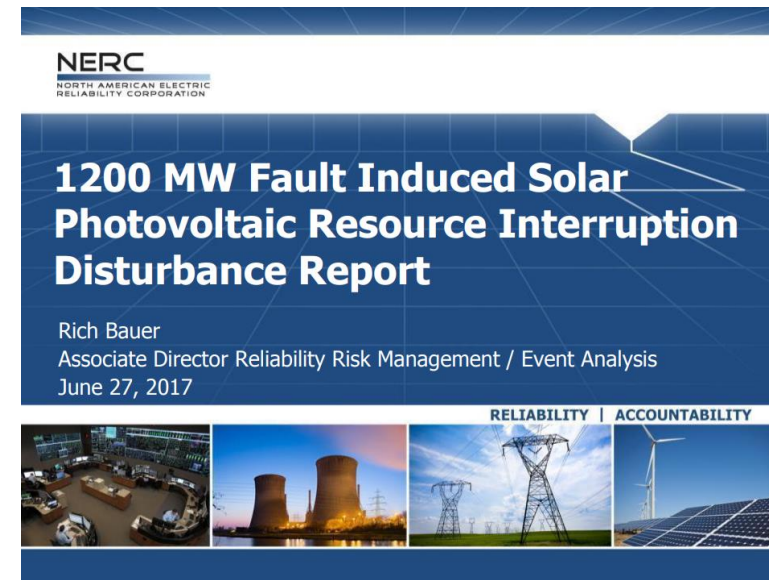
- Follows Industry Best Practices
 - Survey conducted by NREL on Utility IEEE 1547-2018 adoption illustrates peer utilities have already adopted the standard, or near future

- Arizona
- New Mexico
- California
- Hawaii



Benefits of implementing Advanced Inverter settings (cont.)

- IEEE 1547-2018 Category III Abnormal Performance functions were created as a mitigation in response to findings within [NERC Report](#)
 - “[...] is based on both BPS stability/reliability and distribution system reliability/power quality needs and is coordinated with existing interconnection requirements for very high DER penetration”



Benefits of implementing Advanced Inverter settings (cont.)

- Customer Impacts
 - Implementing these settings will minimize effects a Generating Facility (GF) could have on power quality and allow for greater Hosting Capacities (HC)
 - Will not impact design of GFs, but to meet expected kW output, utilize the ratio below:
 - $\frac{kW (nameplate)}{kVA (nameplate)} = 0.9$, allows for a PF range of +/- 0.9
Inverters < 10 MW (APS IRM Sec 12.4)
 - Allow for more interconnections while also mitigating the potential need for line-side devices due to issues caused by GFs

Service Equipment Modifications

Shelly R. Born
April 17, 2024



Service Equipment

Unapproved Modifications

- ESS Systems
- Backup Generators
- Supply Side Taps

Service Equipment

References

- NEC 110.3(B)
- NEC 230.46
- John Wiles article - IAEI Magazine

Example of UL Violation:

Before



After



Questions?



Approved Meter Enclosures

Marlissa Lucero April 17, 2024



Self contained v CT Rated

- Self contained ≤ 200 A
- CT Rated > 200 A
 - Can be approved via uploaded cutsheets

<https://www.aps.com/construction>



Pre- approved lists

Construction Resources: Lay the Groundwork Before You Build

+
Voltage & As-Built Requirements

Electric Service Requirements Manual

To help your project comply with APS energy guidelines, download our full [Electric Service Requirements Manual](#) or browse requirements by category:

- [ESRM Front Section](#)
- [100 - General Information](#)
- [200 - Application for Service](#)
- [300 - Metering Installation](#)
- [400 - Overhead Service](#)
- [500 - Underground Service](#)
- [600 - Trenching](#)
- [700 - Grounding and Bonding](#)
- [800 - Short Circuit Protection](#)
- [900 - Irrigation Pumping](#)
- [1000 - High-Voltage Metering/Service](#)
- [1100 - Manufacturing](#)
- [1200 - Special Applications](#)
- [1300 - High-Rise Metering & Equipment](#)
- [1400 - Clearances](#)

You can also view recent revisions to the ESRM and pre-approved lists:

- [Current Revisions](#)
- [Pre-Approved Residential Manufacturer List](#)
- [Pre-Approved Commercial SC Panel List](#)
- [CT Rated Pre-Approved Panelboard List](#)

+
Equipment Clearance Requirements

+
Extended Power Charges

+
Industry-Wide References

Self contained

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PRE-APPROVED RESIDENTIAL MANUFACTURER LIST

PRE-APPROVED PRODUCTION METER SOCKETS

The following list of "Production Meter Sockets" has been put together with the Manufacturers' cooperation. Representative samples were submitted to the APS Renewables team and the APS Meter Shop for evaluation to verify they comply with the APS ESRM requirements, EUSERC requirements and the APS Interconnect Standards. The Manufacturers have agreed to supply only those meter sockets listed below for use as production meter sockets on the APS system.

<u>MANU-FACTURER</u>	<u>REPRE-SENTATIVE</u>	<u>AMP S</u>	<u>PHAS E</u>	<u>CATALOG NUMBER</u>	<u>UG/OH</u>	<u>NOTES</u>
COOPER (B-LINE)	Apex Elect Sales	100	1 ϕ , 3W	011, 4 Jaw	OH	Add Catalog #50365 for 5 th Jaw
		100	1 ϕ , 3W	011MS73, 4 Jaw	OH	2" hub included
	Shawn Russell 480-494-1010	100	3 ϕ , 4W	927, 7 Jaw	OH	Includes 2" hub & screw type sealing ring.
		100	1 ϕ , 3W	U011, 4 Jaw	UG	Screw type sealing ring Catalog # 25016D included with MS73 catalog numbers
		200	1 ϕ , 3W	204, 4 Jaw	OH	MS21 = 2" hub installed
		200	1 ϕ , 3W	204MS68**, 4 Jaw*	OH	
		200	1 ϕ , 3W	204MS68A***, 4 Jaw*	OH	
		200	1 ϕ , 3W	U204, 4 Jaw	UG	

CT Rated

ARIZONA PUBLIC SERVICE COMPANY

CT RATED PRE-APPROVED PANELBOARD LIST

CT RATED METER PANELBOARDS

(WHICH SHALL COMPLY WITH APS ESRM 302.3 & 302.3-1)

All CT rated meter panelboards on this list are considered residential and commercial, indoor and outdoor, therefore there's no designation on this list. In all cases, APS Service Requirements and EUSERC Manufacturing Requirements shall apply. Noncompliance with the APS ESRM standards will cause delays in energization. All CT rated meter panels that are not listed below shall be submitted for review and approval prior to purchase and install.

<u>MANUFACTURER</u>	<u>VOLTAGE</u>	<u>AMPS</u>	<u>AIC</u>	<u>CATALOG#</u>	<u>PHASE</u>	<u>OH/UG</u>	<u>Socket Config.</u>
JMT	120/240	400	42K	JMT-401-OH-240	1-PH	OH	8 CLIP
	120/240	400	42K	JMT-401-UG-240	1-PH	UG	8 CLIP
	120/240	600	42K	JMT-601-OH-240	1-PH	OH	8 CLIP
	120/240	600	42K	JMT-601-UG-240	1-PH	UG	8 CLIP
	120/240	800	42K	JMT-801-OH-240	1-PH	OH	8 CLIP
	120/240	800	42K	JMT-801-UG-240	1-PH	UG	8 CLIP
	120/208	400	42K	JMT-403-OH-208	3-PH	OH	13 CLIP
	120/208	400	42K	JMT-403-UG-208	3-PH	UG	13 CLIP
	277/480	400	42K	JMT-403-OH-480	3-PH	OH	13 CLIP
	277/480	400	42K	JMT-403-UG-480	3-PH	UG	13 CLIP
	120/208	600	42K	JMT-603-OH-208	3-PH	OH	13 CLIP

Don't see your model on the list?

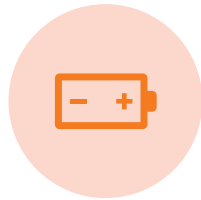
Equipment Review Committee

2121 W. Cheryl Dr. Phoenix AZ 85029 Attn: Metershop

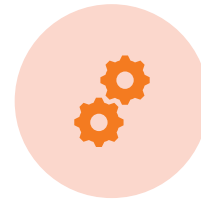
1st Wednesday of each month at 11:00 a.m.



DRE Reminders:



If it generates, we care!



Automatic Transfer Switch (ATS) make and model



Pictures of existing equipment



New technology?
Send in a spec sheet!



Site plan
equipment call outs

Questions?

