Rule 21 Status Update

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Agenda

- **Rule 21 Phase 1 – Autonomous Operation**
  - Beginning
  - Revision process
  - Decision

- **Rule 21 Phase 2 – Communication and Aggregation**
  - Scope and Status

- **Rule 21 Phase 3 – Utility Control of DER**
  - Scope and Status

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Rule 21 Phases

- **Phase 1 – Autonomous Functions**

  - Support Anti-Islanding to trip off under ride-through conditions

  - Provide low/high voltage ride-through

  - Provide low/high frequency ride-through

  - Provide volt/var control in autonomous fashion

  - Provide fixed power factor

  - Reconnect by "soft-start" method

- **Phase 2 – Communications Capabilities for Monitoring, Updating Settings and Control**

  - IEC 61850, SEP2 and DNP3

- **Phase 3 –Interactive Functions**

  - Utility control; directly or through aggregator

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Rule 21 Phase 1

History and Status

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Rule 21 Beginning

- **CPUC adopted Rule 21 in the 1980s to provide interconnection of non-utility owned DEG**

- **Sept, 2011 the Commission initiated Rulemaking (R.) 11-09-011 to revise Electric Tariff Rule 21 governing PG&E, SCE, SDG&E**

- **Modifications to support "smart inverters"**

  - Generate or Absorb reactive power

  - Aid with voltage and frequency regulation

  - Deliver power in four quadrants

  - In combination with a communication link to control DG and storage in accordance with signals from the utility

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Rule 21 Revision Process

- **Feb 2013 SIWG Formed**

- **Jan 2014 SIWG Submitted Phase 1 Recommendations**

  - New voltage and frequency ride-through settings

  - Dynamic Volt-var Operations

  - Ramp Rates

  - Fixed Power Factor

  - Soft Start

- **Aug, 2014 Industry Comments were Filed**

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Rule 21 Decision

- **Dec, 2014 Decision 14-12-035 issued**

  - **Establishes mandatory date:** shall be the later of December 31, 2015, or 12 months after approval of UL 1741 Supplement SA

  - **Replacement Inverters:** existing inverters allowed to be replaced with an existing inverter not classified as a Smart Inverter, but of equal or greater ability than the original

  - **Volt/Var:** Decision asks utilities to provide detailed specifications and make a proposal with in on year's time

  - **Connect/Reconnect Ramp-up Rate:** Ramp-up rate adjustable between 1 and 100% per second

  - **Adjusted Ride-Through Tables:** See below

  - **Harmonizing Rule 21 with FERC:** ALJ asked utilities to seek approval from FERC

  - **Realizing the Value of Smart Inverters:** How is the system owner compensated financially? Decision deferred. Future workshops proposed to address subject

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Voltage and Frequency Ride-Through Tables

Table Hh-1: Voltage Ride-Through Table

Region	Voltage at Point of Common Coupling (% Nominal Voltage)	Ride-Through Until	Operating Mode	Maximum Trip Time
High Voltage 2 (HV2)	V ≥ 120			0.16 sec.
High Voltage 1 (HV1)	110 < V < 120	12 sec.	Momentary Cessation	13 sec.
Near Nominal (NN)	88 ≤ V ≤ 110	~~Continuous Operation~~ Indefinite	Continuous Operation	~~Continuous Operation~~ Not Applicable
Low Voltage 1 (LV1)	70 ≤ V < 88	20 sec.	Mandatory Operation	21 sec.
Low Voltage 2 (LV2)	50 ≤ V < 70	10 sec.	Mandatory Operation	11 sec.
Low Voltage 3 (LV3)	V < 50	1 sec.	Momentary Cessation	1.5 sec.

Table Hh-2: Frequency Ride-Through Table

System Frequency Default Settings	Minimum Range of Adjustability (Hz)	Ride-Through Until (s)	Ride-Through Operational Mode	~~Default Clearing~~ Trip Time (s)
f > 62	62 - 64	No Ride Through	Not Applicable	0.16
60.5 < f ≤ 62	60.1 - 62	299	Mandatory Operation	300
58.5 ≤ f ≤ 60.5	Not Applicable	Indefinite	Continuous Operation	Not Applicable
57.0 ≤ f < 58.5	57 – ~~60~~ 59.9	299	Mandatory Operation	300
f < 57.0	53 – 57	No Ride Through	Not Applicable	0.16

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Rule 21 Phase 1 Standards Development

- **UL 1741 SA**

  - Working Group developing Supplemental Amendment

  - Draft was circulated and comments were due July 2015

  - WG in process of addressing comments, estimated completion Oct 2015

  - STP votes on proposal

  - UL publishes standard, November of 2015

  - Rule 21 effectivity date, estimated November of 2016

- **IEEE 1547 full revision being updated to include Rule 21 requirements, Q4 2016**

- **IEEE 1547.1 full revision will address Rule 21 testing, Q4 2017(?)**

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Rule 21 Phase 2

Rule 21, Phase 2

- **Defines Communication Protocols between Utilities and other Parties**

  - IEC 61850 data objects over IEEE 2030.5, SEP2

  - Cyber Security

- **IEEE 1815/DNP3 for Direct SCADA Control and Management**

- **Aggregators can Manage Fleets by Providing Control**

- **Feb, 2015 SIWG Released Phase 2 Recommendations**

- **CPUC kicked back the recommendation to IOUs**

  - IOUs need to generate common protocol document

  - IOUs need to develop individual Generation and Interconnection Handbooks

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Rule 21, Phase 2 CSIP

- **From SDG&E, first draft of Common Smart Inverter Profile (CSIP) for California, Draft V0.6.3**

  - Goal is to achieve interoperability with simple data model, messaging model, communication profile, and security

  - Based on IEEE 2030.5

  - Group Management

    - System

    - Sub-transmission

    - Substation

    - Feeder

    - Segment

    - Service Transformer

  - 10 points / curve, 8 curves / inverter - This is a departure from the SIWG recommendations

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Rule 21, Phase 2 Handbooks

- **Individual IOUs need to update Generation Interconnection Handbooks, to include:**

  - IEEE 2030.5 implementation guide - Minimum DER Data Exchange Requirements

  - IEEE 2030.5 Optional parameters

  - Data exchange performance requirements

  - Cyber security requirements – Authentication, Authorization, Accountability, and Data Integrity, also key management, certificate authorities and management procedures

  - Cyber security related passwords and cryptographic keys

  - Privacy policies define what is or not publicly available

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Phase 3

Just getting started

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Phase 3 Scope

- **Functions being proposed – Under Utility control, includes storage**

  - Monitor DER Status and Output

  - Command DER to Connect or Disconnect

  - Set or Limit Maximum Real Power

  - Set Storage Charge/Discharge

  - Counter act voltage and frequency excursions: Frequency-Watt, Voltage-Watt, and Dynamic Reactive Current Support

  - Scheduling of DER and Storage functions

  - Energy Storage Management and Scheduling

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Phase 3 Today

- **Aug, 2015, SIWG has Recommendation Document**

- **Many functions are real power limiting and there is a financial tariff needs to be written to compensate owner/operators**

- **Sept. 27, 2015, Phase 3 Workshop**

  - CPUC Auditorium, San Francisco, CA

- **Stay tuned**

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Resources

- **Rule 21 Documents (CPUC R. 11-09-11)**

  - SIWG Phase 2 Recommendations, Draft V9, Feb 2015

  - CPUC Decision 14-12-035

  - Rule 21 Ombudsman

- **EPRI "Common Functions for Smart Inverters, Version 3"**

- **Sandia "**
  Draft Electric Rule 21 Test Protocols for Advanced Inverter Functions, 19 Dec 2014 Edition"

- **IEEE**

  - "IEEE 1547-2003", Version 26 August 2003

  - "IEEE 1547a-2014", Version 20 May 2014

- **UL 1741 SA – Not published at this time**

Questions