

Spring NPCC Compliance and Standards Workshop May 22-23, 2019

Reliability Standards Outlook

Guy V. Zito
NPCC AVP - Standards

Discussion Items:

- Overview of Standards Development
- RISC Emerging Risks and Resilience/HEMP
- Process and Stakeholder tools
- Distributed Energy Resources
- NPCC's Regional Standard
- NPCC Criteria Services
- NPCC Regional Standards Committee

NERC Standards Development

- NERC Reliability Standards Development
 - Project 2016-02 Modifications to CIP Standards (**BA, DP, GOP, GO, RC, TOP, and TO**)
 - Project 2015-09 Establish and Communicate System Operating Limits - FAC-010, FAC-011, FAC-014, FAC-015-new (**PC, RC, TOP, TP, GO, and TO**)
 - Project 2017-01 Modifications to the BAL-003-1.1 (**BA and FRSG**)
 - Project 2018-04 PRC-024-3 – Generator Frequency and Voltage Protection Settings (**GO and TO**)
 - Project 2019-02 BES Cyber System Information Access Management (**RC, TOP, TO, GO, GOP, BA, and DP**)
 - Project 2019-01 Modifications to TPL-007-3, Transmission System Planned Performance for Geomagnetic Disturbance (**PC, TP, TO, and GO**)
 - Project 2017-07 Standards Alignment with Registration

NERC Standards Development

– Additional Considerations

- Reliability Issues Steering Committee (RISC)
- Essential Reliability Services Task Force (ERSTF) recommendations
- Industry Feedback Loops (e.g. Events Analysis, Compliance, RAPA)
- IEEE 1547 and VER Modeling
- Standards Efficiency Review (SER)
- Standards Grading
- DOE Report and NOPR to FERC (Resiliency concerns)
- High Impact Low Frequency events

NERC Standards Development

- Cost Effectiveness:
 - Analysis of the Risk being reduced
 - Cost associated with reducing that risk
 - Cost associated with not reducing the risk (reliability and societal if possible)
 - Standards Drafting Teams, Periodic Review Teams, and Standards Grading
 - **Drafting Teams asked to develop alternatives**
 - **Add question(s) to the Comment forms**
 - Application to all Standards projects

Reliability Issues Steering Committee (RISC) and Emerging Risks

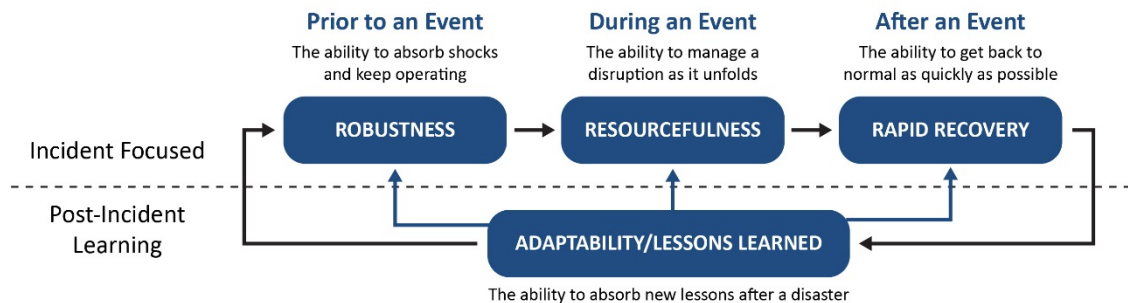
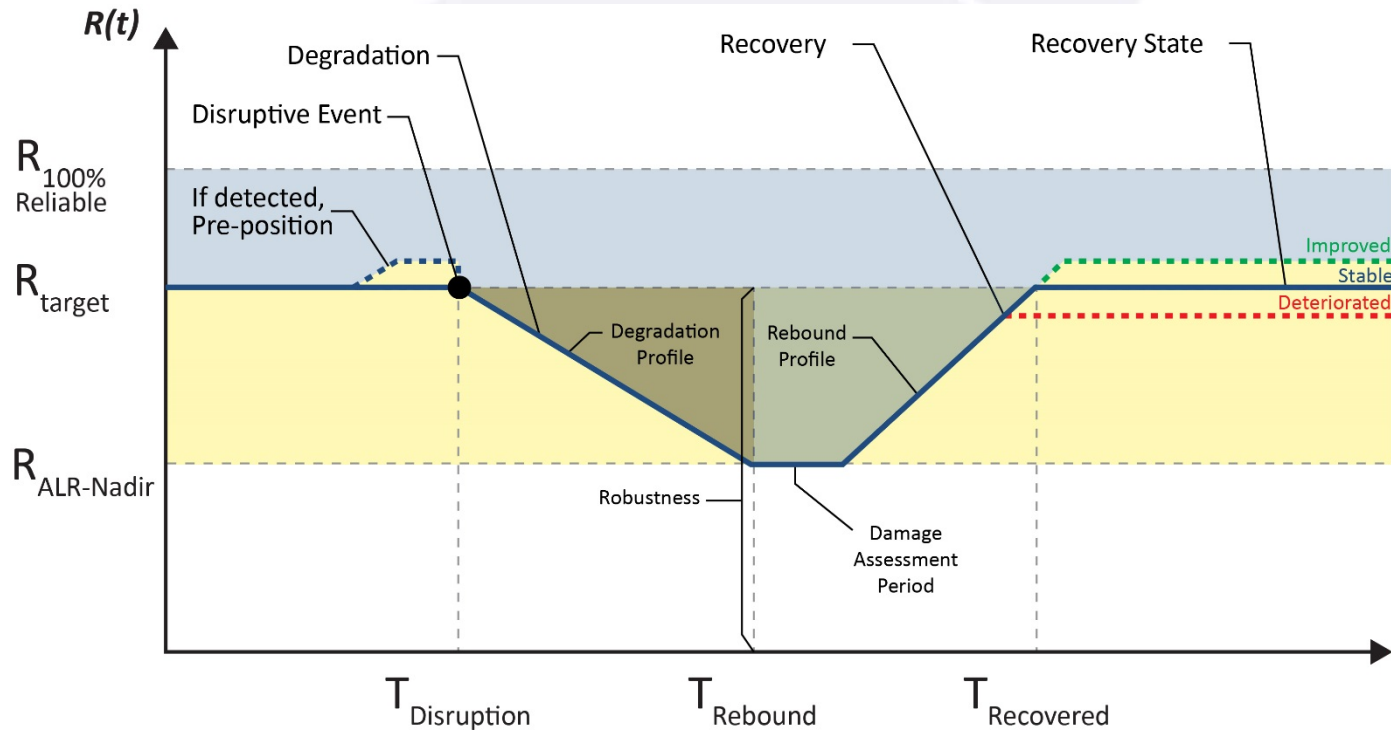
“ERO Reliability Risk Priorities,” – 2018 BOT Approved Report - Risks Identified and a potential framework for Resilience

- Risk Profile #1: Changing Resource Mix (**High**)
- Risk Profile #2: Bulk-Power System Planning (**High**)
- Risk Profile #3: Resource Adequacy and Performance (**High**)
- Risk Profile #9: Cybersecurity Vulnerabilities (**High**)
- Risk Profile #4: Increasing Complexity in Protection and Control Systems and Asset Management (**Moderate**)
- Risk Profile #6: Loss of Situational Awareness (**Moderate**)
- Risk Profile #7: Extreme Natural Events (**Moderate**)
- Risk Profile #8: Physical Security Vulnerabilities (**Moderate**)
- Risk Profile #5: Human Performance and Skilled Workforce (**Low**)

Resilience

- Four outcome-based abilities of resilience (framework) are as follows:
 - **Robustness** – the ability to absorb shocks and continue operating
 - **Resourcefulness** – the ability to **detect and manage a crisis as it unfolds**
 - **Rapid recovery** – the ability to get services back as quickly as possible **in a coordinated and controlled manner and taking into consideration the extent of the damage**
 - **Adaptability** – the ability to incorporate lessons learned from past events to improve resilience
- FERC Chairman-“Top priority of the Commission” address concerns- DOE Staff Report and NOPR”
- FERC terminated the DOE NOPR and developed a FERC NOPR
 - what resilience of the bulk power system means and requires;
 - understand how each RTO and ISO assesses resilience in its geographic footprint; and
 - use this information to evaluate whether additional Commission action regarding resilience is appropriate at this time.
- RISC Report on Resilience

Resilience



Electromagnetic Pulse (High Altitude “HEMP”)

- Electric Power Research Institute EPRI Study of E1
 - Study to be released Spring 2019
 - Study uses wave guides and direct injection
 - Study will recommend cost effective mitigation methods to harden the grid against E1
- FERC
 - Waiting for study
 - Potential for a NOPR to address possible BES E1 risks
 - Potential for a similar approach as GMD, one for operational and one for planning (i.e. EOP-010 and TPL-007)
 - Critical facility list development identifying where potential weaknesses may exist

NPCC Regional Standards

- PRC-006-NPCC-1 Revision to:
 - Review for potential revisions made necessary by:
 - NERC PRC-006-1/PRC-006-2 Automatic Underfrequency Load Shedding
 - NERC PRC-024-1/PRC-024-2 Generator Frequency and Voltage Protective Relay Settings standards.
 - Review for Dispersed Generation (DG) issues
 - Developed to enable retirement of NPCC Directory 12
 - Three 45-day formal postings for comments
 - 30 day pre-Ballot Review and 10 + day ballot in fourth quarter 2018-approved by Stakeholders
 - Approved by NPCC Board of Directors May 1, 2019
 - Transmittal to NERC BOT for adoption at August 15, 2019
 - File with FERC and Provincial Governmental Authorities

NPCC Criteria Services

- Maintain and Revise Directories and Criteria
- A-10 “Classification of BPS Elements” Revision
- Cost Effectiveness and Resilience Pilot on two Directories
- Revise Directory Development and Revision Manual
- SPS to RAS Transition
- Criteria Enforcement Program
- Applicability (Member or Tariff)

NPCC Regional Standards Committee (RSC)

- Interface with RISC- emerging issue identification
- Review and comments on NERC/ERO and Eastern Interconnection Regional Standards
- Develops Ballot Recommendations for NERC/ ERO Standards and Interpretations
- Participates in NERC Standards drafting and influence processes through various groups-formal and informal
- Oversees the Development and Maintenance of NPCC Regional Standards
- Oversees the Development and Maintenance of NPCC Regional Directories
- Regional Delegation Agreement-Standards Program Area
- Review all FERC Orders, Rulings, NOPRs and Petitions related to Standards
- Participates in Feedback loop mechanisms to improve standards

NPCC Regional Standards Committee

- Distributed Energy Resources (DER) Forum
 - Initiated at the May 2019 RSC meeting-second day of RSC meetings
 - Evaluation of DER opportunities and challenges
 - Information sharing and coordination
 - Identification of reliability gaps
 - Develop guidance document(s)
 - Coordinate with State and Provincial regulators
 - Coordinate with area efforts underway for utility scale distribution level DER

“Intelligence is the ability to adapt to change.”- Stephen Hawking



Stephen Hawking (Jan 1942-March 2018)

Questions or Comments ?

NPCC 2019 Spring Compliance and Standards Workshop

Standards Efficiency Review (SER) Update

Guy V. Zito, NPCC

Greg Campoli, NYISO

Michael Puscas, ISO-NE

SER Overview

- Industry requested BOT in May 2017 to evaluate all standards using a risk based approach to identify potential retirements or modifications to standards
- Give consideration to:
 - FERC P-81 Criteria from FFT Order
 - IERP previous recommendations
 - Excessive compliance reporting burdens
 - Compliance self reports and violations

SER Overview Phase 1

- Conduct the project in multiple phases, O&P and then CIP, initially three teams
- Functional Advisory Group –oversight
- Phase 1 SDT approximately ~114 in SAR, ~84 reqs. and sub.
- SER vs Standards Grading-what's the difference?

SER Overview, cont.

- Retirement proposals consisted of:
 - Certification candidates (incorporate into TOP, BA, or RC Certifications)
 - Business Practices (potential to be NAESB standards)
 - P81 – duplicative, administrative or little benefit to reliability
 - Part of a Periodic Review and in the process of review for potential retirement
 - Part of an active Standards Development Project where some preliminary work from a drafting team shows opportunity to retire requirement(s)

Future SER Process Challenges

- Justifications for retirements-FERC ruled them to be necessary for “reliable operation” as defined in the statute.
- Due diligence in reviewing to ensure no FERC Directive was once associated with a retirement candidate.
- Some requirements may have to be cross reviewed by other team(s). Coordination between the three teams and uniform analysis and decision making.
- Dividing up the resultant recommended work
- Incorporation into the Reliability Standards Development Plan
- Timeline for completion (teams and industry)
- Industry resource constraints due to SER, Standards Projects, Standards Grading and any FERC Directives being issued.
- Process not clearly documented, industry awareness

SER Next Steps

Phase 2:

- Alternatives to retirement (Consolidate-Modify)
- Form SER Phase 2 team by supplementing from CCC & SC
- Identify key issues to address with Advisory Group (complete)
- Develop new efficiency concepts (2018 Q4 to 2019 Q2)
- Conduct industry webinar and solicit input on concepts (2019 Q1)
- Evaluate and identify best efficiency concepts (2019 Q2-Q3)
- Draft SAR(s) or implement concepts (2019)
- Industry NERC Webpage

<http://www.nerc.com/pa/stand/pages/standards-efficiency-review.aspx>

SER Next Steps

Phase 2 possible Concepts to promote future efficiency of standards:

- Concept 1: Evidence Retention Overhaul
- Concept 2: Prototype Standard
- Concept 3: Move Requirements to Guidance
- Concept 4: Consolidate & Simplify Training Requirements
- Concept 5: Consolidate Information/Data Exchange Requirements
- Concept 6: Relocate Competency-based Requirements to Certification Program/CMEP Controls Review process

Posted for an informal comment period 2/22-3/22

“Are we there yet?”

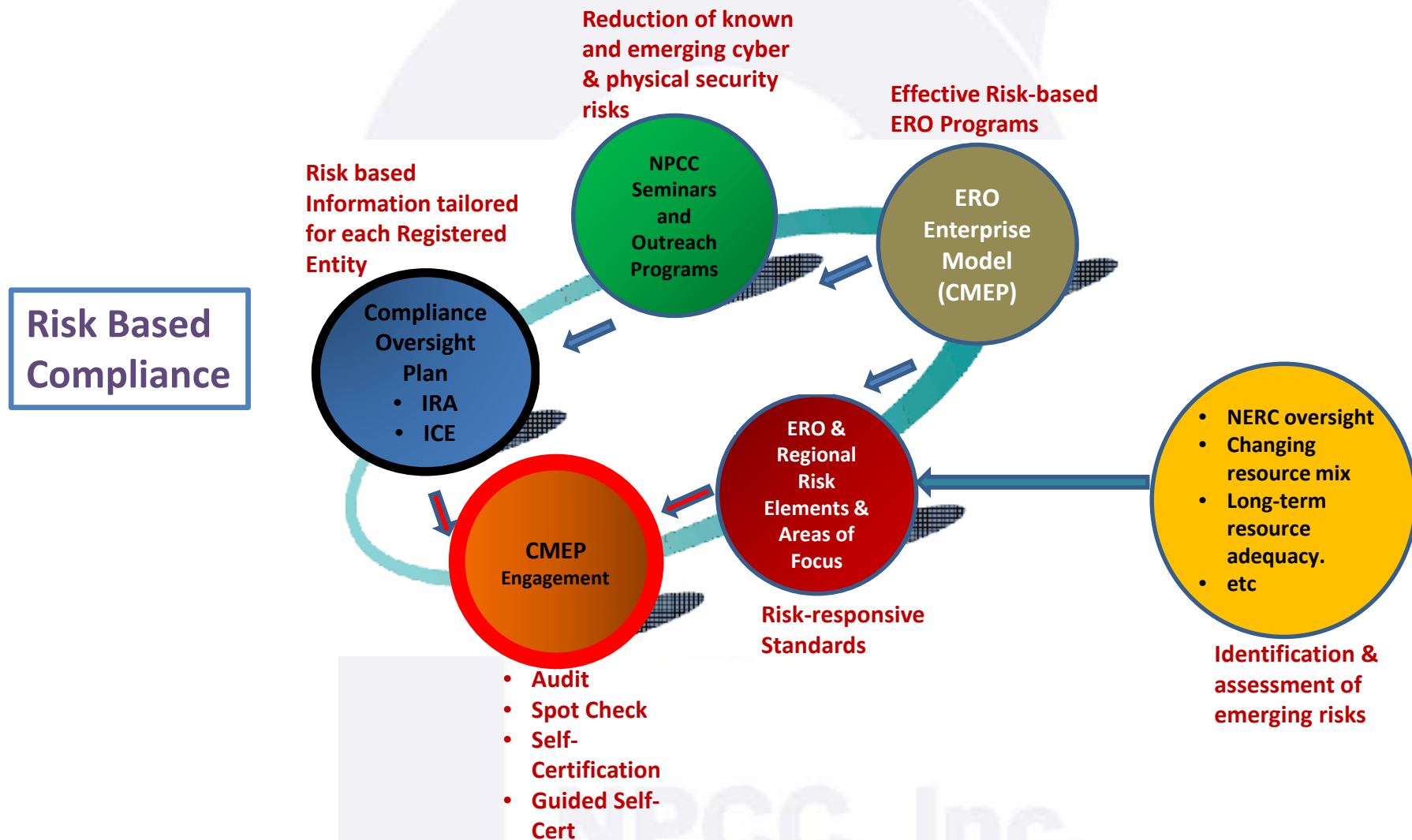
Sal Buffamante

NPCC 2019 Spring Compliance & Standards Workshop

The Journey: *Where Are We Going?*

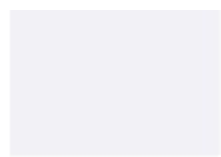


How Do We Get There?





Any Questions?



NPCC, Inc.

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NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Centralized Organization Registration ERO System (CORES)

NPCC Workshop
May 29, 2019

RELIABILITY | ACCOUNTABILITY



- Overview
- Registered Entity Pilot Sessions
- Upcoming activities and events

- The objective of the Centralized Organization Registration ERO System (CORES) project is to create a centralized registration system for the ERO. This project will address:
 - Processing of registration requests
 - Granting of a NERC Compliance Registry (NCR) identification number
 - The information collected in CORES will be based upon the existing [Common Registration Form](#) that each Regional Entity currently uses for processing registration requests
 - Link to CORES project page – FAQs, timeline, opportunities for engagement (<https://www.nerc.com/pa/comp/Pages/CORESTechnologyProject.aspx>)

- The CORES application is hosted on the ERO Portal
 - Each entity user that will register or modify registration with NERC will need an ERO Portal account
 - <https://eroportal.nerc.net/>
- Registered entities will not need to register again
- The process for collecting data is different – the data is virtually the same

- **Benefits**

- CORES will expand current functionality, align regional registration processes, and provide an improved system-based approach to processing registration requests.
- Central repository for collecting registered entity data and related documentation
- New functionality for entities in multiple regions
 - Coordinated Oversight information updated to My Entity page
 - Process is the same
- Easily update information in a central location
 - Functional registration
 - Parent company & affiliates
 - Functional mapping

- CORES is not currently planned to be used for
 - Compliance Monitoring and Enforcement Functions – see the Align project.
 - <https://www.nerc.com/ResourceCenter/Pages/CMEPTechnologyProject.aspx>
 - Certification or Certification Reviews
 - No system in place for certification or certification reviews at this time
 - BES Processing
 - BES processing will continue to utilize the BESnet application

- The information collected in CORES will be based upon the Common Registration Form
 - Entity names
 - Contact information
 - Functional registration request information
 - Parent company and affiliate information

Entity Registration Form

This form should be submitted via e-mail to Registration@mro.net

Entity Information			
Entity Name/Company (Legal Name):			Date:
Corporate Address:			
City, State, Zip:		Country:	
Corporate Website:			
NERC Compliance Registry (NCR) ID:		New Facility test power sync date:	
Registration Request: New ☐ Deactivation ☐	BA ☐ GO ☐ GOP ☐ DP ☐ PA ☐ RC ☐ RP ☐ RSG ☐ TO ☐ TOP ☐ TP ☐ TSP ☐ DP UFLS only ☐		
DP Function:			
What is the peak Load (MW)?			
As a DP, does your entity own, control or operate:	1. a required Undervoltage Load Shedding (UVLS) program or	Yes ☐ No ☐	
	2. a required Special Protection System or Remedial Action Scheme or	Yes ☐ No ☐	
	3. a required transmission Protection System or an	Yes ☐ No ☐	
	4. Underfrequency Load Shedding (UFLS) program?	Yes ☐ No ☐	
Reason for request: (i.e. new registration, name change, removal of function, etc.)			
Has a BES Exception request been submitted?	Yes ☐ No ☐		
List parent company and NERC ID (if applicable):			
List affiliates and NERC ID (if applicable):			
Coordinated Functional Registration (CFR):	Yes ☐ No ☐	CFR Number:	
Joint Registration	Yes ☐ No ☐	Joint Registration Number:	

- The information collected in CORES will include
 - Joint Registration Organization (JRO) information
 - Multi-Regional Registered Entity (MRRE) information
 - Functional model relationships
 - Role information for specific contacts

Entity Registration Form

This form should be submitted via e-mail to Registration@mro.net

Entity Information			
Entity Name/Company (Legal Name):			Date:
Corporate Address:			
City, State, Zip:		Country:	
Corporate Website:			
NERC Compliance Registry (NCR) ID:		New Facility test power sync date:	
Registration Request: New ☐ Deactivation ☐	BA ☐ GO ☐ GOP ☐ DP ☐ PA ☐ RC ☐ RP ☐ RSG ☐ TO ☐ TOP ☐ TP ☐ TSP ☐ DP UFLS only ☐		
DP Function: What is the peak Load (MW)?			
As a DP, does your entity own, control or operate:	1. a required Undervoltage Load Shedding (UVLS) program or	Yes ☐ No ☐	
	2. a required Special Protection System or Remedial Action Scheme or	Yes ☐ No ☐	
	3. a required transmission Protection System or an	Yes ☐ No ☐	
	4. Underfrequency Load Shedding (UFLS) program?	Yes ☐ No ☐	
Reason for request: (i.e. new registration, name change, removal of function, etc.)			
Has a BES Exception request been submitted?	Yes ☐ No ☐		
List parent company and NERC ID (if applicable):			
List affiliates and NERC ID (if applicable):			
Coordinated Functional Registration (CFR):	Yes ☐ No ☐	CFR Number:	
Joint Registration	Yes ☐ No ☐	Joint Registration Number:	

- Focus Group
- AWG
- ORCS
- CCC
- Bulletins
- Regional Workshops
- Registered Entity Pilots – Testing
- Training

https://www.nerc.com/pa/comp/Pages/CORESTechnologyProject.aspx

About Compliance Operations

Regional Entity Compliance Programs
ERO Enterprise Program Alignment Process

Compliance Analysis and Certification

Organization Certification
Compliance Investigations
Compliance Hotline

Organization Registration

Audit Assurance and Oversight

Regional Audit Reports of Registered Entities

Physical Security Standard Implementation

Risk-Based Compliance Monitoring and Enforcement Program (CMEP)

Compliance Tools and Auditor Resources

Compliance Guidance
Compliance Application Notices (CANs)
Compliance Process Bulletins
ERO Enterprise Compliance Auditor Manual
Compliance Directives and Bulletins for Regional Entities
Reliability Standards Audit Worksheet (RSAWs)
Compliance Archive Documents

Compliance Webinars

Compliance Reports

Enforcement and Mitigation

Enforcement Analysis and Violation Statistics

CMEP Annual Reports
Vegetation Management Reports

Committees

Compliance and Certification Committee (CCC)

Compliance Resource Documents

Supply Chain Webinars

Centralized Organization Registration ERO System (CORES) Technology Project

Home > Program Areas & Departments > Compliance & Enforcement > Centralized Organization Registration ERO System (CORES) Technology Project

Centralized Organization Registration ERO System (CORES) Technology Project

The Entity Registration project was established to take the core registration functions currently managed in three systems – OATI – webCDMS, Guidance – CITS and CRATS and move all registration functions to a single, consolidated system.

- This will also allow for an expansion of current functionality.
 - The expansion will produce consistent Regional Entity and registered entity processes.
 - More control over the future of the application
 - The effort will also include capturing data elements for Coordinated Oversight and tracking Coordinated Oversight of Multi-Regional Registered Entities (MRREs).
 - It will include making the ERO Portal designed in such a way to allow entities to be able to manage their JROs, CFRs and other registration needs.
 - This tool will capture the data elements that need to be integrated with the CMEP Tool.

Industry Outreach Engagements

The ERO is engaging the industry on the CORES technology project through the Compliance and Certification Committee (CCC), as well as the Organization Registration and Certification Subcommittee (ORCS) Alignment Working Group (AWG) of the CCC Outreach will also target an industry focus group and Regional Entities.

The CCC will be providing oversight of the technology project through the ORCS and AWG. The ORCS will be focusing on the technical registration activities involved in the project and the AWG will be focusing on the alignment of regional activities in the technology project.

The Industry Focus Group will provide input on the project in each phase from a registered entity perspective.

The Regional Entities will be engaging registered entities on the CORES technology project through user acceptance testing (UAT), training, and outreach.

To find out more about these engagements contact [NERC Registration](#) or use the links under "Industry Outreach Engagement Links" to the right.

News and Communications

Industry Outreach Engagement Links

Compliance and Certification Committee (CCC)

Organization Registration and Certification Subcommittee (ORCS)

Alignment Working Group (AWG)

NERC Organization Registration (Website)

NERC Organization Registration (Email)

CORES Technology Project Documents

🔍 Title

There are no documents in this view.

Summary Milestone Schedule

Project Milestone	Quarter
Project Charter	3Q2018
Project Kickoff	3Q2018
Requirements (Business & Functional)	4Q2018
Design	4Q2018
Tollgate 1: End of Plan/Analyze/Design	4Q2018
Development	1Q2019
Test	2Q2019
Tollgate 2: End of Develop/Test	2Q2019
Deploy to Production	2Q2019

- **Registered Entity Pilot Sessions**

- **Limited Seating In-person Engagements – Invitations sent directly to interested entities**
 - **May 14 | RF Hosted Reg. Entity Pilot Roadshow**
 - **May 16 | Texas RE Hosted Reg. Entity Pilot Roadshow**
 - **May 21 | NPCC Hosted Reg. Entity Pilot Roadshow**
 - **May 23 | NERC/Slalom Hosted Reg. Entity Pilot Roadshow**

- **Planned Training Dates (subject to change)**
 - June 6/7 | Post Training Materials
 - June 11 | NERC hosted ERO Webex (pre-release)
 - June 17-22 | System release this week
 - June 27 | NERC hosted ATL ERO In-person & Webex, open Q&A, (post-release)
 - July 17 | NERC hosted ERO Webex (*in-person), open Q&A, (post-release)
*optional



Questions and Answers

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

2019 Spring Compliance and Standards Workshop

Northeast Power Coordinating Council, Inc.

James Merlo, PhD

Vice President, Reliability Risk Management

May 22, 2019

RELIABILITY | ACCOUNTABILITY



The ERO Enterprise: NERC and 7 Regional Entities



15 Reliability Coordinators

184 Transmission Operators

108 Balancing Authorities

4 Interconnections

991 Generator Owners

398 Distribution Providers

4,353,740,908 MWh

2018 Actual Energy

1,028,629 MW

2018 Summer Peak Capacity

469,842 mi

Total Transmission Circuit Miles > 100kV

13,756

Number of Conventional Generating Units

99.92%

Time firm load was served

0

Category 3, 4, or 5 Events



Bulk Power System Situation Awareness Inputs and Products in 2018

233

DOE OE-417 Reports

459

EOP-004-2 Reports

2

EOP-002-3 Reports



2,963

Intelligent Alarms

4,239

FNet Notifications

1,855

RCIS Messages



NERC BPS Situational Awareness



255

Daily Reports

5

Special Reports

646

Event Notifications



0

Level 1 Alert

1

Level 2 Alerts

2014-2018 Event Analysis Trends



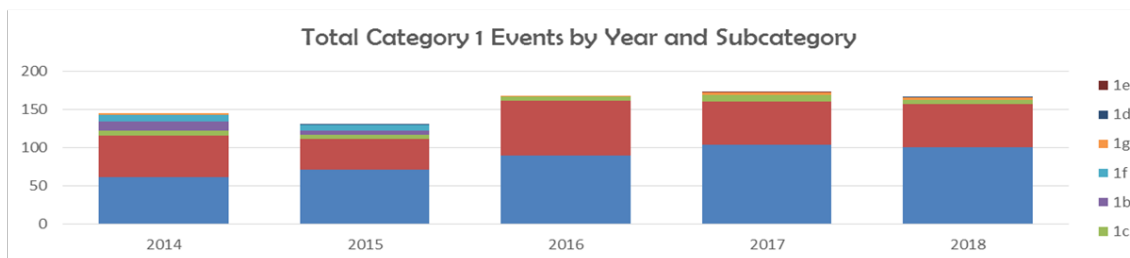
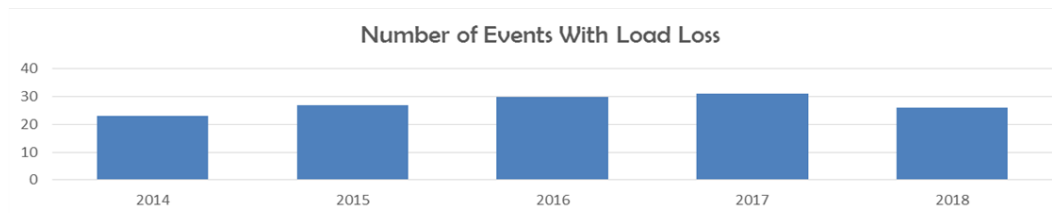
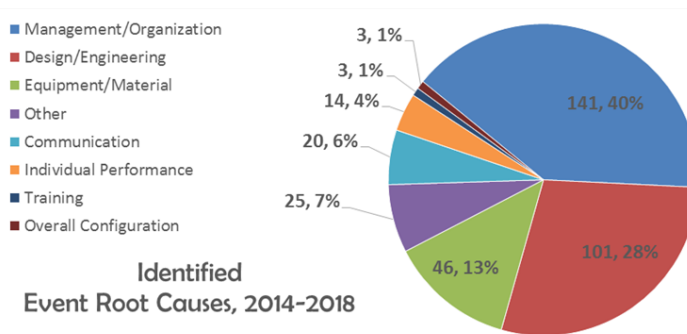
851 Event Reports

353 Identified Root Causes



306 MW

Average Load Loss of Events with Load Loss



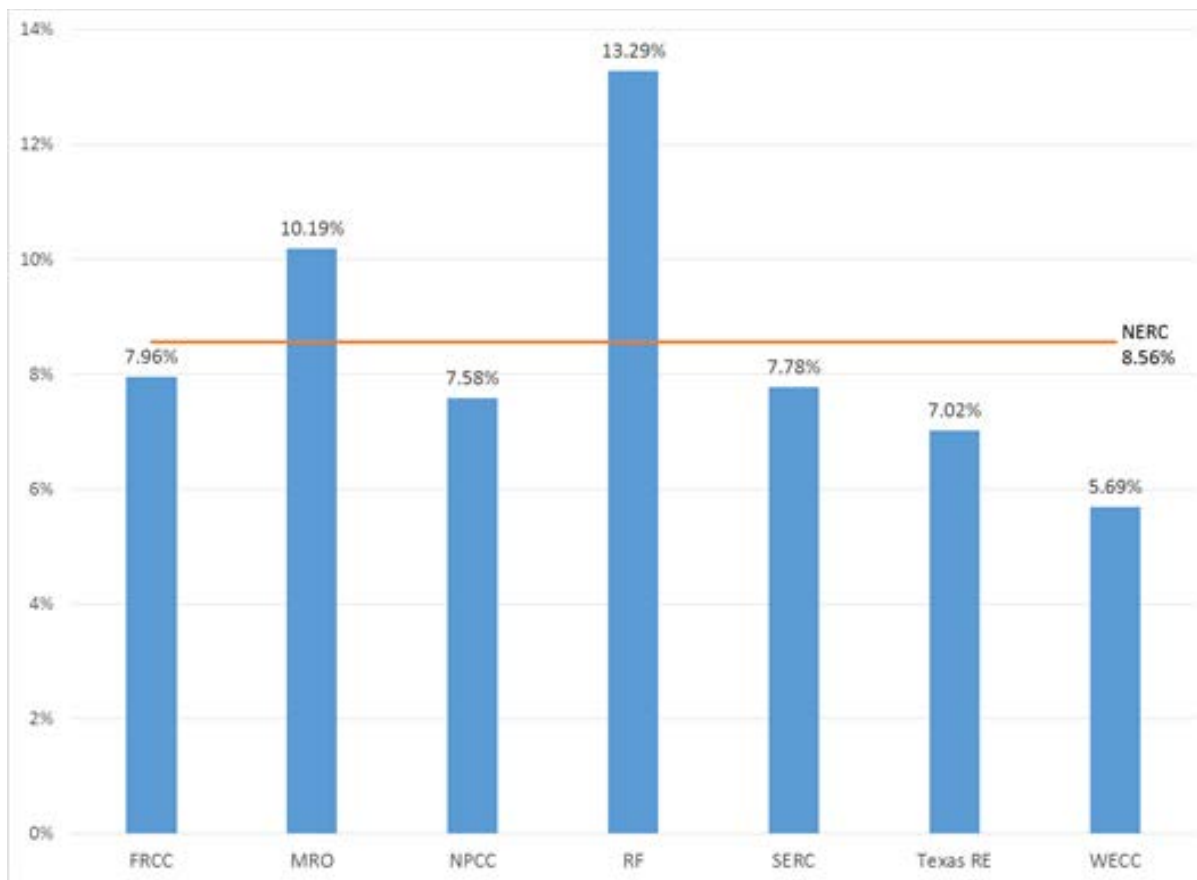
- **2 NERC Lessons Learned published to date in 2019**
 - 2 - Transmission Facilities
- **15 NERC Lessons Learned were published in 2018**
 - 1 - Generation Facilities
 - 6 - Communications
 - 7 - Transmission Facilities
 - 1 - Relaying and Protection Systems

Lessons Learned Published in 2018

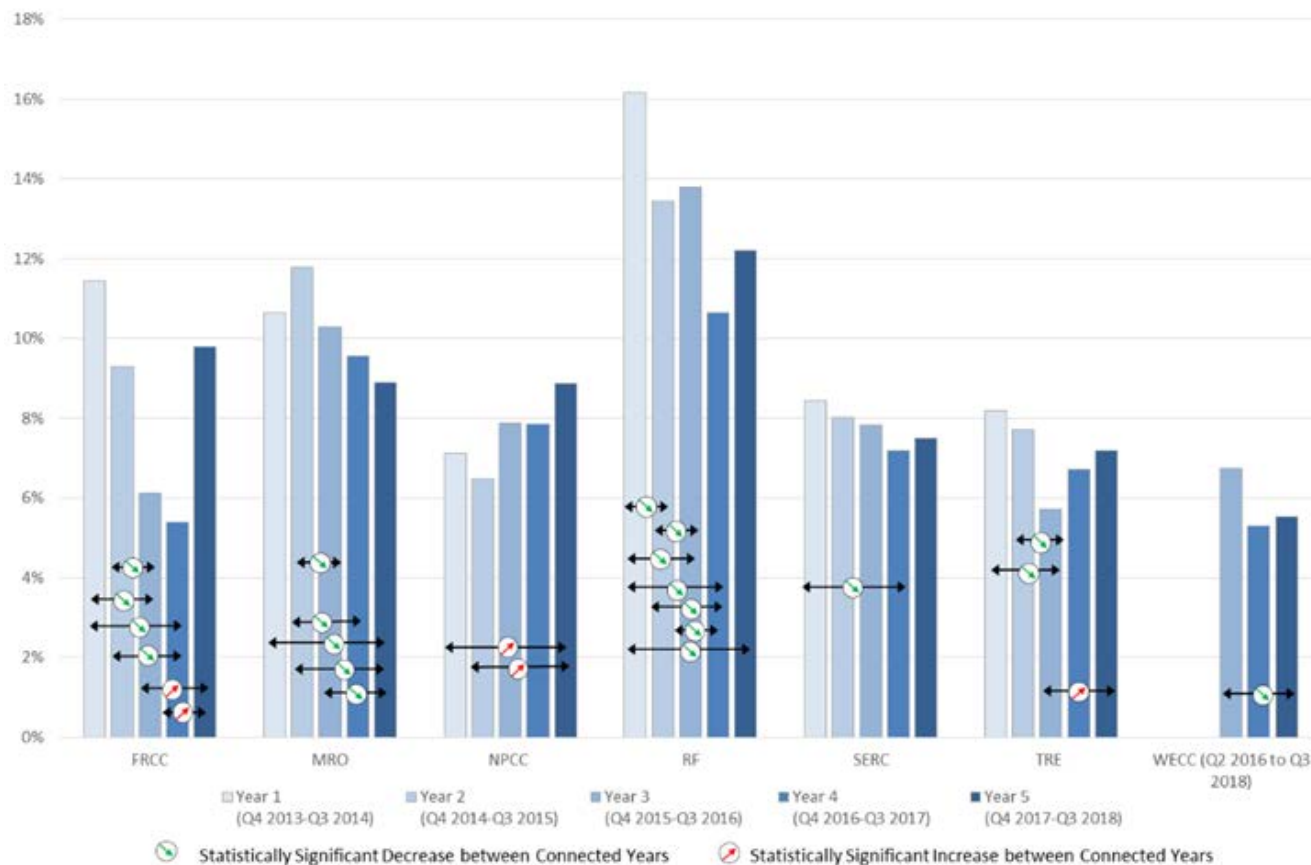
Lessons Learned Published in 2018		
LL #	Category	Title
LL20181203	Bulk-Power System Operations	<u>Cascading Analysis Identifies Need for Pre-Contingent Load Shed</u>
LL20181202	Communications, Transmission Facilities	<u>Avoiding IROL Exceedances with Rigorous Inspections during Commissioning, Consistent IROL Alarms, and Improved Training</u>
LL20181201	Relaying and Protection Systems	<u>Initiatives to Address and Reduce Misoperations</u>
LL20181002	Transmission Facilities	<u>Incorrect Field Modification and RAS Operation Lead to Partial System Collapse</u>
LL20181001	Communications	<u>Networking Packet Broadcast Storms</u>
LL20180802	Transmission Facilities	<u>Firewall Failure After Time Limit Exceeded</u>
LL20180801	Communications	<u>Loss of Substation Data Circuits to SCADA</u>
LL20180702	Transmission Facilities	<u>Preparing Circuit Breakers for Operation in Cold Weather</u>
LL20180701	Transmission Facilities	<u>Risk of Internet Accessible Cyber Assets</u>
LL20180603	Communications	<u>Back Office EMS Support Tools Impact Real-Time Situational Awareness</u>
LL20180602	Communications	<u>External Model Data Causing State Estimator to Not Converge</u>
LL20180601	Transmission Facilities	<u>Loss of Communication to Multiple SCADA RTUs at a Switching Center</u>
LL20180302	Transmission Facilities	<u>Breaker Failure Due to Trip Coil Polarity</u>
LL20180301	Communications	<u>State Estimator Outages Requiring Tuning/Calibrating EMS Settings</u>
LL20180101	Communications	<u>Inadequate Battery Configuration Management Damaged a Generating Station and Tripped an HVDC Conversion Station</u>

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
ERO Team*	0	0	0	0	0	0	0	0	0	1	1
FRCC	0	0	0	1	3	1	2	0	0	0	7
MRO	0	2	2	0	3	1	2	0	3	0	13
NERC	23	1	0	0	1	0	0	1	0	0	26
NPCC	0	5	2	5	4	10	6	2	4	0	38
RF	0	3	1	3	4	1	1	1	5	0	19
SERC	0	1	0	1	1	1	0	0	0	0	4
TRE	0	5	8	1	2	1	1	2	0	0	20
WECC	0	5	5	3	1	1	1	3	3	1	23
Total	23	22	18	14	19	16	13	9	15	2	151

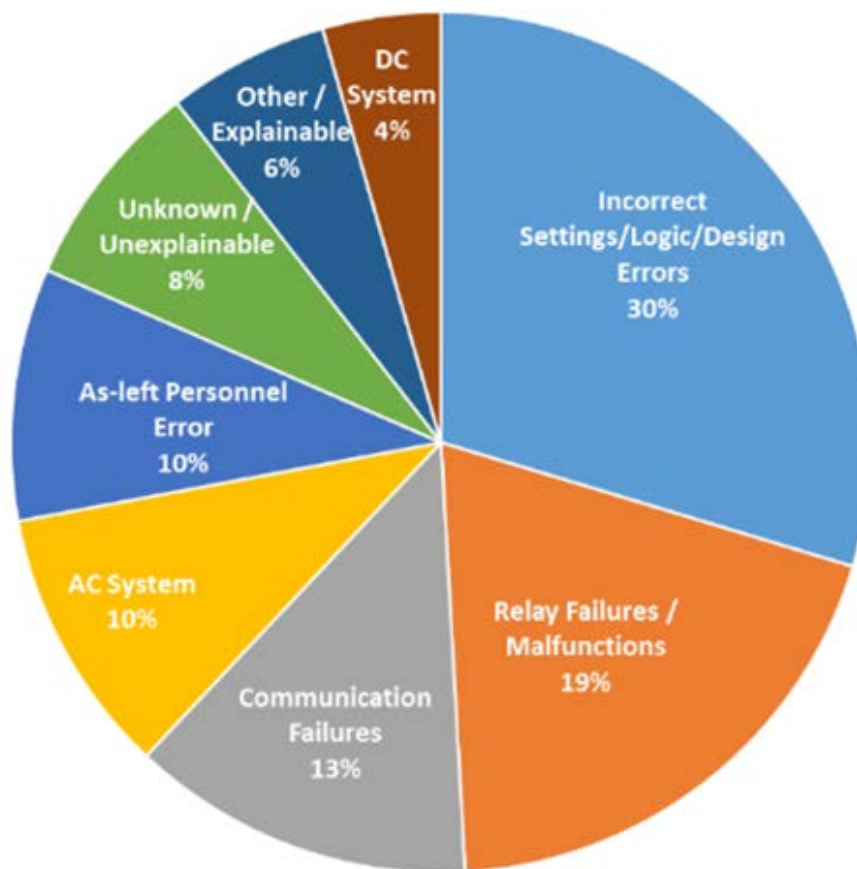
***“ERO Team” means multiple Regions contributed**



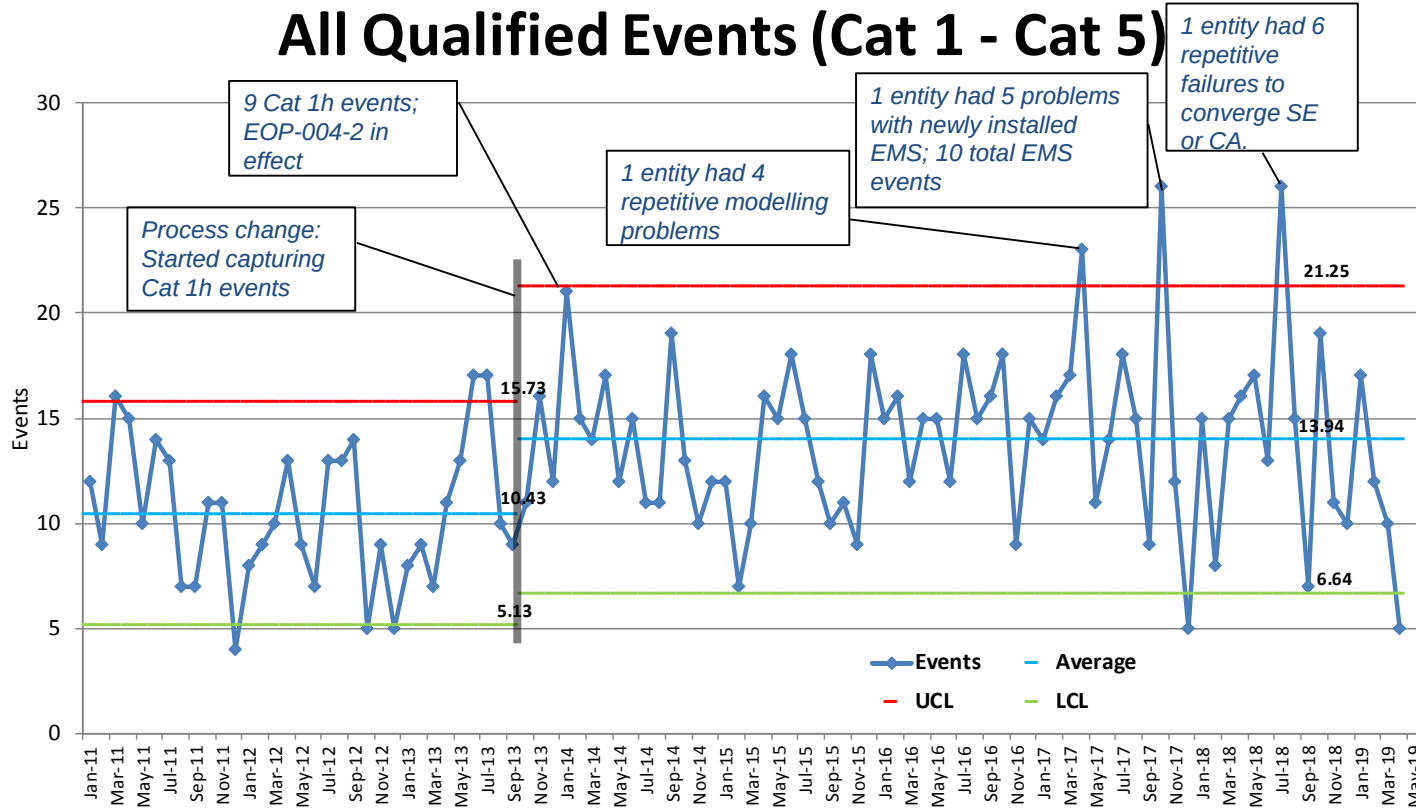
Misoperations Rate Over Time



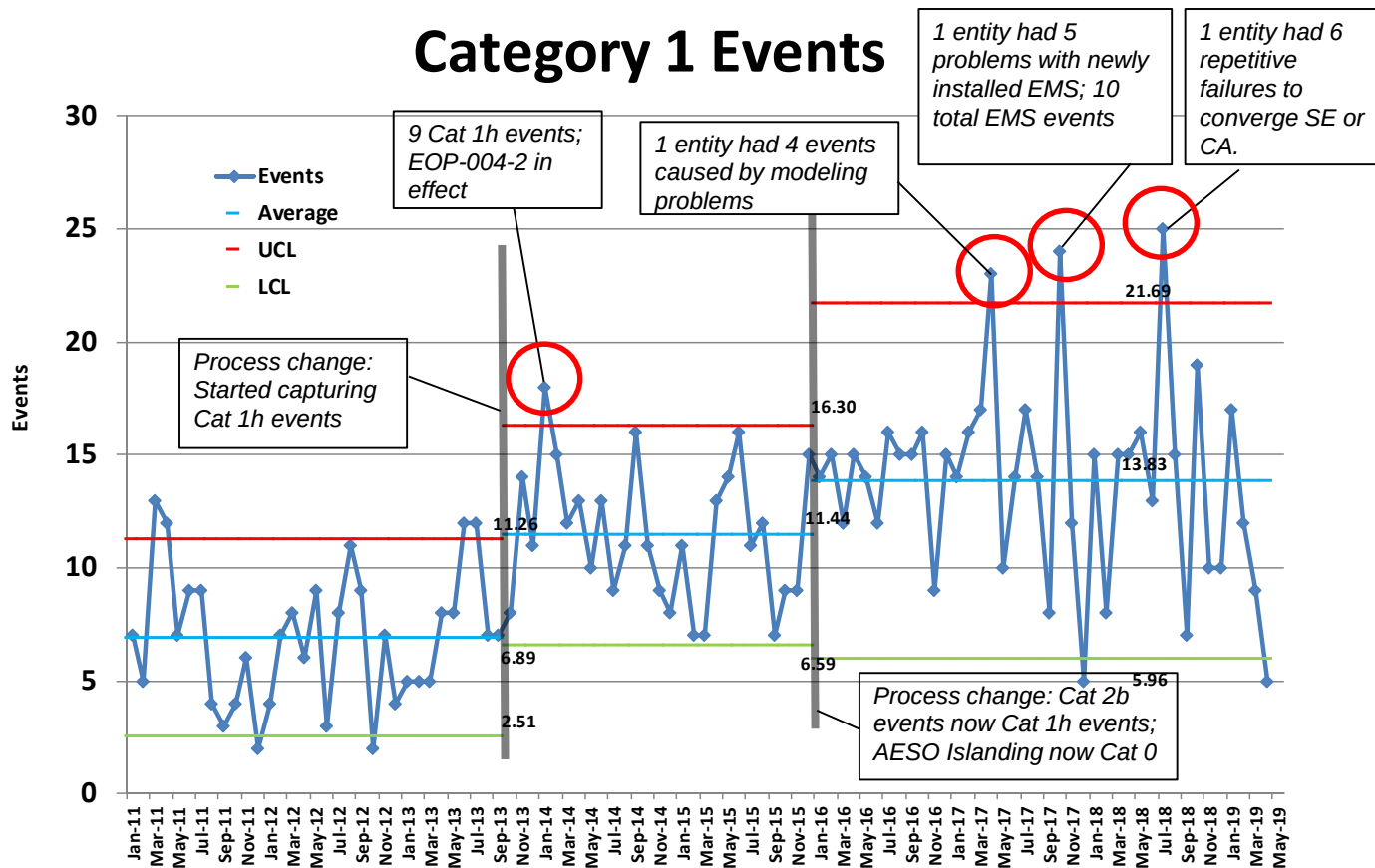
Misoperations by Cause Code (4Q 2013 through 3Q 2018)



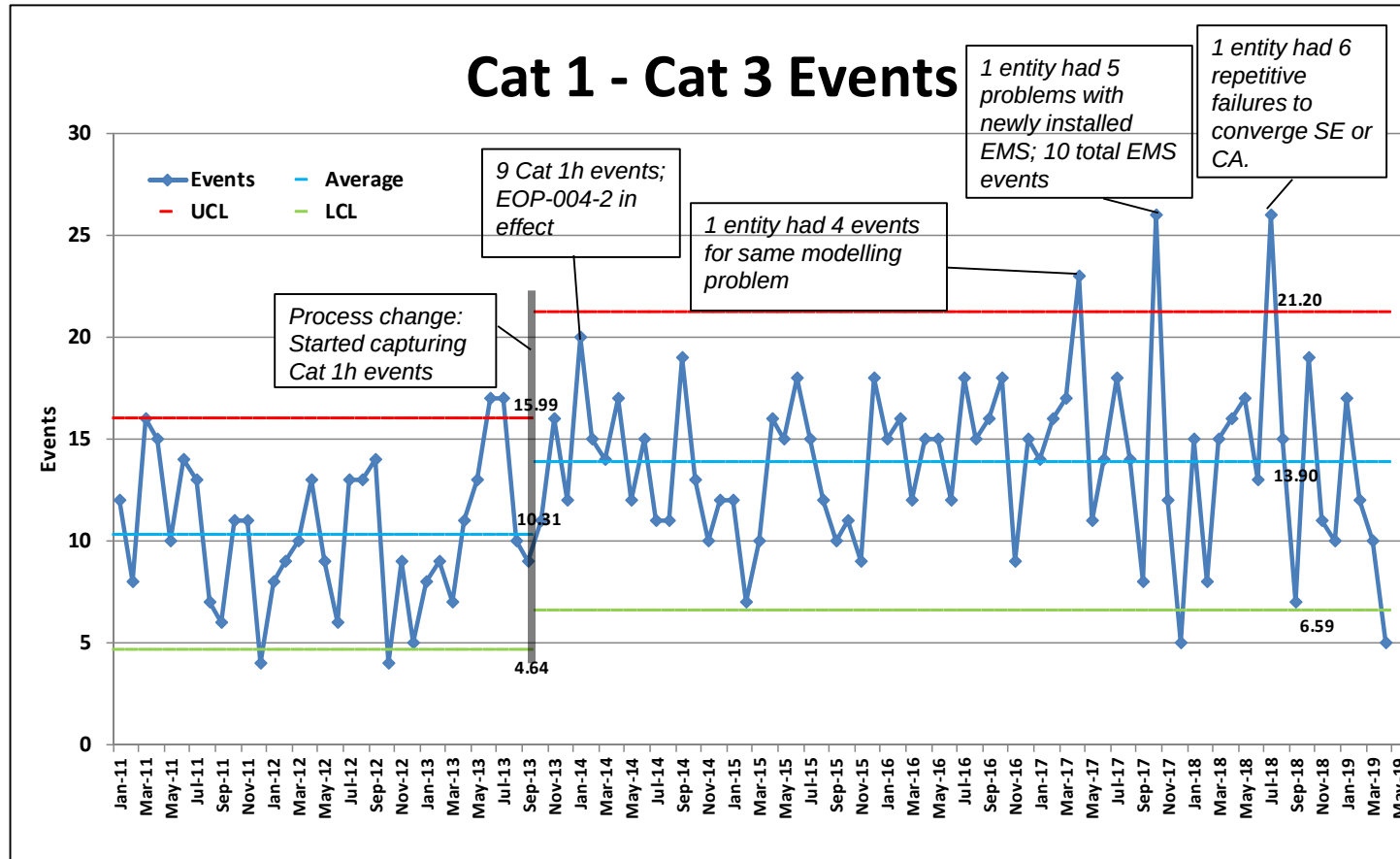
Control Chart of Qualified Events

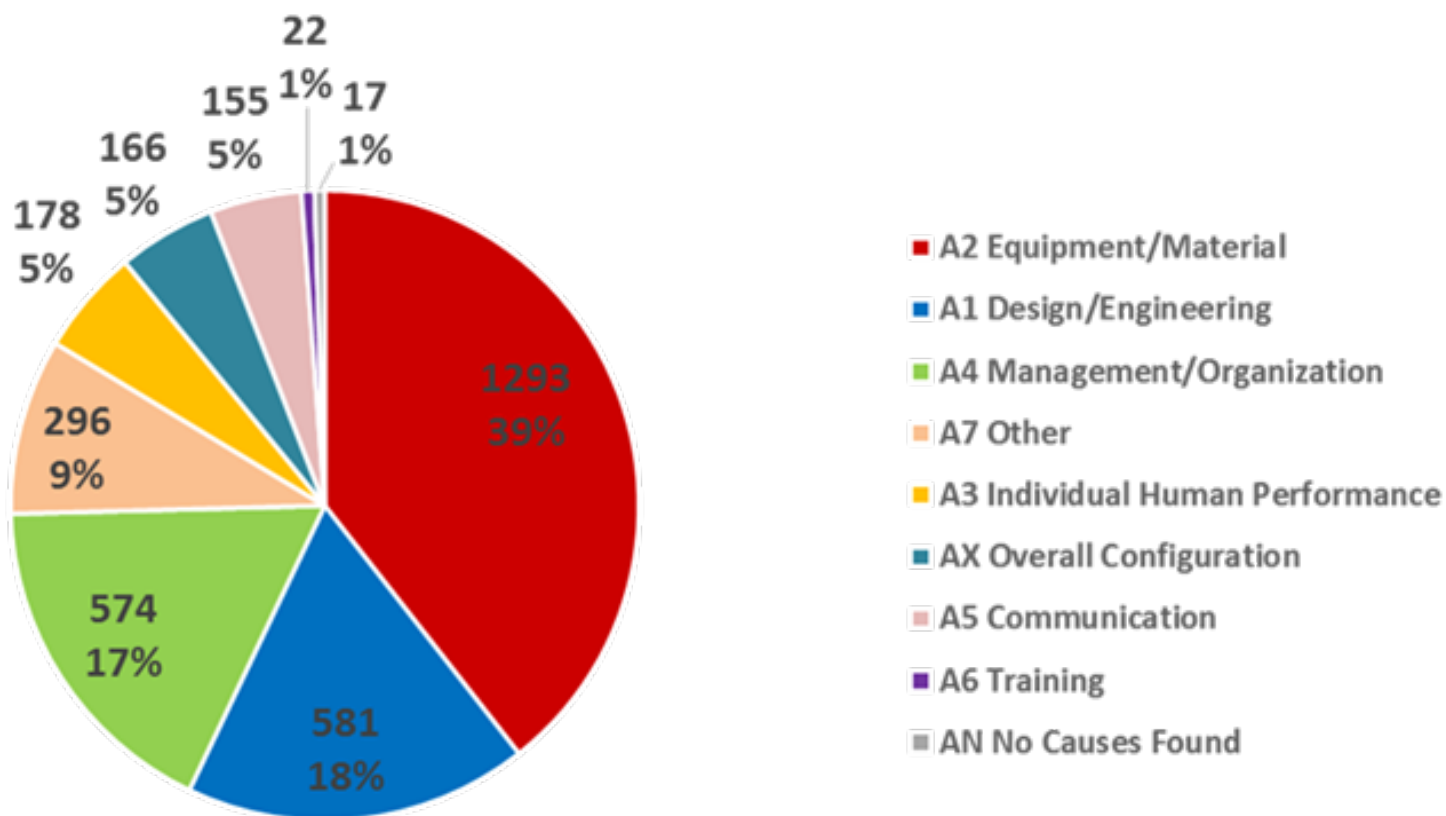


Control Chart of Cat 1 Events

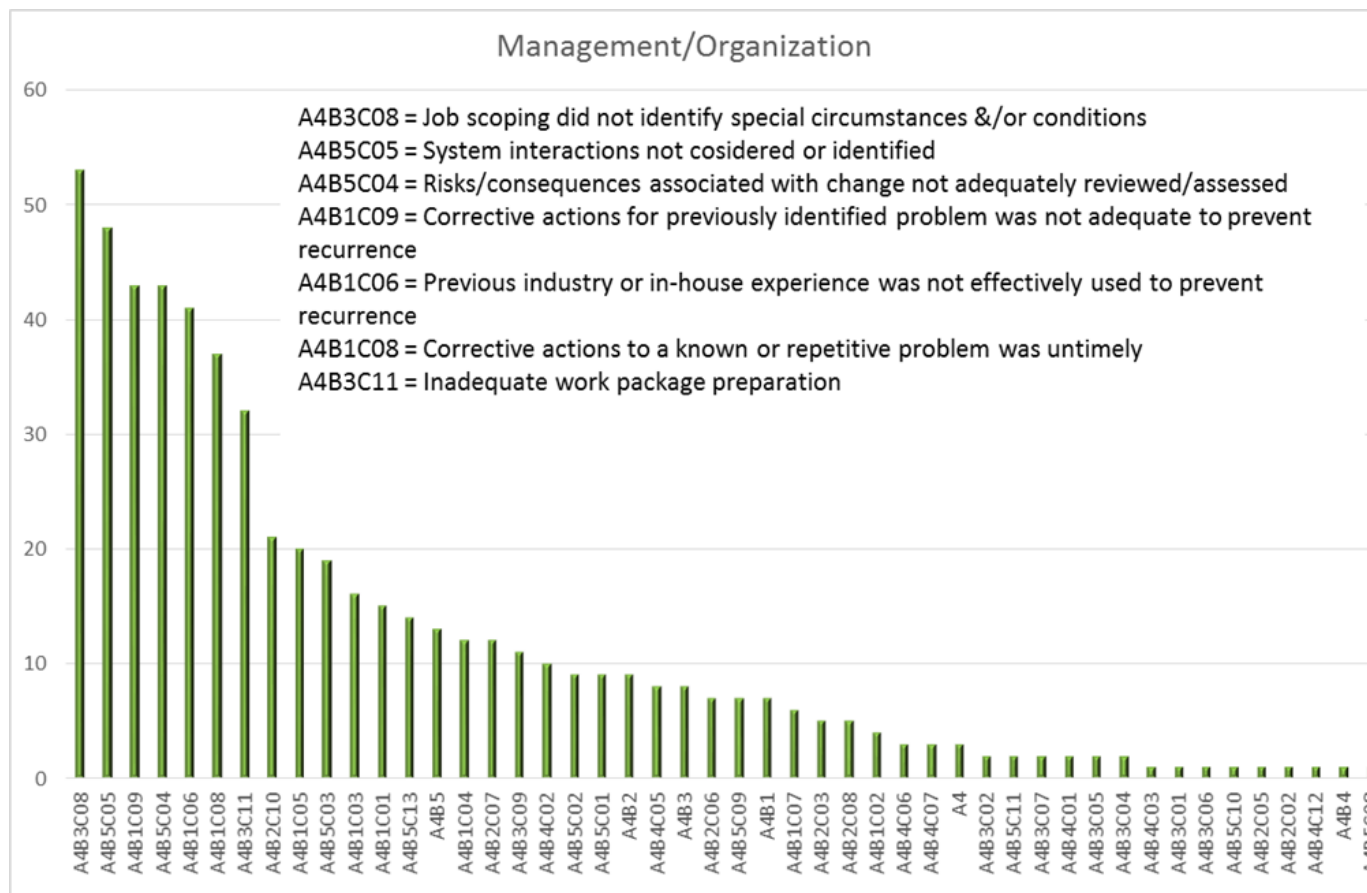


Control Chart for Cat 1 – 3 Events

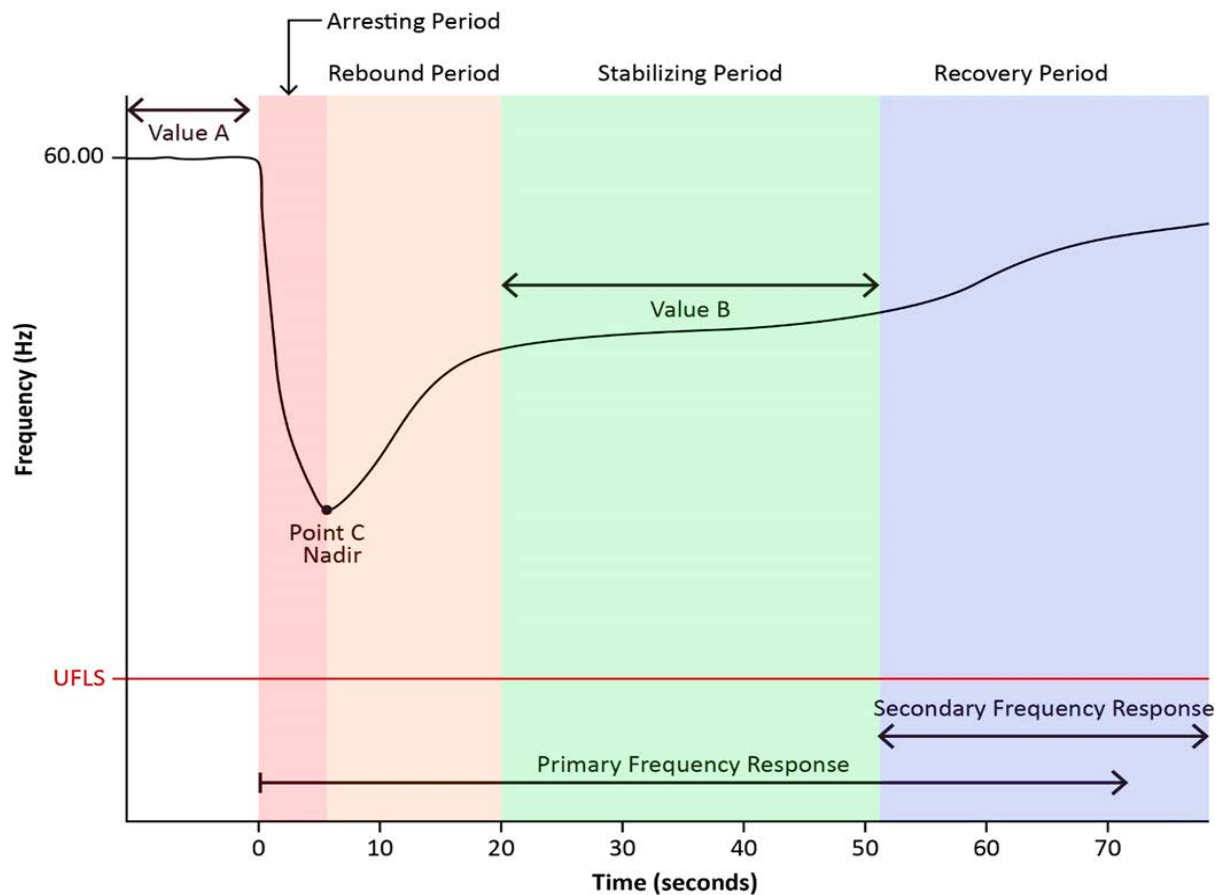




943 Events have been cause coded, with 3282 identified causes

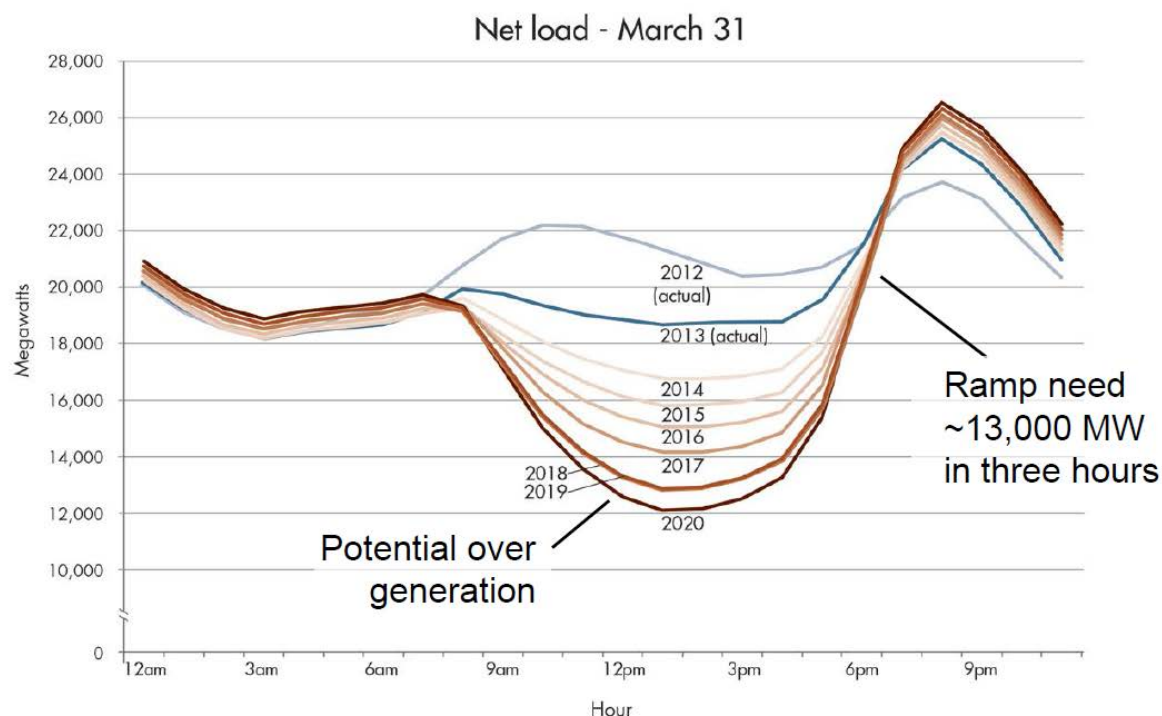


- Retirement/displacement of conventional generation
 - Variable energy resources
 - Rapid penetration of electronically-coupled resources
- Essential Reliability Services
 - Reduced inertia
 - Frequency Responses
 - Voltage Support
 - Ramping and flexibility needs
- Rapid penetration of new loads
- System controls and protection coordination
- Modeling and simulation constraints
- Increasing interface with distribution-centric resources





Non-summer months — Net load pattern changes significantly starting in 2014













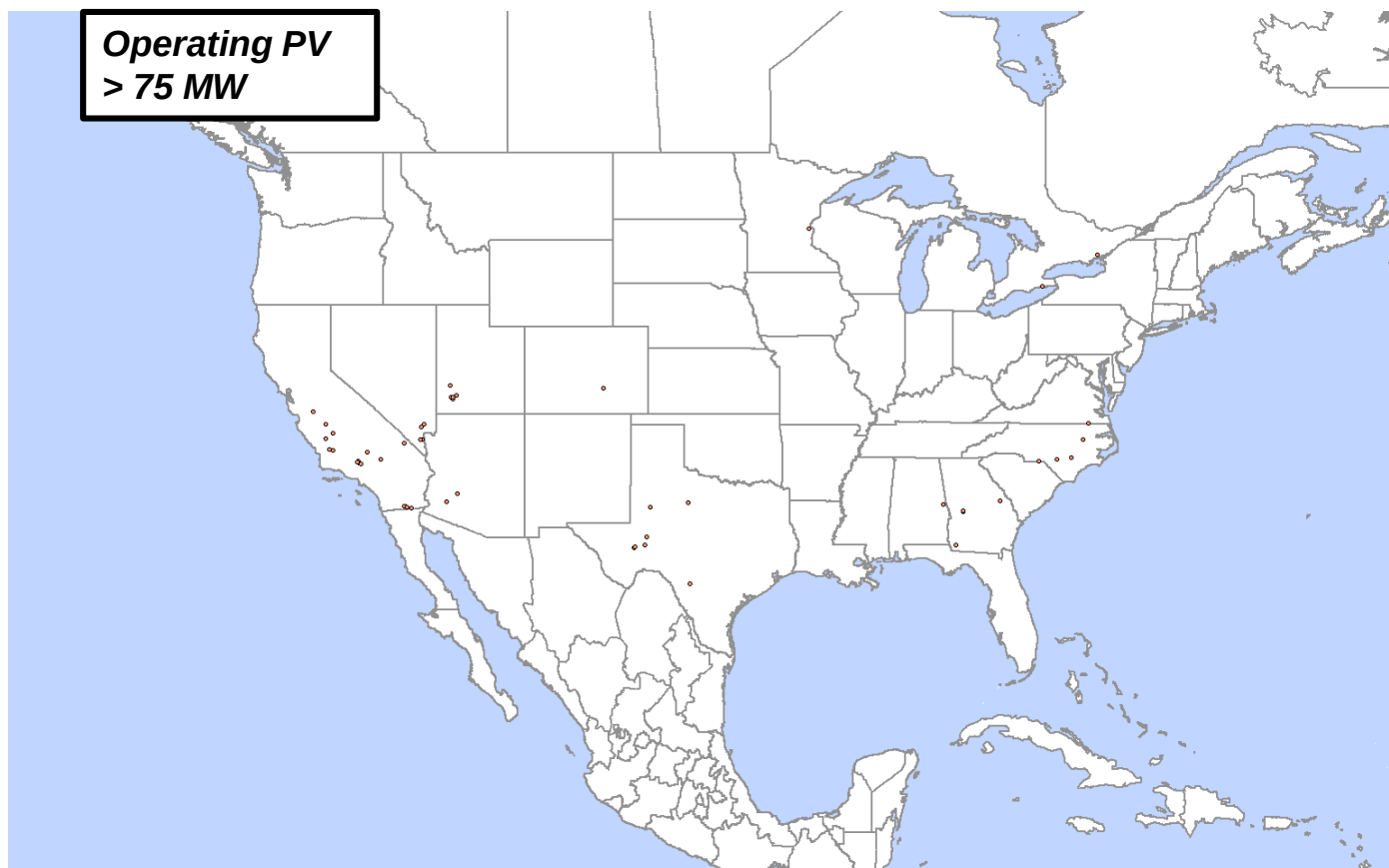


Illustration Purposes Only

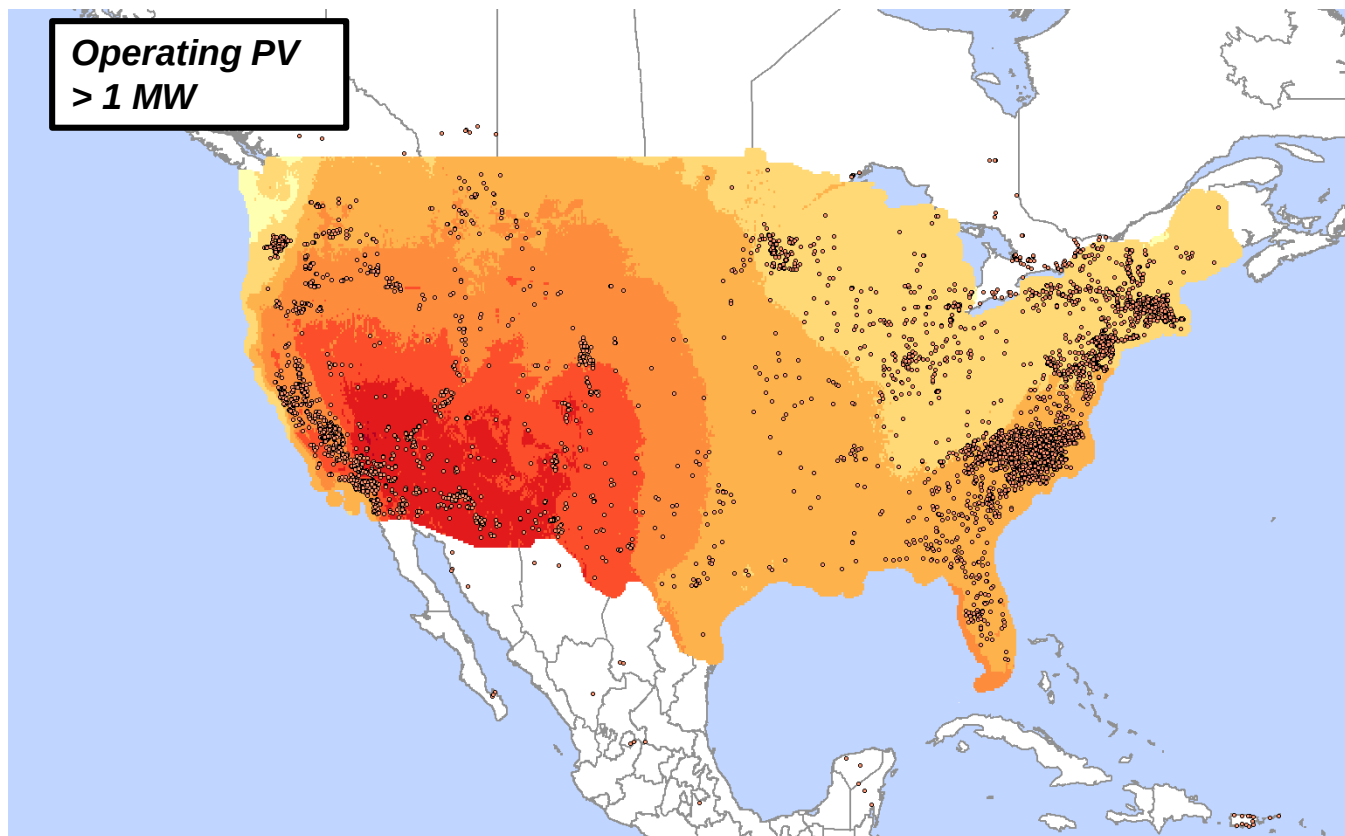
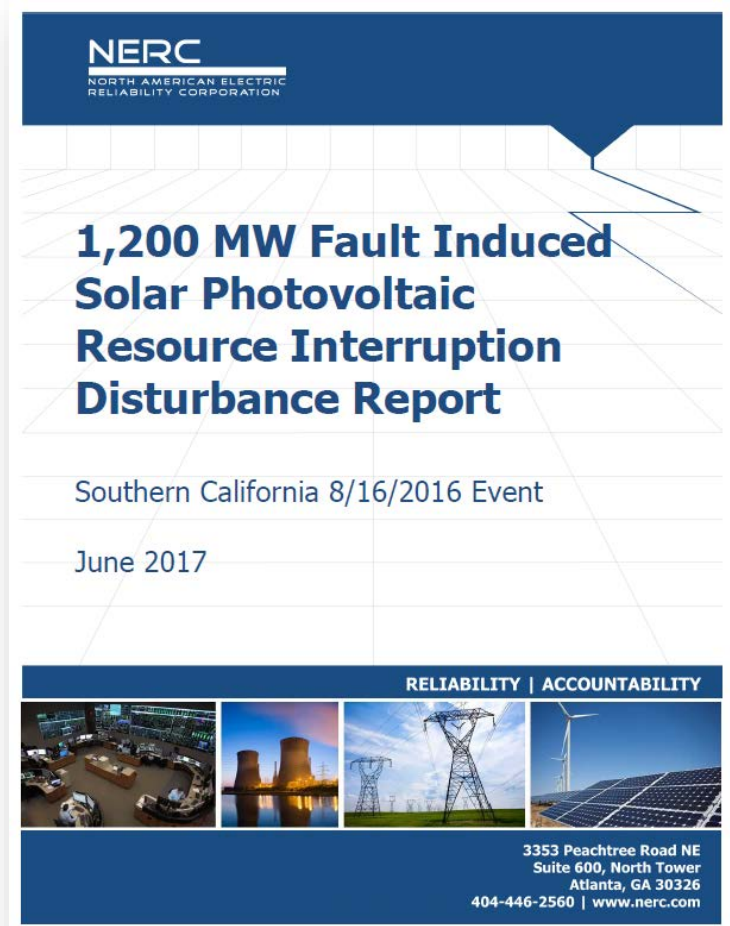


Illustration Purposes Only

- Event occurred on August 16, 2016
 - Not a qualified event
 - Entities volunteered to work with ERO
- Fire caused 13 500 kV line faults and two 287 kV line faults
- NERC/WECC ad hoc task force created to identify causes
- Published disturbance report in June 2017
- Key Findings:
 - Use of momentary cessation
 - Frequency-related tripping



- Recommended actions:
 - Mitigate erroneous frequency tripping
 - Recovery from momentary cessation
- Data collection to understand extent of condition

NERC
NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Industry Recommendation

Loss of Solar Resources during Transmission Disturbances due to Inverter Settings

Initial Distribution: June 20, 2017

NERC identified a potential characteristic exhibited by some inverter-based resources, particularly utility-scale solar photovoltaic (PV) generation, which reduces power output during fault conditions on the transmission system. An example of this behavior has been observed during recent BPS disturbances, highlighting potential risks to BPS reliability. With the recent and expected increases of utility-scale solar resources, the causes of this reduction in power output from utility-scale power inverters needs to be widely communicated and addressed by the industry. The industry should identify reliability preserving actions in the areas of power system planning and operations to reduce the system reliability impact in the event of widespread loss of solar-resources during faults on the power system.

For more information, see the [1,200 MW Fault Induced Solar Photovoltaic Resource Interruption Disturbance Report](#)

[About NERC Alerts >>](#)

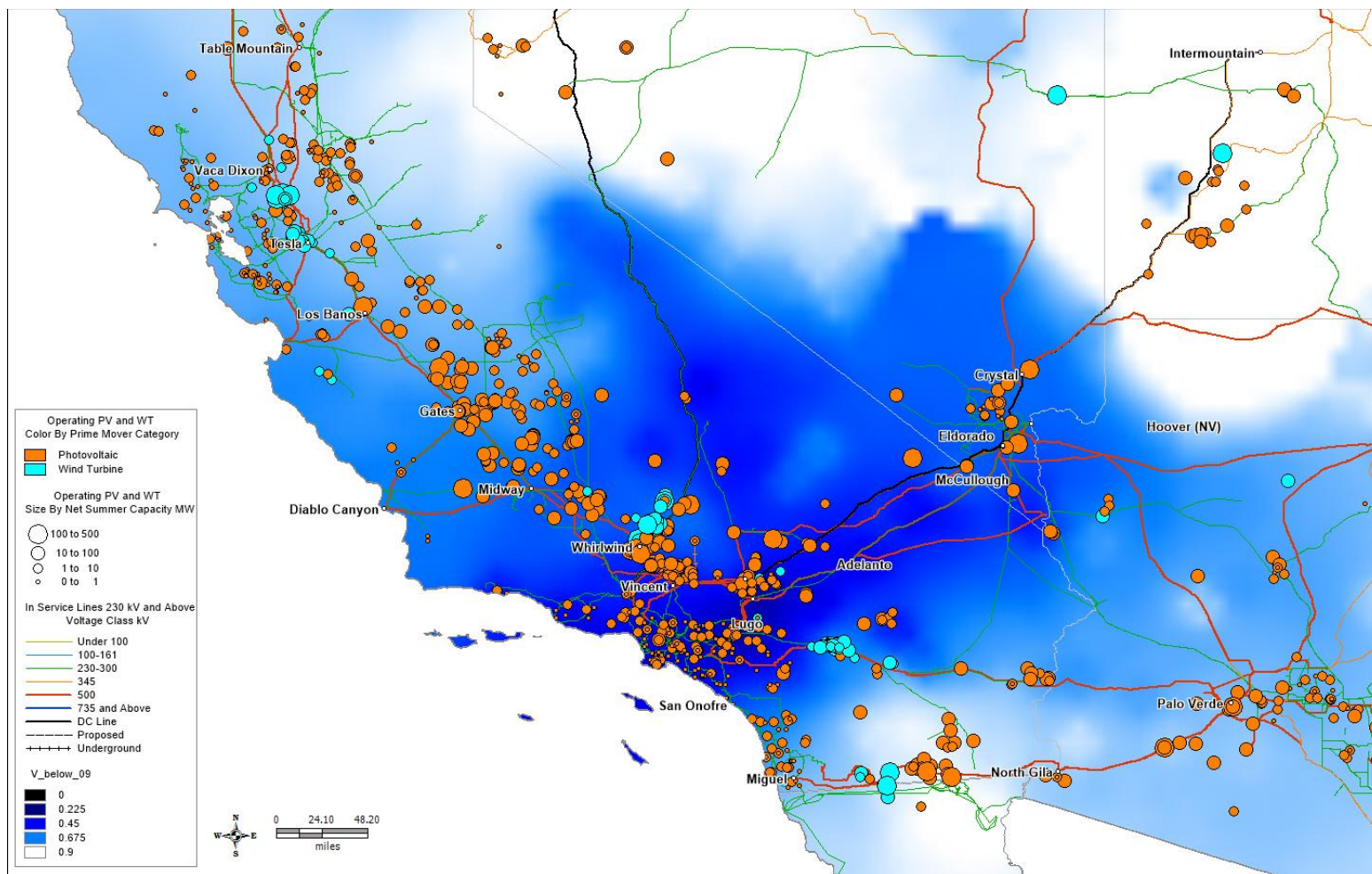
Status: Acknowledgement Required by Midnight Eastern on June 27, 2017
Reporting Required by Midnight Eastern on August 31, 2017

    PUBLIC: No Restrictions
[More on handling >>](#)

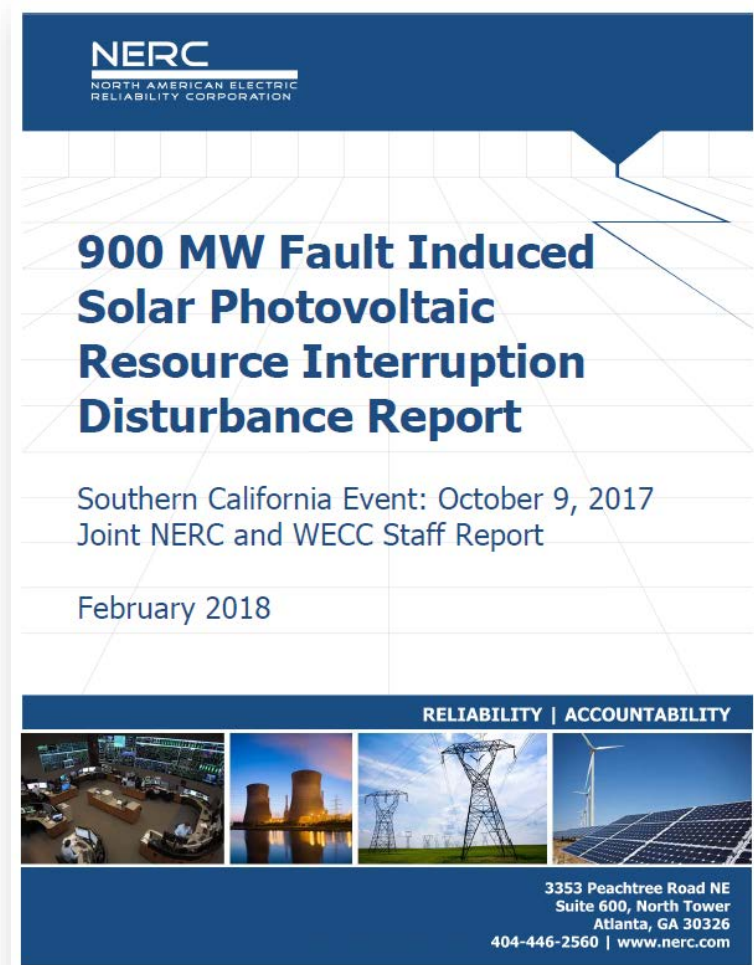
Instructions: This recommendation provides specific actions NERC registered entities should consider taking to respond to a particular issue. Pursuant to Rule 810 of NERC's Rules of Procedure, NERC registered entities shall 1) acknowledge receipt of this advisory within the NERC Alert System, and 2) report to NERC on the status of their activities in relation to this recommendation as provided below. For U.S. entities, NERC will compile the responses and report the results to the Federal Energy Regulatory Commission.

RELIABILITY | ACCOUNTABILITY

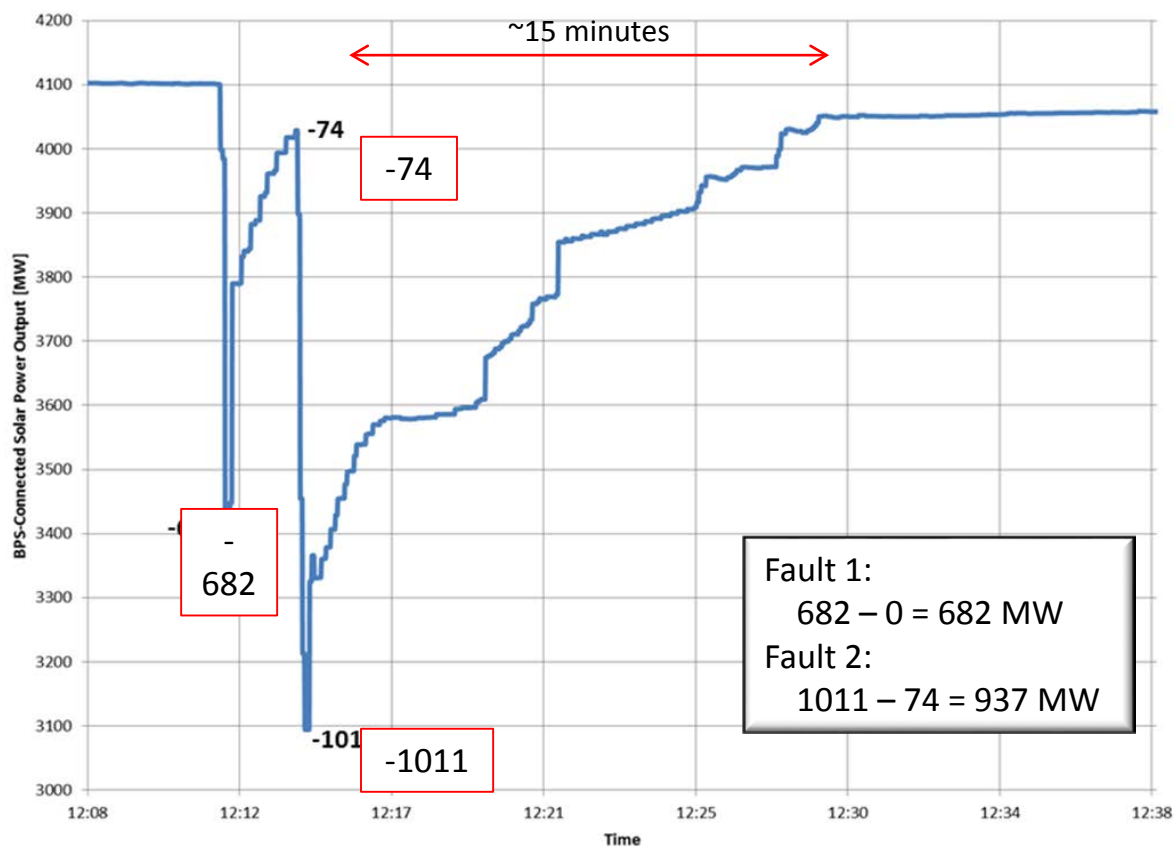
Clarification and Recommendation for Momentary Cessation



- Event occurred on October 9, 2017
 - Not a qualified event
 - Entities volunteered to work with ERO
- NERC/WECC event analysis, NERC IRPTF technical support
- Published disturbance report in February 2018
- Key Findings:
 - No frequency-related tripping
 - Continued use of momentary cessation
 - Voltage-related tripping

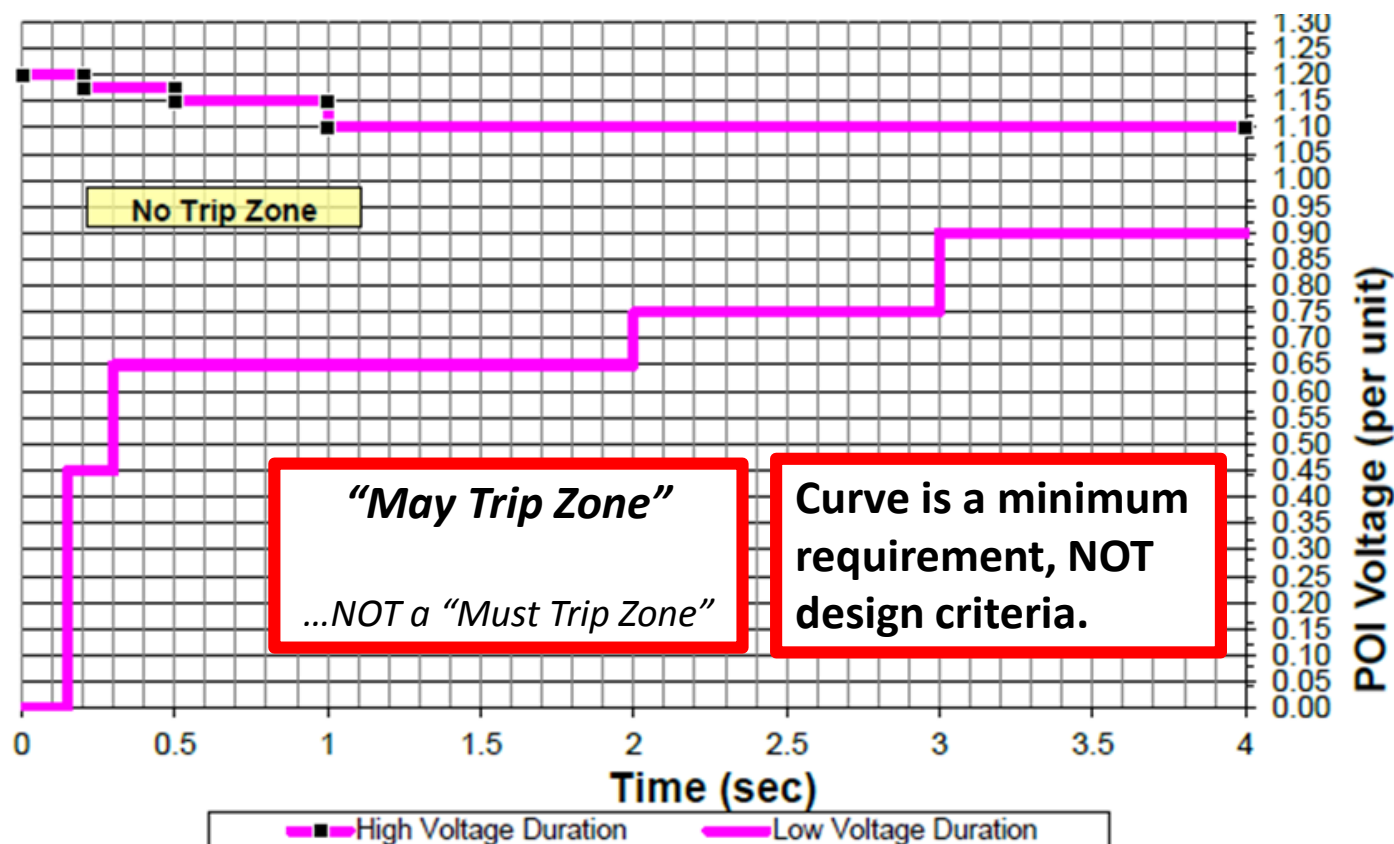


Canyon 2 Fire Disturbance Aggregate Solar PV Response



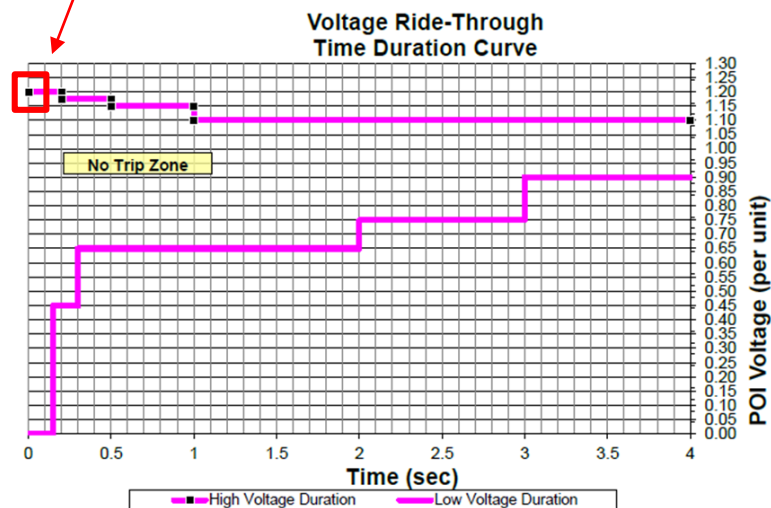
- No erroneous frequency tripping
 - Actions from first Level 2 Alert appear to have mitigated identified issue
 - By Canyon 2 Fire disturbance, 97% of manufacturer's BPS-connected fleet had been updated
- Continued use of momentary cessation
 - Most inverters use momentary cessation ($V < 0.9$ pu)
 - Recovery following momentary cessation varies, relatively slow for grid dynamics
 - Updated recommendation for momentary cessation – **eliminate the greatest extent possible**
- Transient overvoltage tripping and application of the PRC-024-2 ride-through curve

Key Finding: Application of Voltage Ride-Through



Key Finding: Transient Overvoltage Tripping

High Voltage Ride Through Duration		Low Voltage Ride Through Duration	
Voltage (pu)	Time (sec)	Voltage (pu)	Time (sec)
≥ 1.20	Instantaneous Trip	≤ 0.45	0.15
≥ 1.175	0.20	≤ 0.65	0.30
≥ 1.15	0.50	≤ 0.75	2.00
≥ 1.10	1.00	≤ 0.90	3.00



- Mitigating actions:
 - Dynamic model improvements
 - Mitigation of momentary cessation
 - Plant control loop coordination
 - Mitigation of voltage-related tripping
 - Information sharing among operating entities
- Planning and operations studies to ensure no potential stability risks
 - Response to Regional Entity of study findings by December 7, 2018

The image is a screenshot of a NERC (North American Electric Reliability Corporation) document titled "Industry Recommendation". The document header includes the NERC logo and the title "Industry Recommendation". The main heading is "Loss of Solar Resources during Transmission Disturbances due to Inverter Settings - II". Below this, it states "Initial Distribution: May 1, 2018". The body text explains that NERC has identified adverse characteristics of inverter-based resource performance during grid faults that could present potential risks to reliability of the BPS. It notes that as the penetration of inverter-based resources (particularly solar PV resources) continues to increase in North America, these adverse characteristics need to be widely communicated. This Level 2 Industry Recommendation alerts industry to these adverse characteristics observed with BPS-connected solar PV resources, and provides recommended actions to address fault ride-through and timely restoration of current injection by all inverter-based resources connected to the BPS. (See Background section for more information.)

Although this NERC Alert pertains specifically to BES solar PV resources, the same characteristics may exist for non-BES¹ solar PV resources connected to the BPS regardless of installed generating capacity or interconnection voltage. Owners and operators of those facilities are encouraged to consult their inverter manufacturers, review inverter settings, and implement the recommendations described herein.

For more information, see the October 9, 2017 Canyon 2 Fire [Disturbance Report](#).

[About NERC Alerts >>](#)

Status: Acknowledgement Required² by Midnight Eastern on XXXX XX, 2018
Reporting Required by Midnight Eastern on XXXX XX, 2018

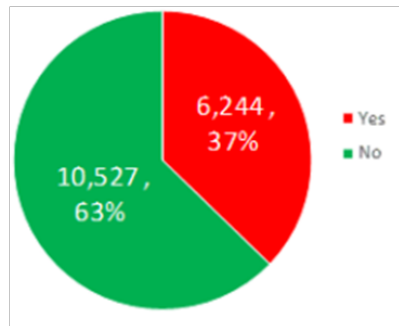
 **PUBLIC:** No Restrictions
[More on handling >>](#)

¹ These resources do not meet the Bulk Electric System definition, and are generally less than 75 MVA yet connected to transmission-level voltage.
² To the extent that Canadian jurisdictions have implemented laws or requirements that vary from Section 810 of the ROP, NERC requests entities in such jurisdictions voluntarily participate in response to this Alert.

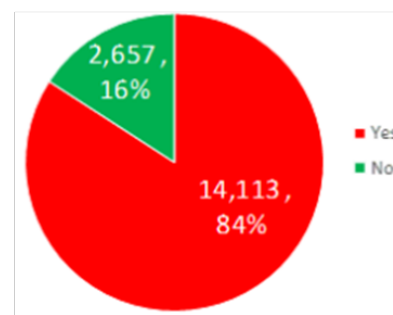
RELIABILITY | ACCOUNTABILITY

NERC Alert 1

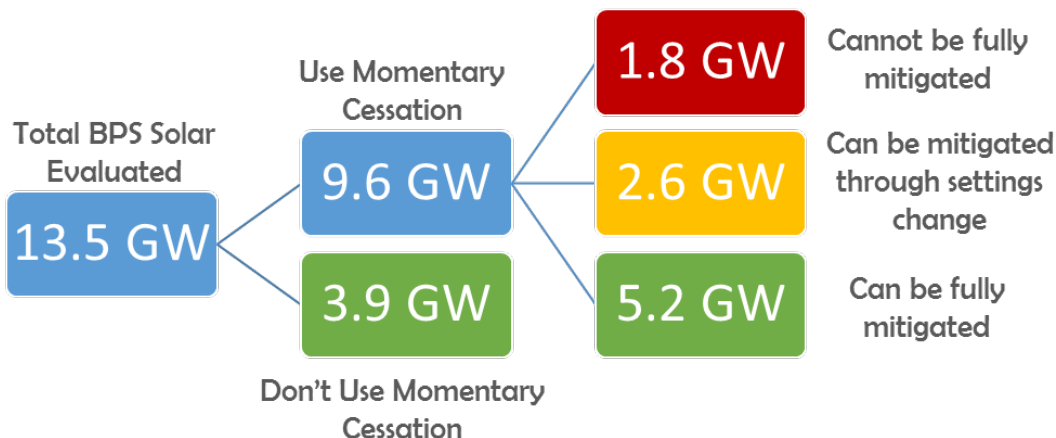
Susceptible to Erroneous
Frequency Calculations?



Inverter cease output during
abnormal voltages?



NERC Alert II



- Issue: Existing models largely DO NOT accurately represent installed resource performance
- Identified issue that needs to be addressed for models in planning and operations studies
- Developed notification to help industry in modeling efforts
- Guidance provided as part of second NERC Alert

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Modeling Notification

Recommended Practices for Modeling Momentary Cessation

Initial Distribution: February 2018

This Modeling Notification provides Generator Owners who own inverter-based resources, particularly solar photovoltaic (PV) resources, with recommendations for accurately modeling momentary cessation for existing resources that are not able to eliminate its use. Specific modeling requirements and steps to accurately model this behavior in the second-generation positive sequence generic renewable energy system models are provided in the notification.

Primary Interest Groups

Generator Owners (GOs), Generation Operators (GOPs), Transmission Planners (TPs), Planning Coordinators (PCs), Reliability Coordinators (RCs), MOD-032 Designees

Background

The [Blue Cut Fire](#) in August 2016 identified that the vast majority of solar PV resources connected to the bulk power system (BPS) use an operating mode known as momentary cessation. Momentary cessation is an inverter operating state where the power electronic “firing commands” are blocked such that both active current and reactive current go to zero output.¹ The NERC Inverter-Based Resource Performance Task Force (IRPTF)² is developing recommended performance specifications for inverter-based resources, including recommendations for momentary cessation. The task force has determined that momentary cessation should not be used for newly interconnecting resources to the BPS and should be eliminated to the greatest extent possible for existing resources on the BPS due to the reliability risk that the operating mode poses.

However, the NERC IRPTF recognizes that older vintages of inverters may require that momentary cessation be used due to design considerations at the time of commissioning. This is considered an equipment limitation that should be reported by the GO to their TP and PC. For these resources, it is critical that momentary cessation be captured with the dynamic models used to plan and operate the BPS. The second-generation generic renewable energy system models are, in general, recommended for modeling inverter-based resources in interconnection-wide base cases.^{3,4,5} These models have some capability to model momentary cessation, and are described in detail in this notification.

¹ Momentary cessation is sometimes referred to as “blocking” for this reason.

² The NERC IRPTF consists of inverter manufacturers, GOs, GOPs, TPs, PCs, Balancing Authorities (BAs), Fast AC Transmission System (FACTS) device manufacturers, renewable energy resource modeling experts, Regional Entities, NERC, and FERC.

³ “The second-generation generic renewable energy system models” refer to the latest generic models used to represent inverter-based resources (e.g., *regc_a* and *reec_a* models).

⁴ More detailed vendor-specific models may be used for local planning studies. These models may already capture momentary cessation. However, they are generally not allowed or recommended for the interconnection-wide cases. The focus of this guideline is on the generic models used for interconnection-wide modeling, and recommends the use of the second-generation renewable energy system models for this reason.

⁵ Some interconnections, for example the Texas Interconnection, allow for more detailed, user-written models in their interconnection-wide cases. This is left to the discretion of the MOD-032 Designees for each interconnection.

RELIABILITY | ACCOUNTABILITY

- Disturbance analyses and reports
 - Blue Cut Fire, Canyon 2 Fire, (and upcoming Angeles Forest) Disturbances
- Level 2 NERC Alerts
 - Identifying extent of condition and recommending mitigating actions
- IRPTF Reliability Guideline
 - Recommended BPS-connected inverter-based resource performance
- Modeling and simulations
 - Modeling Notifications
 - Leading interconnection-wide stability studies to identify potential risks
- Industry education – webinars and workshops
- Outreach to BPS-connected non-BES resources (e.g., < 75 MVA)
- Reliance on SGIA, LGIA, and Facility Connection Requirements



Questions and Answers