GRID ASSURANCE® LLC

December 2017
PUBLIC INTEREST
Addressing Vulnerability and Security of the Grid

There is a clear, reinforced need to address these new emerging threats to the grid and it requires timely action to implement an industry solution valuable to all stakeholders

- Documented and emerging threats facing the industry
  - Physical threats - 2013 in California, the Metcalf substation was seriously damaged by a coordinated rifle attack damaging 17 large power transformers. In 2016, a substation in south-central Utah was attacked by a high powered rifle.
  - Cyber attacks - the simultaneous 2015 cyber attacks in Ukraine
  - Extreme weather events - represent a growing threat to the resiliency of the grid.

- Legislators and regulators are pursuing solutions and looking for action
  - NARUC Resolution – Resilience in Regulated Utilities (2013)
  - FAST Act directs DOE to submit a plan to Congress evaluating the feasibility of strategic transformer reserve to protect from extreme events which threaten the reliability of the transmission grid (2015-2017)
  - Second Installment of QER (2017)
  - DOE Strategic Transformer Report (2017)
New Threat Landscape

High impact, low frequency (HILF) threats require a higher level of resiliency and increased capacity to respond

Traditional Failures
- Individual equipment failures
- Isolated events impacting a single location
- System planned and designed to withstand impact
- Planned, orderly restoration
- Companies self-perform

Emerging Threats
- Catastrophic, multi-site events
- Widespread impact – loss of load/social unrest
- Unplanned with potentially significant impact
- High degree of restoration urgency – potential for extreme social & political intervention
Hurricane Harvey, Hurricane Irma and California Wildfires

Hurricane Harvey, Hurricane Irma, the following catastrophic flooding events in Texas and Florida and the recent wildfires in California are exactly the reasons why Grid Assurance was created.

Many utilities have limited surplus major transmission equipment on hand and that equipment often is stored within the same facility as the equipment it is meant to replace and therefore could be similarly impacted by the emergency event.
2015 FASTAct prompted DOE to engage a study on LPTs

On April 5, 2017, DOE submitted its report on Strategic Transformer Reserve to Congress. In summary:

- DOE confirmed the need to develop a reserve of large power transformers.
- DOE concluded the most efficient and effective approach is to build on industry-based approaches like Grid Assurance.
- DOE evaluated options and recommended encouraging and supporting industry-based approaches combined with NERC reliability standards.
- DOE emphasized prompt industry action and recommended a reassessment of whether sufficient progress has been made in one year.

Grid Assurance agrees with the proposed next steps for DOE and has been working closely with DOE and other Federal Government agencies to ensure and enhance the resilience of the Nation’s electric grid.

May 2017, DOE & ORNL launched a Phase II Study, titled “Transformer Fleet Resilience Assessment: A Regional Threat Scenario Evaluation.” The motivation for continued investigation is enhancing DOE & ORNL’s understanding of the issue and the degree to which industry resources are currently available to effectively recover from extreme events.
INNOVATIVE SOLUTION FOR ENHANCED GRID RESILIENCE & RESTORATION
Six electric utility companies with wide geographic and technical diversity formally launched Grid Assurance May 6, 2016 to provide a cost-effective industry solution via pooling to expedite restoration following high-impact low-frequency events.

- Provide subscribers access to pooled inventory matching their system needs
- Optimize inventory volume to meet requirements at lower cost
- Actively manage inventory to mitigate risk of obsolescence
- Establish transferable asset warranties for Subscribers with appropriate length and terms

**Optimized Inventory of Critical Equipment**

- Secure, cost-effective storage
- Located apart from Protected Equipment
- Strategic, geographically diverse storage locations
- Sites not prone to natural disaster
- Indoor facilities add to security and ease of maintenance

**Secure Storage**

- Create and maintain advance logistics plans to reduce deployment time
- Coordinate/facilitate transportation capabilities
- Access to equipment and vehicles that could transport inventory
- Engage state/federal authorities regarding permitting and priority

**Transportation & Logistics Support**
Benefits to Subscribers

• **Diversification & Pooling Leads to Cost Savings:** By optimizing inventory to the resiliency needs of a large diverse group of subscribers, each subscriber’s share of the cost of access to inventory will be minimized. Thus, this approach is expected to be more cost-effective than utility-by-utility sparing strategies.

• **Economies of Scale:** Grid Assurance will seek to take advantage of volume purchases to obtain favorable pricing on equipment supply and maintenance agreements.

• **Secure Storage and Management of Inventory:** Grid Assurance will store the equipment at secure, strategically-located warehouses and contract with equipment manufacturers to periodically test, service and maintain equipment in inventory. The equipment will include a transferrable 5-year warranty at the time of deployment.

• **Improved Logistics to Expedite Delivery:** Grid Assurance will establish warehouses strategically located (e.g., sites near key modes of transportation) to maximize efficiency of delivery. Grid Assurance will perform ongoing logistics planning and maintain expertise in large asset transportation, including intermodal transportation for inbound and outbound inventory.
STATUS
Status Update

[Subscriber Engagement]

Progress is continuing and interest is strong from 13 large utilities (IOUs, Public Power & Federally-Owned). Collectively, these 13 parent companies represent a broad geographic and voltage diversity, spanning 32 states and over 80 million customers.

Timeline:

[Equipment]

- Optimized inventory results in 7 transformer and 4 circuit breaker classes with an asset inventory of approximately over 50 and 100 spares, respectively
- Developed transformer and circuit breaker order specification and released RFP to top 10 manufacturers
- Order inventory by early 2018 and have in place by 2019

[Secure Warehouse]

- Determined 3 top regional sites for warehouses based on defined site criteria
- Defined warranty storage requirements with top equipment manufacturers
- Warehouses to be secured in 2018
Contact Information

Website:  [www.gridassurance.com](http://www.gridassurance.com)

If you have any questions or need additional information, please contact:

<table>
<thead>
<tr>
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</tr>
</tbody>
</table>
- Reliability Guideline on inverter-based resource performance
- Recommendations on inverter-based resource dynamic performance during abnormal grid conditions
- Detailed studies of any potential reliability risks under high penetration of inverter-based resource
- Webinars and technical workshops to share findings
- Other activities as directed by the NERC Planning Committee (PC) and Operating Committee (OC)
- Detailed studies of any potential reliability risks under high penetration of inverter-based resource
  - On-going and long term as technology advances
- Webinars and technical workshops to share findings
  - To be conducted upon completion of Guideline
- Other activities as directed by the NERC Planning Committee (PC) and Operating Committee (OC)
  - TBD
• Items We Can Complete
• Items Requiring Collaboration With BA/TOP/PC
• Items Requiring Further Study
Guideline Status - Items We Can Complete

• Intended voltage and frequency ride-through performance and clarification of the frequency and voltage curves of PRC-024-2

• Review and document recommended delays for the lowest levels of frequency to ensure transient/distorted waveform “ride through”

• More clearly understand the potential limitations in early generation inverter technology to meet the proposed performance characteristics that support BPS reliability. Identify the extent to which these inverters may be modified to support BPS reliability
Guideline Status - Items Requiring Collaboration

- Recommend performance characteristics related to momentary cessation, including the expected voltage levels and restore output characteristics

- Recommended operation for inverter-based resources during abnormal operating conditions. This should include the type of current (active or reactive, positive-negative- zero sequence) that should be injected across the full range of potential voltage levels.
  - Note: For Items 1 & 2, the IRPTF will be providing default settings to be used unless circumstances necessitate different settings

- Recommendations on inverter-based resource performance and any modifications to NERC Reliability Standards related to the control and dynamic performance of these resources during abnormal grid conditions
Guideline Status - Future Study or Discussion

- Explore more detailed simulations of high penetration inverter-based resource conditions and the impact that momentary cessation may have on BPS reliability criteria. Determine if momentary cessation should be allowed, and to what extent these conditions are allowable. Develop technical justification for these recommended performance characteristics. Account for technological advances and incorporate dynamic simulations of high penetration operating conditions as part of the justification.

- Detailed studies of any potential reliability risks under high penetration of inverter-based resource (particularly solar PV) given the findings from the Blue Cut Fire event and other related grid disturbances involving fault-induced solar PV tripping.
Guideline Status - Future Study or Discussion

• Coordinate with FERC, IEEE, UL, NFPA and state jurisdictions to develop a solution to any relevant conflicting requirements with NERC Reliability Standards.

• Coordinate with IEEE P1547 members to ensure a coordinated response of inverter-based resources connected to the BES and non-BES facilities. Align terms, practices, and requirements to the extent possible.
Questions and Answers
Methodologies for Evaluating IROLs
Task Force (MEITF)
Status Update
Wayne Guttormson, MEITF Member
Joint PC/OC Session
December 12, 2017
Task Force Update – Main Objectives

- Joint PC/OC Status Update
- Requested PC/OC actions:
  - endorse MEITF white paper - *Proposed Modifications to NERC Glossary Definitions Related to IROLs*,
  - endorse MEITF white paper - *Proposed IROL Framework for FAC Standards*,
  - *white papers to be provided to the FAC SDT for their consideration and use*, and
  - approve posting MEITF draft reliability guideline - *Methods for Establishing IROLs* for a 45-day industry comment period.
Task Force Goals - What is an IROL?

I’ll know it when I see it!

• Goals
  ▪ Address requests of Project 2015-09 SDT
  ▪ Develop recommendations for IROL related definitions and framework
  ▪ Develop technical guidance material around methods for establishing IROLs
  ▪ *Balance flexibility with the need to ensure an adequate level of reliability.*
• Eastern Interconnection - PJM, ISO-NE, MISO, TVA, SOCO, FPL, SPC
• Western Interconnection - PEAK, NWPP, XCEL
• ERCOT Interconnection - ERCOT
• Quebec Interconnection - HQ
• Regulatory - FERC/NERC
• SDT - Project 2015-09
• Responded to comments from PC & OC sub-team on proposed IROL related definition revisions and additions.
  ▪ Consulted SDT for input and feedback.
  ▪ Seeking whitepaper endorsement prior to delivery to the SDT.
• Finished whitepaper - proposed IROL framework.
  ▪ Consulted SDT for input and feedback.
  ▪ Seeking endorsement prior to delivery to the SDT.
• Finished draft guideline on Establishing IROLs.
  ▪ Seeking approval to post for industry comment.
• Next meeting scheduled
  ▪ Feb 06 - 07, Atlanta (in-person)
  ▪ Review industry comments.
• Address inconsistencies or gaps with the existing NERC definitions to aid the FAC SDT.
• Support development of IROL methodologies with a set of revised or new definitions.
• Challenge: Clear and concise language for a complex issue.
• Definitions:
  ▪ Interconnection Reliability Operating Limit (IROL)
  ▪ Stability / System Stability
  ▪ Instability / System Instability
  ▪ Controlled Separation / Uncontrolled Separation
## IROL Related Definitions - Highlights

<table>
<thead>
<tr>
<th>Definition (s)</th>
<th>Highlights</th>
</tr>
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<tbody>
<tr>
<td>IROL</td>
<td>A SOL that, if exceeded, could result in any of the following on the BES: (1) System Instability; or (2) an unacceptable* amount of load loss caused by Instability, Uncontrolled Separation, or Cascading.</td>
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</tbody>
</table>
| Stability / Instability (Antonym)           | • Addition of Elements to differentiate between system.  
• Addition of initial operating condition  
• Use of regain vs maintain for equilibrium.  
• Addition of after being subjected to a Disturbance |
| System Stability / System Instability (Antonym) | • Distinction between Stability and System Stability  
• Definition of System |
| Uncontrolled / Controlled Separation        | • Uncontrolled means unintended  
• Islanding a portion of the BPS due to separation  
• Controlled Separation - caused by expected actions  
• Separation and Instability  
• Intended - not controlled and/or known ahead of time  
• Uncontrolled Until Proven Controlled |
• Recommendations on the establishment of IROLs, and to propose a framework for establishing IROLs.
  ▪ Challenge – Common technical framework for understanding impacts and risk

• Framework areas (for RC):
  ▪ Description of Analytical Techniques
  ▪ Distinguishing System Instability
  ▪ Unacceptable Instability, Uncontrolled Separation, or Cascading
    ○ Upper Size Threshold on Load Loss – 2000 MW
    ○ Lower Threshold of 300 MW Load Loss
  ▪ Risk Assessment between Upper and Lower Load Loss Thresholds
## IROL Framework – 2000 MW Context

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Metro Area</th>
<th>Population (2014)</th>
<th>Approx Peak Demand [MW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>New York City</td>
<td>23,632,722</td>
<td>18,500</td>
</tr>
<tr>
<td>2</td>
<td>Los Angeles</td>
<td>18,550,288</td>
<td>23,000</td>
</tr>
<tr>
<td>3</td>
<td>Chicago</td>
<td>9,928,312</td>
<td>19,800</td>
</tr>
<tr>
<td>58</td>
<td>Tucson</td>
<td>1,051,211</td>
<td>3,000</td>
</tr>
<tr>
<td>59</td>
<td>El Paso</td>
<td>1,050,374</td>
<td>2,800</td>
</tr>
<tr>
<td>60</td>
<td>Fort Myers</td>
<td>1,028,290</td>
<td>2,200</td>
</tr>
</tbody>
</table>
Need to include:

- Amount of pre-contingency load shedding
- Resulting impacts to neighboring RCs
- Nature of the affected load at risk
  - e.g., economics, criticality, geographic region, etc.
- Restoration plans
  - estimated time to restore the affected load at risk
- Risk of contingencies
  - more severe than single contingency events
• Provide guidance and clarity to industry on a complex issue.
  ▪ Challenge – Common technical framework for understanding impacts and risk.

• Guideline areas:
  ▪ Analytical Framework for Establishing IROLs (Ch 1)
  ▪ System Stability Classification (Ch 2)
  ▪ Instability Assessment Techniques (Ch 3)
  ▪ Controlled and Uncontrolled Separation (Ch 4)
  ▪ Cascading Analysis Assessment Techniques (Ch 5)
General Process & Timeframes

Study of Potential IROLs

Pre-Contingency Operating State
Pre-contingency operating state studied to identify the risk of System Instability, Cascading, and Uncontrolled Separation.

Post-Contingency Operating State
Study shows that System Instability, Cascading, and Uncontrolled Separation could occur if the critical contingency(ies) were to occur under the studied operating conditions.

Definition of IROLs

Constraint
The set of system elements that comprise the constraint to be monitored to manage the risk of System Instability, Cascading, and Uncontrolled Separation does not occur.

Limit
The limiting value of the constraint to ensure that System Instability, Cascading, and Uncontrolled Separation does not occur if the critical contingency(ies) were to occur.

Unplanned or Unexpected Operating State
Real-time operating state enters into a condition that is unexpected or unplanned. Unknown risk of System Instability, Cascading, and Uncontrolled Separation.

“IROL-Like Conditions” Operator Action
Manage pre-contingency operating state back to within known reliable operating limits within 30 minutes (e.g., treated as an “IROL-like condition”) to mitigate risks of System Instability, Cascading, and Uncontrolled Separation does not occur.

Expected or Planned Operating State
Operate Below IROLs
Manage pre-contingency operating state to within the IROL such that the identified risk of System Instability, Cascading, and Uncontrolled Separation does not occur.

Inform Future SOL/IROL Studies
Establishment of IROLs
Inform Future SOL/IROL Studies
Return to Known Operating State
Real-Time Operations

Operations Planning
Next-Day OPA
Intra-Day
Near Real-Time

10+ Years
1 Year
2 Days
1 Day
1 Hour

RELIABILITY | ACCOUNTABILITY
Stability Classification

Power System Stability

- Rotor Angle Stability
  - Transient Stability Assessment
  - Small Signal Stability Assessment
  - Eigenvalue Analysis
- Frequency Stability
  - Short-Term
    - Transient Stability Assessment
  - Long-Term
    - Governor Powerflow
- Voltage Stability
  - Transient
    - Transient Stability Assessment
  - Mid-Term
    - Transient Stability Assessment
    - Time Step Simulation
  - Long-Term
    - PV Analysis
    - QV Analysis
    - Contingency Analysis

Equilibrium types:
- Stable
- Unstable
- Neutral

Need to be here
Don’t want to be here!
Instability Assessment

Detailed Guidance

identified Instability from simulated contingency

Able to identify out-of-step (OOS) BPS units?

Yes

No

Protection Modeling

Generator protection modeled?*

Transmission protection modeled?*

Protection system operation beyond expected elements?

Yes

No

IROL

System Instability

SOL

Instability

Yes

No

Quantifiable impact & stability boundary?

Yes

No

Within RC size threshold?
Separation Analysis Framework

Contingency Event

Separation Assessment

Uncontrolled Separation

The unintended islanding of a portion of an electric system that includes generation or load

- Unplanned removal of a portion of the electric system due to operation of protection or control systems.
- Studies indicate that contingency causes unintended relay action resulting in some form of islanding.
- Separation events are considered uncontrolled until otherwise proven by study to be controlled through operation of protection systems, RAS, or other control systems intentionally used to separate portions of the system.

Controlled Separation

The intended islanding of a portion of an electric system that includes generation or load

- As-designed protection systems, RAS, or other control systems operating specifically to separate part of the BPS.
- Points of separation are planned ahead of time, and separated system studied to perform as expected.
- May involve large separated systems or small load pockets.
- Ensures integrity of the larger BPS by disconnecting potentially weak or unstable portions of the system.
- Does not include load lost as a consequence of the contingency
- May be accompanied by RAS or other control actions to balance generation-load equilibrium in the separated system(s)

Yes

Leads to System Instability?

No

Quantifiable Load Loss Less Than Threshold?

Yes

SOL Instability

No

IROL System Instability
Uncontrolled Separation

Illustrative example

Sequence of intended and unintended actions leading to uncontrolled separation
Illustrative example: bounded impact
Questions and Answers
Electric Reliability in Mexico

NERC

December 2017

Disclaimer: The opinions expressed in this presentation and on the following slides are solely those of the presenter and not necessarily those of CRE.
National Electrical System in Mexico: Numbers 2016

Total installed capacity: 73,510 MW

Control regions:
1 interconnected system and three isolated systems

Peak demand: 42.6 GW

Demand growth:
 Nearly 4% per year

Population ≈ 120 million

*Fuente: Programa de Ampliación y Modernización 2016-2030.*
Generation mix in Mexico

Total generated Energy (2016) = **319,364 GWh**

By 2024, 35% of total generated Energy has to be provided by clean energy sources.

Source: PRODESEN
Estructure of the Power Sector (previous)

Dispatch + Control + Transmission + Distribution + Retail

Vertically Integrated state-owned company + Private Generation

Generation

CFE

IPPs
Self Supply
IM + EX
Cogeneration
New Legal Framework in order to boost the Mexican Energy Sector

Constitutional Reform (Arts. 27 & 28)

- General Law in Climate Change
- Geothermal Energy Law

Energy Transition Law

- Electric Industry Law
- Hydrocarbons Law

- Law of the Coordinated Regulatory Agencies of the Energy Sector
- Petroleos Mexicanos Law (State Productive Enterprise)
- Hydrocarbons Revenue Law
- Industrial Security and Environmental Protection of Hydrocarbons Sector
- Mexican Oil Fund

Independent system operators created for:
- Electricity Grid and Market
- Natural Gas
After: Unbundled with Deepened Competition

- **Policy Making**
- **Regulation**

**Open Access**
- **Generation**
  - CFE Split into Gencos
  - Private Generators
- **System and Market Operations**
  - CENACE OSI/OM
- **Transmission**
  - CFE Subsidiaries + Private Sector
- **Distribution**
  - CFE Subsidiaries + Private Sector

**Commercialization**
- Pure Commercialization
- Suppliers of Qualified Users
- Suppliers of Regulated Consumers

**Final Consumers**
- Qualified Users
- Regulated Users

**Spot, Medium, and long Term Markets**

1 MW
Players and roles in reliability

**Responsible for establishing the Energy Policy**
(LOLP, Reserve Margins, VNSE, Approves Expansion)

**Responsible for developing, adopting and enforcing Reliability Criteria**
(Grid Code, Protocols, Auctions, Penalties, Assess Expansion)

**Responsible of operating the System and running the Market**
(Economic Dispatch + Clearing the Market + Propose T Expansion)
Needed Investments: 2017-2031 National Electricity System Expansion Plan (PRODESEN)

- Investments:
  - Generation: 97,023 BUSD
  - Transmission: 12.86 BUSD
  - Distribution: 9.68 BUSD

- Total Investment: 119.5 Billion dollars (BUSD) in next 15 years

- 55,840 MW of additional capacity is planned to meet the demand for electricity in the period 2017-2031

- 63% Clean Energy
- 37% Conventional

Source: Sener, 2016
Transmission Plan: Evolution of Investments Needs (MMUSD)

HVDC relevant projects, feasible start operation year

- **2021, Oaxaca to Center of Mexico**
  - $1,700 MMUSD

- **2022, Southeast to Peninsula**
  - $1,142 MMUSD

- **2022, South Baja to National System**
  - $999.8 MMUSD

Source: Prodesen 2017-2031, Sener; Exchange rate 19.0117, Banxico
The Grid Code

Contains the **minimum technical requirements** necessary to assure the efficient development of all processes regarding: planning, operation, Access and use of the National Electrical System.

**Objective of the Grid Code:**

Establish, *in a transparent and open process*, the technical criteria to allow and encourage the National Electrical System to be developed, maintained, operated, planned and modernized in an efficient, coordinated and economical manner.
Bilateral Principles
January 2017
Principles to promote the reliability and security of interconnected power systems.

Address events and identifiable risks affecting the power grid (improvement in reliability).

Apply knowledge and resources to promote continuous improvement of reliable operations of interconnected systems.

Address emerging issues that impact the reliable operation of the system.

Promote reliable performance of interconnected systems avoiding undue preferences or discrimination.

Cooperate if a cross-border reliability event occurs, understanding and mitigating its causes.

Ensure consistency while observing sovereign jurisdictions with individual policy and regulations.

Principles are to be implemented through the North American Electric Reliability Corporation (NERC) and the Electric Reliability Organization (ERO).
Services Agreement 2017
Services Agreement CRE-WECC

Current Status:

✓ The objective of the Agreement is to establish the collaboration between CRE and WECC in monitoring the reliability of the Baja California interconnection.

✓ CRE in coordination with WECC has developed a draft Agreement.

✓ CRE and WECC are aiming to sign the Agreement on December, 2017.
MoU
March 2017
Memorandum of Understanding

Objective

Establish a collaboration mechanism between the Parties to strengthen their regulatory and technical capacities in order to perform their functions.

Initial activities

- Identification/assessment of risks related to critical infrastructure, physical and cyber security.
- Integration of renewables: reliability performance and risk.
- Practices, tools and techniques derived from system events.
- Strengthening technical and regulatory capacities.
Technical working groups

Reliability Standards Working Group (RSWG)

*Establish mechanisms to coordinate the adoption of standards.*

**Deliverables:**
- Reliability standards.
- Main standards to be implemented in Mexico.
- Inclusion of standards in grid code.

**CRE**
- **Lead:** NERC

Reliability Assessment Working Group

*Shared experiences and practices to evaluate reliability in short and long term.*

**Progress:**
- Discussion group to evaluate long term reliability.

**NERC**
- **Lead:**

Operational Reliability Working Group (ORWG)

*Best practices with industry.*

**Progress:**
- Facilitate interaction of the group with main actors in industry.
- Meetings have been scheduled and information shared.

**CENACE**
- **Lead:**

Cibersecurity

*Develop tools to increase knowledge on best practices.*

**Progress:**
- Evaluation of CENACE’s TI systems to detect needs for a integration with USA TI systems (E-ISAC)
- Recommendations on protection of critical infrastructure.

**NERC**
- **Lead:**
Reliability challenges in Mexico:

1. Primary frequency response.
2. Transmission restrictions.
3. Inertia requirements.
5. Fuel restrictions.
Electric Reliability in Mexico

NERC

December 2017

Disclaimer: The opinions expressed in this presentation are solely those of the presenter and not necessarily those of CRE.
Planning Restoration Absent SCADA or EMS (PRASE)
FERC, NERC, Regional Entity Joint Study Report

Dave Huff, Electrical Engineer - FERC
Joint OC/PC/CIPC Session
December 12, 2017

This report was prepared by the staff of the Federal Energy Regulatory Commission and staff from the North American Electric Reliability Corporation and its Regional Entities. This report does not necessarily reflect the views of the Commission or any Commissioner.
Background & Objective

- Assess applicable entities’ system restoration plan steps that may be difficult in the absence of SCADA or EMS.
- Identify viable resources, methods, or practices that would expedite system restoration despite the loss of SCADA or EMS, and identify where those could be incorporated into restoration training.

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• Formed FERC, NERC and Regional Entity subject matter expert study team.
• Identified sample of registered entities that could inform study, who voluntarily participated (the “participants”).
• Collaborated with participants throughout the study period, including conference calls and site visits.
• Collaboration of participants with team was exemplary.
• All participants would remain capable of executing their restoration plan without SCADA/EMS availability.

• Completion of all restoration steps would be more time consuming and more involved under such conditions, especially those steps requiring a larger degree of coordination.
1. **Backup communications**: Planning for backup communications measures to provide effective means of communications in the event of the loss of normal communication means during system restoration absent SCADA or EMS.

2. **Personnel support**: Planning for personnel support during system restoration absent SCADA, to support the field and control room personnel.

3. **Backup power supplies**: Planning backup power supplies to ensure they are available for an extended period of time beyond the normal expectation from battery backups.
4. **Analysis tools**: Analysis tools for system restoration, especially for use during the later stages of restoration in the absence of SCADA or EMS.

5. **Training**: Incorporating loss of SCADA or EMS scenarios in system restoration training, to practice implementation of restoration plan steps absent SCADA/EMS functionality.
Examples observed:

• Have additional backup or alternate phones (e.g., satellite phones) for use by field personnel for communications to the transmission system operator.

• Incorporate periodic training for non-traditional roles, e.g., use of remote training tools such as pre-recorded videos to augment classroom training on substation monitoring.

• Account for on-site fuel shelf life and/or use of long shelf life fuels for backup generators to ensure that extended backup power supplies are available when needed.
Questions and Answers
Planning Restoration Absent SCADA or EMS


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NATF Update
NERC Joint OC/PC/CIPC Meeting

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Topics

• NATF Membership Overview*
• Strategic Objectives and Focus Areas*
• Update on NATF Publicly-available Documents
• NATF-NERC Coordination
• Resiliency Activities

* will not be covered during presentation, but included in printed slides for background material
NATF Public Documents (Recently Published)

- Implementation and Use of Transient Cyber Assets (TCAs) – CIP-010-2*
- NATF Guidance for CIP-005-6 Vendor Remote Access*
- NATF Guidance for CIP-010-3 Software Integrity*
- NATF Practices Document for CIP-014-2 R4*
- NATF Practices Document for CIP-014-2 R5*

*Submitted to NERC for consideration as compliance “Implementation Guidance”

See also: NATF CEO reports to NERC Board of Trustees
Publicly Available Information About NATF Activities

• Overview Video
  – Posted on www.natf.net

• Quarterly Newsletters and Updates
  – Public versions posted on www.natf.net

About the North American Transmission Forum (NATF)
NATF-NERC Coordination

Objective: Effective deployment of industry SMEs
- NERC role = identify areas of reliability and security risk
- NATF role = develop and implement practices and solutions to address risks

Method:
- Quarterly senior leadership meetings (includes NATF board members)
- Periodic meetings with regional entity leadership
- NATF increased transparency, publication of documents for industry
- Joint Workshops (Human Performance; Modeling)
NATF-NERC Coordination

• Equipment Performance – Breaker Failure
  – NERC-NATF-Industry SME interaction – taped for future use
  – NATF take-away – topics for possible practices, additional training

• Misoperations Performance Measure
  – NERC-NATF-Industry SME interaction
  – Two dimensions of performance
    • Dependability
    • Security
  – Evaluation of risk by type and voltage class of misoperation
NATF-NERC Coordination

• NATF-EPRI-NERC Inverter-based Resources Webinar Series (2018)

Four 90-minute sessions – available to NATF members and industry as a whole:

- Inverter Fundamentals, DER Technologies and Power Electronics Interface
- Smart inverter functionalities and standards driving smart inverters.
- Inverter modeling for transmission planning.
- Inverter modeling for protection, harmonics, EMT studies, and review of real-world variable energy resource related events
NATF Resiliency Activities

- Key strategic focus area
- Definition of Transmission System Resiliency
- NATF-EPRI Resiliency Technical Advisory Group
- Transmission System Resiliency One-Pager
- Transmission Resiliency Activities Survey
- NATF-EPRI Resiliency Summits
- Supplement Operating Strategies ("Spare Tire")

Transmission System Resiliency Defined:
"... the ability of the system and its components to withstand instability, uncontrolled events, and cascading failures, during normal operation and routine (i.e., reasonably expected) events."
NATF-EPRI Resiliency Summit – October 16-17, 2017

Open Session
• External panel: policy/regulatory considerations re: resiliency (NERC, FERC, DOE, EEI)
• Structural shielding from multiple threats (blast protection/IEMI/HEMP)
• NATF supplemental operating strategies (“Spare Tire”) update
• Summer 2017 resiliency activities survey summary results

Closed (Member Only) Session
• Summer 2017 resiliency activities survey detailed results
• Cyber resiliency
• Resiliency in control center design and construction
• Resiliency and protection of critical substations
  – Hardening of control houses
  – Protection and control equipment in substations
  – Transmission line hardening
Supplemental Operating Strategies ("Spare Tire")

- Implementation of Recommendations/Collaboration with EPRI
- "No Regrets" Actions

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<thead>
<tr>
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<th>EPRI</th>
<th>NATF</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Alternative voice and data communications</td>
<td>Provide input to contingencies that will be studied and advise development</td>
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<tr>
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<td>Evaluate emergency communications requirements, technologies, and standards</td>
<td>Provide input to contingencies that will be studied and advise development</td>
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<td>2</td>
<td>Additional reliability tools/data availability for situational awareness</td>
<td>Conduct detailed simulations and analysis to:</td>
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<td>• develop processes and procedures for voltage and frequency control, situational awareness, prot. &amp; control implications</td>
<td>• determine if power flow cases can be scaled using available (sparse) measurement data</td>
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<tr>
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<td>• determine if power flow cases can be scaled using available (sparse) measurement data</td>
<td>• develop methods to determine gen dispatch</td>
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<tr>
<td>3</td>
<td>Formal strategies and plans for spare tire operations scenarios</td>
<td>Conduct detailed simulations and analytical analysis to inform and evaluate new processes</td>
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<td>Formalize data sharing on spare tire operations strategies</td>
<td>Develop best practices and validate with 2-3 sites visits</td>
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<td>5</td>
<td>Harden EMS hardware components and develop streamlined EMS recovery process and capabilities</td>
<td>Identify implementation of new strategies and share key learnings</td>
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To Be Determined
Questions?
Allen D. Schriver, P.E.
PGD General Manager of Compliance
NextEra Energy
and
COO North American Generator Forum
Allen.Schriver@nexteraenergy.com

December 12, 2017
The NAGF mission is to promote the safe, reliable operation of the generator segment of the bulk electric system through generator owner and operator collaboration with grid operators and regulators.
Agenda

- Executive Coordinator
- Supply Chain Whitepaper
- Non-Synch Workshop
- Training Working Group
- Questions
The NAGF to continue its growth has hired its first employee, Wayne Sipperly as the NAGF Executive Coordinator.
The NAGF in collaboration with the NATF is in the process of writing a Cyber Security Supply Chain best practices whitepaper.
NAGF UVIG Workshop

NAGF UVIG Collaboration

• In June, the NAGF and UVIG began discussing opportunities for collaboration

• Through participation in the NERC/WECC Inverter Task Force, the Inverter-Based Resources Performance Task Force (IRPTF) and the OC/PC, we came to the conclusion the there was a gap in the discussion of Essential Reliability Services

• While there was much discussion of the need to provide ERS and concern with the changing resource mix, there was little discussion on solutions, i.e., could non-synchronous generation provide ERS?
NAGF UVIG Workshop

- Workshop Organization
  - With NERC, organized NAGF/UVIG Non-Synchronous Generator Attributes and Systems Operations Workshop
  - Attendees - FERC, NERC, BA/TOP’s, OEM’s, GO/GOP’s
  - Discussed non-synch capabilities, constraints, economics and how to design and operate wind, solar and battery storage to provide ERS
  - Most interesting was the bi-directional transfer of knowledge between system operators/regulators and the GOs/OEM’s
Action Items

• Via WebEx’s and conference calls, work to develop a guidance document for OEM’s, detailing the capabilities to be programmed into the inverter controls – voltage support, ramping and frequency response along with default parameters

• Conduct the workshop again in six months
The NAGF is developing a Training Working Group to share and develop best practices for training.
Q & A
Thank you!

www.GeneratorForum.org
Standards Efficiency Review

Howard Gugel, Senior Director of Standards and Education
OC/PC/CIPC Joint Meeting
December 12, 2017
Advisory Group

• Gordon van Welie – ISO-NE
• Greg Ford – Georgia Systems Operations Corporation
• Carol Chinn – Florida Municipal Power Agency
• John Pespisa – Southern California Edison Company
• Amy Casuscelli - Xcel Energy, Inc.
• Randy Crissman – New York Power Authority
• Ken McIntyre – NERC Executive Sponsor
• Define project scope and develop review criteria
• Solicit input for requirement candidate list
• Solicit candidates for review teams
• Evaluate review team product to ensure scope conformation
• Consider modifications to scope based on feedback
• Control parking lot list of items out of scope for this project
Considerations

- 2016 and 2017 Standards Grading
- Incorporate experience from “Paragraph 81” effort and Independent Expert Review Panel (IERP)
- Evaluate compliance history
- Formulate and vet candidate list
### Progress on Paragraph 81 and IERP

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<th>Current Status</th>
<th>P81 and IERP Recommendations for Retirement</th>
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## Progress on Paragraph 81 and IERP

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<th>Percent of Enforceable Requirements as of 1/1/2013</th>
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<td>6%</td>
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<td>274</td>
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</table>
- Create project page on NERC website - Complete
- Advisory Team finalize scope, criteria, and approach – Complete
- Solicit industry experts for review teams – Complete
- Present scope and approach to Standards Committee – Complete
- Assemble review teams (2017 Q4 – 2018 Q1)
- Review teams submit draft SARs to industry for comment (2018 Q1 – 2018 Q2)
• Industry ballots on proposed retirements/modifications to standards (2018 Q2 – 2018 Q3)
• Propose balloted standards to NERC Board of Trustees – 2018 Q3 – Q4 (changes to standards to include consolidation, modification, and retirement)
Questions and Answers