Meeting Agenda

MRO Protective Relay Subgroup

February 22, 2022 – 8:00 a.m. to 3:00 p.m.

Via Webex

MIDWEST RELIABILITY ORGANIZATION

380 St. Peter St, Suite 800
Saint Paul, MN 55102

651-855-1760

www.MRO.net

VIDEO AND AUDIO RECORDING

Please note that Midwest Reliability Organization (MRO) may make a video and/or an audio recording of this organizational group meeting for the purposes of making this information available to board members, members, stakeholders and the general public who are unable to attend the meeting in person.

By attending this meeting, I grant MRO:

1. Permission to video and/or audio record the meeting including me; and
2. The right to edit, use, and publish the video and/or audio recording.
3. I understand that neither I nor my employer has any right to be compensated in connection with the video and/or audio recording or the granting of this consent.

MRO ORGANIZATIONAL GROUP GUIDING PRINCIPLES

These MRO Organizational Group Guiding Principles complement charters. When the Principles are employed by members, they will support the overall purpose of the organizational groups.

Organizational Group Members should:

1. Make every attempt to attend all meetings in person or via webinar.
2. Be responsive to requests, action items, and deadlines.
3. Be active and involved in all organizational group meetings by reviewing all pre-meeting materials and being focused and engaged during the meeting.
4. Be self-motivating, focusing on outcomes during meetings and implementing work plans to benefit MRO and MRO's registered entities.
5. Ensure that the organizational group supports MRO strategic initiatives in current and planned tasks.
6. Be supportive of Highly Effective Reliability Organization (HEROTM) principles.
7. Be supportive of proactive initiatives that improve effectiveness and efficiency for MRO and MRO's registered entities.

MEETING AGENDA

Agenda Item	
1	**Call to Order and Determination of Quorum** *Greg Sessler, PRS Chair* a. Determination of Quorum and Introductions *PRS Meeting Secretary* b. Robert's Rules of Order
2	**Standards of Conduct and Anti-Trust Guidelines** *Jake Bernhagen, PRS Technical Liaison*
3	**Consent Agenda** *Greg Sessler, PRS Chair* Approve November 16, 2021 PRS Meeting Minutes PRS Nominations
4	**Chair's Report** *Greg Sessler, PRS Chair*
5	**New Members' Welcome Presentation** *Jake Bernhagen, PRS Technical Liaison*
6	**PRS Business** *Jake Bernhagen, PRS Technical Liaison* a. Charter Update b. Other Updates c. PRS Number of Members Discussion d. Action Item List Review *Greg Sessler, PRS Chair*
Break – 10:00 a.m.	
7	**NERC Activities** *Jake Bernhagen, PRS Technical Liaison* a. Update on NERC SPCWG *Mark Gutzmann Director, System Protection & Communication Engineering, Xcel Energy* b. NERC MIDASWG Update c. FERC/NERC Protection System Commissioning Program Review Update *Max Desruisseaux, Senior Power Systems Engineer* d. TADS *John Grimm, Principal Systems Protection Engineer*
8	**Misoperations** *Jake Bernhagen, PRS Technical Liaison* a. Q3 2021 Results and Review and Discussion b. Technical Presentations i. Failure Modes and Mechanisms Task Force *Richard Hackman, NERC* ii. Out of Step Tripping *Kevin Jones, Xcel Energy* c. Project Updates i. Instantaneous Ground Overcurrent *Jake Bernhagen, PRS Technical Liaison*

Lunch - 12:00 p.m.	
9	**MRO 2022 Regional Risk Assessment** *John Seidel, Principal Technical Advisor*
10	**Event Analysis Report** *Jake Bernhagen, PRS Technical Liaison*
11	**2022 Dates** *Greg Sessler, PRS Chair*
12	**PRS Roundtable Discussion** *Greg Sessler, PRS Chair*
13	**Other Business and Adjourn** *Greg Sessler, PRS Chair*
Closed Session	
14	**PRS Nominations Discussion**

AGENDA 1

Call to Order and Determination of Quorum

a. Determination of Quorum and Introductions

PRS Meeting Secretary

Name	Locale	Company	Term
Greg Sessler, Chair	Wisconsin	American Transmission Company	12/31/2023
David Wheeler, Vice-Chair	AR/TX/LA/NM	Southwestern Public Services Co.	12/31/2023
Adam Daters	Iowa	ITC Holdings	12/31/2024
Alex Bosgoed	Canada	Saskatchewan Power Company	12/31/2022
Casey Malskeit	Nebraska	Omaha Public Power District	12/31/2022
Cody Remboldt	Dakotas	Montana-Dakota Utilities	12/31/2024
Dennis Lu	Canada	Manitoba Hydro	12/31/2023
Derek Vonada	Kansas/Missouri	Sunflower Electric Power Cooperative	12/31/2022
Derrick Schlangen	Minnesota	Great River Energy	12/31/2023
Glenn Bryson	AR/TX/LA/NM	American Electric Power	12/31/2024
Greg Hill	Nebraska	Nebraska Public Power District	12/31/2022
Josh Erdmann	Minnesota	Xcel Energy	12/31/2024
Matt Boersema	Oklahoma	Western Farmers Electric	12/31/2022
Ryan Einer	Oklahoma	Oklahoma Gas & Electric Co.	12/31/2023
Sarah Marshall	Wisconsin	Alliant Energy	12/31/2024
Scott Paramore	Kansas/Missouri	Kansas City Board of Public Utility	12/31/2024
Terry Fett	Iowa	Central Iowa Power Cooperative	12/31/2023
OPEN	Minnesota	N/A	12/31/2022
OPEN	Dakotas	N/A	12/31/2022

AGENDA 1

Call to Order and Determination of Quorum

b. Robert's Rules of Order

Greg Sessler, PRS Chair

Parliamentary Procedures. Based on Robert's Rules of Order, Newly Revised, Tenth Edition

Establishing a Quorum. In order to make efficient use of time at MRO organizational group meetings, once a quorum is established, the meeting will continue, however, no votes will be taken unless a quorum is present at the time any vote is taken.

Motions. Unless noted otherwise, all procedures require a "second" to enable discussion.

When you want to…	Procedure	Debatable	Comments
Raise an issue for discussion	Move	Yes	The main action that begins a debate.
Revise a Motion currently under discussion	Amend	Yes	Takes precedence over discussion of main motion. Motions to amend an amendment are allowed, but not any further. The amendment must be germane to the main motion, and cannot reverse the intent of the main motion.
Reconsider a Motion already resolved	Reconsider	Yes	Allowed only by member who voted on the prevailing side of the original motion. Second by anyone.
End debate	Call for the Question *or* End Debate	No	If the Chair senses that the committee is ready to vote, he may say "if there are no objections, we will now vote on the Motion." Otherwise, this motion is not debatable and subject to majority approval.
Record each member's vote on a Motion	Request a Roll Call Vote	No	Takes precedence over main motion. No debate allowed, but the members must approve by majority.
Postpone discussion until later in the meeting	Lay on the Table	Yes	Takes precedence over main motion. Used only to postpone discussion until later in the meeting.
Postpone discussion until a future date	Postpone until	Yes	Takes precedence over main motion. Debatable only regarding the date (and time) at which to bring the Motion back for further discussion.
Remove the motion for any further consideration	Postpone indefinitely	Yes	Takes precedence over main motion. Debate can extend to the discussion of the main motion. If approved, it effectively "kills" the motion. Useful for disposing of a badly chosen motion that cannot be adopted or rejected without undesirable consequences.

Request a review of procedure	Point of order	No	Second not required. The Chair or secretary shall review the parliamentary procedure used during the discussion of the Motion.

Notes on Motions

Seconds. A Motion must have a second to ensure that at least two members wish to discuss the issue. The "seconder" is not required to be recorded in the minutes. Neither are motions that do not receive a second.

Announcement by the Chair. The chair should announce the Motion before debate begins. This ensures that the wording is understood by the membership. Once the Motion is announced and seconded, the Committee "owns" the motion, and must deal with it according to parliamentary procedure.

Voting

Voting Method	When Used	How Recorded in Minutes
	When the Chair senses that the Committee is substantially in agreement, and the Motion needed little or no debate. No actual vote is taken.	The minutes show "by unanimous consent."
Vote by Voice	The standard practice.	The minutes show Approved or Not Approved (or Failed).
Vote by Show of Hands (tally)	To record the number of votes on each side when an issue has engendered substantial debate or appears to be divisive. Also used when a Voice Vote is inconclusive. (The Chair should ask for a Vote by Show of Hands when requested by a member).	The minutes show both vote totals, and then Approved or Not Approved (or Failed).
Vote by Roll Call	To record each member's vote. Each member is called upon by the Secretary, and the member indicates either "Yes," "No," or "Present" if abstaining.	The minutes will include the list of members, how each voted or abstained, and the vote totals. Those members for which a "Yes," "No," or "Present" is not shown are considered absent for the vote.

Notes on Voting.

Abstentions. When a member abstains, he/she is not voting on the Motion, and his/her abstention is not counted in determining the results of the vote. The Chair should not ask for a tally of those who abstained.

Determining the results. A simple majority of the votes cast is required to approve an organizational group recommendations or decision.

"Unanimous Approval." Can only be determined by a Roll Call vote because the other methods do not determine whether every member attending the meeting was actually present when the vote was taken, or whether there were abstentions.

Electronic Votes – For an e-mail vote to pass, the requirement is a simple majority of the votes cast during the time-period of the vote as established by the Committee Chair.

Majorities. Per Robert's Rules, as well as MRO Policy and Procedure 3, a simple majority (one more than half) is required to pass motions.

AGENDA 2

Standards of Conduct and Antitrust Guidelines

Jake Bernhagen, PRS Technical Liaison

Standards of Conduct Reminder:

Standards of Conduct prohibit MRO staff, committee, subgroup, and task force members from sharing non-public transmission sensitive information with anyone who is either an affiliate merchant or could be a conduit of information to an affiliate merchant.

Antitrust Reminder:

Participants in Midwest Reliability Organization meeting activities must refrain from the following when acting in their capacity as participants in Midwest Reliability Organization activities (i.e. meetings, conference calls, and informal discussions):

- Discussions involving pricing information; and
- Discussions of a participants marketing strategies; and
- Discussions regarding how customers and geographical areas are to be divided among competitors; and
- Discussions concerning the exclusion of competitors from markets; and
- Discussions concerning boycotting or group refusals to deal with competitors, vendors, or suppliers.

AGENDA 3

Consent Agenda

a. Approve November 16, 2021 PRS Meeting Minutes

Greg Sessler, PRS Chair

Action

Approve November 16, 2021 PRS meeting minutes.

Report

DRAFT MINUTES OF THE PROTECTIVE RELAY SUBGROUP MEETING

Webex

November 16, 2021 8:00 a.m. – 11:00 a.m. Central
1:00 p.m. – 3:00 p.m. Central

Notice for this meeting was electronically posted to the MRO website here on October 16, 2021.
A final agenda, including advanced reading materials, was also posted on November 15, 2021.

1. Call to Order and Determination of Quorum

   Protective Relay Subgroup (PRS) Vice Chair Bob Soper called the meeting to order at 8:03 a.m. Soper welcomed everyone and brief introductions were made by those on the call. The meeting secretary advised the chair that a quorum of the PRS was present. A complete list of attendees is included as Exhibit A.

2. Standards of Conduct and Antitrust Guidelines

   Pursuant to Policy and Procedure 4, PRS Staff Liaison Jake Bernhagen highlighted MRO's Standards of Conduct, Conflict of Interest, and Antitrust Guidelines

3. Consent Agenda

   The PRS reviewed the consent agenda, which included draft minutes from the August 17, 2021 meeting.

   Upon a motion duly made and seconded, the Protective Relay Subgroup unanimously approved the minutes from the August 17, 2021 PRS meeting as written.

   Agenda item 6c was moved up during the meeting.

   c. FERC/NERC Protection System Commissioning Program Review. MRO Senior Power Systems Engineer Max Desruisseaux provided a brief overview highlighting how the candidates involved in the report were chosen. Gilbert Lowe, FERC provided an overview on the Executive Summary and logistics, Rich Bauer highlighted the history of the IEEE guidance. Discussion ensued.

Bryan Clark extended gratitude to Lowe and Bauer for their time and extended kudos in how the report was conducted with the involvement of entities. In response to an inquiry from Soper regarding outreach, Clark mentioned perhaps the PRS could sponsor a webinar to relay this information.

4. Chair's Report

Vice Chair Soper noted that the PRS unanimously agreed to recommend Adam Daters, Cody Remboldt, Glenn Bryson, Josh Erdman, Sarah Marshall, and Scott Paramore as 2022 PRS Members to the RAC for recommendation and approval by the OGOC. Certificates of service were presented and Soper provided recognition to for PRS members Gary Stoedter, who retired and Ryan Godwin and Wayne Miller who did not nominate for their terms ending in 2021.

5. PRS Business

a. Update. Jake Bernhagen mentioned the closed meeting minutes were sent out and asked the group to provide any updates during the break.

b. PRS Charter Update Discussion. Jake Bernhagen led the discussion noting the complexity of the locale requirement in the Charter and that diversity among the MRO footprint is attained with the other councils and subgroups without this language in their respective charters. A comment was made to remove the member limit of 19 within the PRS. A few people on the call expressed their agreement with removing the member cap as well as the reimbursement for attending in person meetings. Discussion ensued.

Upon a motion duly made and seconded the PRS unanimously agreed to recommend removal of the locale requirements from the PRS Charter as indicated in the redline to the RAC for recommendation and approval by the OGOC.

c. Action Item List Review. Vice Chair Soper reviewed the action item list and updates were made accordingly.

6. NERC Activities

a. Update on NERC System Protection and Control Working Group (SPCWG). Mark Gutzmann, MRO representative on the NERC SPCWG, provided an overview on the recent work of the group, including PRC-019, RC-024, Inter-Entity Short Circuit Model Guidance and a SAR on PRC-025-2. Discussion ensued.

b. NERC Misoperation Information Data Analysis System User Working Group (MIDASUG) Update. Bernhagen provided a brief overview of the MIDASUG Agenda for its meeting of November 16, 2021 which included; the Odessa disturbance report and correlating outreach, DIR revisions, clarification on maintenance exclusion for misops and work on breaker failure clarification.

c. FERC/NERC Protection System Commissioning Program Review. ***This item was covered above***.

d. TADS. Jake Bernhagen mentioned the recent work being done in the TADSWG was primarily dedicated to TADS training which recently occurred and that the training received positive feedback.

7. Misoperations

Item 7b was moved up here.

b. Technical Presentations
   i. Review of Misoperation at Crossroads Cap Bank. John (J.V.) Kelly, Principal Engineer, Xcel Energy presented on the topic highlighting the protection scheme involved in the misoperation, relay records, field investigation, and corrective actions. Discussion ensued.
   ii. June 10, 2021 Event. Allen Halling, Lead Engineer, and Mark Hopkins, System Protection Engineering Evergy presented on the CCVT Shawnee Mission Failure highlighting the background involved with the failure and the challenges of reporting the event.

a. Second Quarter 2021 Results and Review. Jake Bernhagen reminded everyone of the deadline to submit Misops data for Q3.
   ii. 2021 Update to Analysis of Composite Protection Systems Misoperations. MRO Principal Systems Protection Engineer, John Grimm presented on the subject highlighting that the presentation was done previously in 2020 and expanded the data to include a three year time span. By equipment type, by cause, by cause subdivided by relay technology, by voltage class. Grimm asked the group for any other data they would like to see analyzed. Discussion ensued.

b. Technical Presentations
   i. Review of Misoperation at Crossroads Cap Bank. ***This was covered above***
   ii. June 10, 2021 Event. ***This was covered above***

c. Project Updates
   i. Static Output Driving High Impedance Inputs. Desruisseaux provided an update noting that the white paper addresses the application of static output driving high impedance inputs and breaker failure schemes, while the NERC lessons learned is based more on a general use of high impedance inputs using a resistor to mitigate misoperations that can occur. Since duplication of efforts has occurred with NERC, the group was asked whether this was worthy of pursuing. It was determined that this project will be dropped from the Agenda.
   ii. Instantaneous Ground Overcurrent. Bernhagen provided an update on the status of the project and whitepaper, noting continued progress is slow with the goal to pick up again beginning 2022.

8. Event Analysis Report

Jake Bernhagen, MRO Sr. Protection Systems Engineer, provided an overview of the event analysis report. He noted the event analysis process is progressing fairly well even though events are a bit higher than in the past. The plan is to close out approximately 12 events by the end of the year. He noted that the process to close events is currently about 7 months from start to finish and the team is working to get the process time back down to 6 months. If any information from more wide spread events would provide value, Bernhagen asked the group to let him know and in turn, the information will be sent to NERC.

9. 2022 Dates

Vice Chair Soper led the discussion regarding the 2022 meeting dates for the PRS. The meetings for all councils and subgroups were displayed for 2022. Soper mentioned that the PRS meetings occurring prior to the RAC meetings is more efficient for approval purposes. The PRS agreed to change the May 2022 PRS meeting date from May 24, 2022 to May 3, 2022.

Soper mentioned the November 8, 2022 closed meeting minutes which were sent out via email and asked the group for any discussion.

Upon a motion duly made and seconded, the Protective Relay Subgroup unanimously agreed to approve the minutes from the November 8, 2021 closed meeting as written

10. PRS Roundtable Discussion

The PRS members next participated in a roundtable discussion. The following items were highlighted:

- MIDASWG work on exemptions for onsite maintenance, there is confusion surrounding the intent of exclusions. If there are construction or relay crews on site on or near the equipment that misoperates, that can be an exclusion. The ERO group is working on defining what is included within those exclusions and the information will be brought back to the group. Discussion ensued.
- Unique and interesting events that people are willing to share and highlight at future PRS meetings were welcomed.
- Single points of failure identification and analysis – the Standard becomes enforceable on July 1, 2023 and any TP assessment that exist on that date must include the single point of failure including batteries, communication, dc control circuits, strip coils, etc. The contingencies must be submitted in June of 2022. The corrective action plans must be submitted by 2029. Discussion ensued.

11. Other Business and Adjourn

Vice Chair Soper asked for any further discussion, hearing none, the meeting was adjourned at 2:40 p.m.

Prepared by: Dana Klem, Reliability Advisory Council Administrator.
Reviewed and Submitted by: Bryan Clark, Director of Reliability Analysis, MRO

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EXHIBIT A – MEETING ATTENDEES

Subgroup Members Present	
Name	**Company, Role**
Robert Soper (Vice Chair)	Western Area Power Administration
~~Alex Bosgoed~~	~~Saskatchewan Power Company~~
Casey Malskeit	Omaha Public Power District
Cody Remboldt	Montana-Dakota Utilities
David Wheeler	Southwestern Public Services Co.
Dennis Lu	Manitoba Hydro
Derek Vonada	Sunflower Electric Power Cooperative
Derrick Schlangen	Great River Energy
~~Gary Stoedter~~	~~MidAmerican Energy Company~~
Greg Hill	Nebraska Public Power District
Greg Sessler	American Transmission Company
~~Jeff Beasley~~	~~Grand River Dam Authority~~
~~Matt Boersema~~	~~Western Farmers Electric Cooperative~~
Ryan Einer	Oklahoma Gas & Electric Co.
~~Ryan Godwin~~	~~American Electric Power~~
Scott Paramore	Kansas City Board of Public Utilities
Terry Fett	Central Iowa Power Cooperative
Wayne Miller	ITC
MRO Staff	
Name	**Title**
Bryan Clark	Director Reliability Analysis
Dana Klem	Administrator, Reliability Analysis
David Kuyper	Power System Engineer

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Jake Bernhagen	Senior Protection Systems Engineer
Max Desruisseaux	Senior Power Systems Engineer
Michelle Olson	Administrator, Compliance Monitoring
Guests	
Name	**Company**
Adam Daters	ITC
Allen Halling	Evergy
Boris Voynik	FERC
Brett Holland	Evergy
Craig Talbot	Minnesota Power
Elsammani Ahmed	ITC
Gil Lowe	FERC
Josh Erdman	Xcel Energy
Justin Fuith	Pro-Tech Power
J.V. Kelley	Xcel Energy
Kevin Thompson	ITC
Mark Gutzmann	Xcel Energy
Mark Hopkins	Evergy
Rich Bauer	NERC
Steve Klecker	MidAmerican
Terry Volkmann	GLP/MPC
Thomas Persinger	MidAmerican

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AGENDA 3

Consent Agenda

a. Approve PRS Nominations

Greg Sessler, PRS Chair

Action

Approve PRS nominations.

Report

Chair Sessler will lead the discussion during the meeting.

MIDWEST RELIABILITY ORGANIZATION

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AGENDA 4

Chair's Report

Greg Sessler, PRS Chair

Action
Discussion

Report
Chair Sessler will provide an oral report during the meeting.

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AGENDA 5

New Members' Welcome Presentation

Jake Bernhagen, PRS Technical Liaison

Action
Information

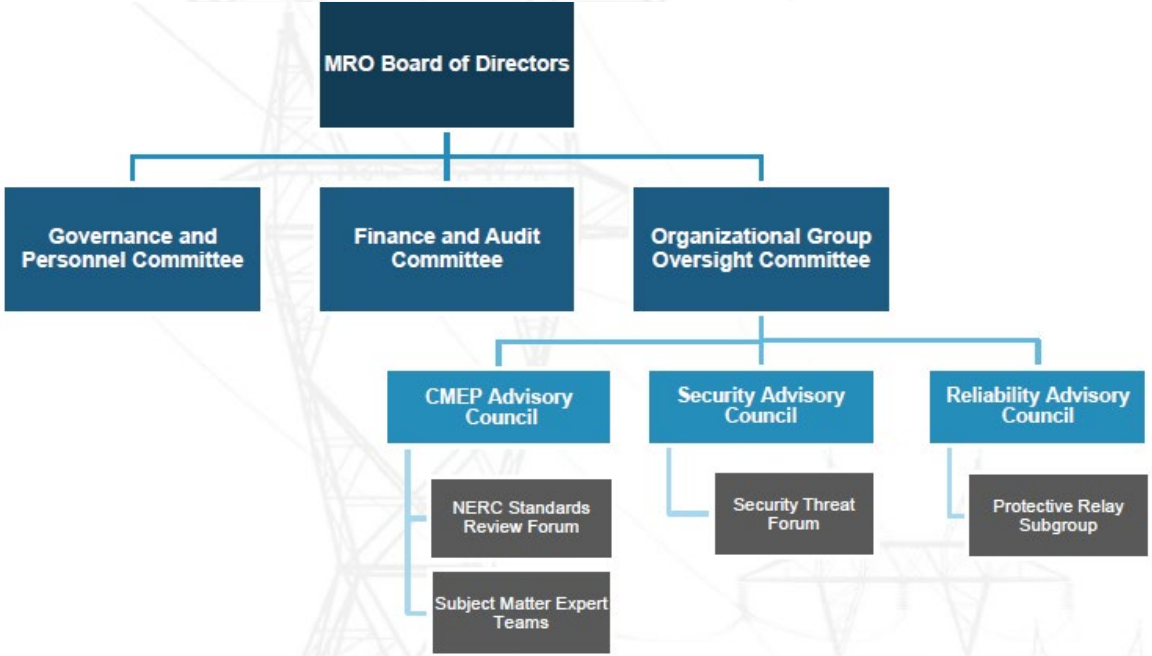
Report
Jake Bernhagen will provide an oral report during the meeting.

MIDWEST RELIABILITY ORGANIZATION

Midwest Reliability Organization

Information for Members of the MRO Reliability Advisory Council (RAC) and Protective Relay Subgroup (PRS)

Advisory Council Structure



Organizational Group Oversight Committee (OGOC)

- **The OGOC:**
  - Establishes and oversees MRO organizational groups and policies applicable to organizational groups
  - Ensures organizational groups are effective and efficient and do not duplicate the work of others
  - Designates individuals to represent MRO on NERC organizational groups
  - The Organizational Group Oversight Committee Charter is posted on MRO's public website

OGOC Roster

Member	Term End	Company
Aaron Bloom	12/31/23	NextEra Energy Resources
Charles Marshall	12/31/22	ITC Holdings
Dehn Stevens	12/31/23	MidAmerican Energy Company
Ben Porath	12/31/22	Dairyland Power Cooperative
Jeanne Tisinger	12/31/22	Independent Director
Jennifer Flandermeyer	12/31/23	Evergy
JoAnn Thompson	12/31/23	Otter Tail Power Company
Eric Schmitt	12/31/22	Independent Director
Paul Crist, **Chair**	12/31/23	Lincoln Electric System
Iqbal Dhami	12/31/22	Saskatchewan Power
Daryl Maxwell	12/31/23	Manitoba Hydro

Guiding Principles for Council Members

- **These MRO Organizational Group Guiding Principles complement charters. When the Principles are employed by members, they will support the overall purpose of the organizational groups.**
- **Organizational Group Members should:**

1. Make every attempt to attend all meetings in person or via webinar.
2. Be responsive to requests, action items, and deadlines.
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4. Be self-motivating, focusing on outcomes during meetings and implementing work plans to benefit MRO and MRO's registered entities.
5. Ensure that the organizational group supports MRO strategic initiatives in current and planned tasks.
6. Be supportive of Highly Effective Reliability Organization (HEROTM) principles.
7. Be supportive of proactive initiatives that improve effectiveness and efficiency for MRO and MRO's registered entities.

Types of Diversity

Inherent Diversity

- Race
- Ethnicity
- Age
- National origin
- Sexual orientation
- Cultural identity
- Assigned sex
- Gender identity

Acquired Diversity

- Expertise (e.g., engineering, operations, security)
- Experience (e.g., executive, technical)
- Geography (e.g., US, Canada, north, south)
- Company (e.g., no more than two members from the same company per group)

Why Diverse Teams are Smarter

- **They focus more on facts**
  - More likely to constantly reexamine facts and remain objective
  - Can lead to improved and more accurate group thinking
- **They process those facts more carefully**
  - Considering the perspective of an outsider can result in improved decision-making and results
- **They are also more innovative**
  - Diversity boosts intellectual potential
  - Conformity discourages innovative thinking

SOURCE: https://hbr.org/2016/11/why-diverse-teams-are-smarter

MRO Reliability Advisory Council

The MRO Reliability Advisory Council is a MRO Organizational Group that provides advice and counsel to MRO's Board of Directors (board), the board's Organizational Group Oversight Committee, staff, members and registered entities on topics such as transmission adequacy and availability, resource adequacy, integration of renewables, essential reliability services, event analysis, system protection, and reliability assessments. The MRO Reliability Advisory Council increases outreach and awareness in these key areas.

https://www.mro.net/committees/rac/Pages/default.aspx

RAC Council Membership

- **MRO's Council consists of 15 members:**
  - Pursuant to Policy and Procedure 3 - Establishment, Responsibilities, and Procedures of Organizational Groups and MRO Sponsored Representative on NERC Organizational Groups, membership on councils is based on experience and expertise.
  - No more than two members of the MRO (Council) may be an employee of a single entity or affiliated entities.
  - At least three sectors will be represented on the MRO (Council). To the extent practicable, membership will reflect geographic diversity and balanced sector representation.
  - Individuals with expertise and experience in the areas of transmission planning, resource planning, power systems engineering, system operations, as well as control and protection systems serve on the MRO RAC.

Reliability Advisory Council Roster

Member	Term End	Company
Dick Pursley, Chair	12/31/22	Great River Energy
Jason Weiers, Vice Chair	12/31/24	Otter Tail Power Company
Binod Shrestha	12/31/22	Saskatchewan Power Company
CJ Brown	12/31/24	Southwest Power Pool, Inc.
Dallas Rowley	12/31/22	Oklahoma Gas & Electric
Derek Brown	12/31/23	Evergy
Durgesh Manjure	12/31/23	MISO
Dwayne Stradford	12/31/24	American Electric Power
Gayle Nansel	12/31/22	Western Area Power Administration
Jeremy Severson	12/31/24	Basin Electric
John Stephens	12/31/23	City Utilities of Springfield Missouri
Nandaka Jayasekara	12/31/22	Manitoba Hydro
Ron Gunderson	12/31/23	Nebraska Public Power District
Open	12/31/23	N/A
Open	12/31/24	N/A

RAC Key Responsibilities

- Recommend the establishment of subgroups to support the Reliability Advisory Council work plan as appropriate. Oversee and provide direction to any subgroups.
- Support the preparation of special assessments and seasonal readiness plans by regional Reliability Coordinators and as may be directed by NERC or the MRO Board of Directors from time to time.
- Review and assess the overall reliability of the MRO region and interregional bulk electric system for long-term planning horizons based on reports from regional Planning Coordinators as may be directed by NERC or the MRO Board of Directors from time to time.
- Support the development of the annual MRO Regional Risk Assessment by identifying risks, trends, and mitigating activities.

RAC Key Responsibilities cont.

- Review significant BES events (generally, Category 2 or higher) which occurred in the MRO Region and the resulting reports and approve larger scale event reports (Category 3 and higher) to assure the appropriate analysis is performed and that any lessons learned are identified and shared with the industry.
- Provide input and guidance on system protection and control matters, including Reliability Standards development, misoperation reviews, and reviews of remedial action schemes.
- Support the applicable NERC program areas.

The Reliability Advisory Council Charter can be found here.

Meetings

- The MRO RAC will meet quarterly or as necessary, in person or via conference call and/or web meeting. Once a year the MRO (Council) will meet with the OGOC the day before a regularly scheduled board meeting.
- All MRO council chairs and vice chairs will meet with the OGOC the day before the fourth quarter regularly scheduled board meeting to review the council's accomplishments during the past year and to develop work plans for the following year.
- Meetings of the RAC are open to public attendance; however, the meeting may be called into closed session by the chair or vice chair. Additional meeting requirements related to agendas and minutes, voting and proxy, and rules of conduct are outlined in MRO Policy and Procedure 3 - Establishment, Responsibilities, and Procedures of Organizational Groups and MRO Representation on NERC Organizational Groups.
- Meeting costs incurred by RAC members are reimbursable by MRO according to MRO Policy and Procedure 2 – Expense Reimbursement.

Future Meeting/Event Dates

Upcoming RAC Meeting/Event Dates

Meeting/Event	Date
Quarter 1	April 6, 2022
Quarter 2	May 19, 2022
Quarter 3	August 17, 2022
Quarter 4	November 16, 2022
Reliability Conference	May 18, 2022

Guidelines for Meetings

- **Meeting Agendas:**
  - Short agenda posted one month prior to meeting
  - Agenda Packet posted one week prior to meeting
- **Meeting Minutes:**
  - Support Staff/Liaison will review up to two weeks after meeting takes place
  - Council will review for one week
  - Council will vote to approve

Work Plan

MRO RAC 2022 Work Plan

Work Item	Source	Activity	Timing	Responsible Party	Item Audience	Item Type	Status	Notes
Conduct Outreach and Awareness	RAC Charter/MRO Strategic Goal 2	Conduct a minimum of 2 webinars/outreach in 2022 to increase reliability and decrease risk to the reliable and secure operations of the bulk power system. Annual Reliability Conference, webinars- lessons learned, newsletter articles, Standard Application Guides	Periodically	RAC Members	OGOC	Workplan	Open	The 2022 Reliability Conference is scheduled for May 17-18, 2022 in Kansas City. A subgroup of RAC members will be formed to develop topics and speakers.
Provide Reliability Standard Reviews	RAC Charter/MRO Strategic Goal 3	Regular interface with other councils(CMEPAC and SAC) as it relates to standard development or standard application guidance. Look for opportunities to provide input from an Operational and Planning perspective.	Periodically	RAC Members	OGOC	Workplan	Open	The RAC plans to assign a member to attend NSRF meetings periodically in 2022 as well as look at opportunities to provide guidance for standards relevant to operations and planning.
Review significant events or disturbances on the BES	RAC Charter/MRO Strategic Goal 3	Review of significant BES events and any resulting reports within the MRO Region and outside the region as relevent.	Periodically	RAC Members	OGOC	Workplan	Open	The RAC will review any significant events or disturbances from a specific entity at quarterly meetings as necessary. Summary presentation from staff on the events process.
Development of the MRO Regional Risk Assessment	RAC Charter/MRO Strategic Goal 4	Support the development of the annual MRO Regional Risk Assessment by identifying risks, trends and mitigating activities.	Qtr 3	RAC Members	OGOC	Workplan	Open	MRO Staff and MRO RAC Members will discuss and prioritize potential regional risks annually to support the development of the MRO RRA. The RAC will also provide two resources to support MRO staff in ranking risks for the 2023 RRA utilizing the Reliability Risk Matrix.
Support Regional representation on NERC organizational groups	RAC Charter	Review NERC Representative reports and provide guidance and feedback to the representatives. The RAC will continue to evaluate the need to follow specific NERC groups with representatives as the RSTC makes changes to the working group structure.	Periodically	RAC Members	OGOC	Workplan	Open	MRO Staff and MRO RAC Members will look into any new working groups formed as well as existing working groups to determine the need to follow them.
Refine the use of the tool for prioritizing and ranking reliability risks	MRO Strategic Goal 4	The RAC will finalize the Reliability Risk Matrix tool created in 2019 to assess, quantify, and prioritize reliability risks. This will potentially be used to rank regional risk among the group.	Qtr 2	RAC Members	OGOC	Workplan	Open	The RAC will continue to collaborate with MRO staff, the CMEPAC, the SAC and others regionally to finalize and utilize the Reliability Risk Matrix in 2022.
Review the summary of misoperations across the MRO Region (prepared by MRO staff)	PRS Charter	The Protective Relay Subgroup will review misoperations across the region to ensure that misoperations are effectively identified and mitigated.	Periodically	PRS Members	OGOC	Workplan	Open	The PRS will look into potential lessons learned and targeted outreach for any misoperations.

he items above this row are seeking/have been granted OGOC approval. The items below this row are example ideas on how the advisory council could implement any approved work plan items.

MRO Protective Relay Subgroup

The purpose of the MRO Protective Relay Subgroup (PRS) is to identify, review and discuss system protection and control issues relevant to the reliability of the bulk electric system and to develop and implement regional procedures for applicable NERC PRC standards. The PRS reports to the Reliability Advisory Council (RAC).

Link to webpage:
https://www.mro.net/committees/rac/PRS/Pages/default.aspx

Protective Relay Subgroup Membership

MRO's PRS consists of 19 members:

- Pursuant to Policy and Procedure 3 - Establishment, Responsibilities, and Procedures of Organizational Groups and MRO Sponsored Representative on NERC Organizational Groups, membership of organizational groups shall be determined based upon experience, expertise and geographic diversity and to the extent practicable, shall include a balanced representation of the sectors.
- Membership is based on geographic representation (locale).

MRO PRS Roster

Member	Term End	Company
Greg Sessler, Chair	12/31/23	American Transmission Co
David Wheeler, Vice-Chair	12/31/23	Southwestern Public Services Co.
Adam Daters	12/31/24	ITC Holdings
Alex Bosgoed	12/31/22	Saskatchewan Power Company
Casey Malskeit	12/31/22	Omaha Public Power District
Cody Remboldt	12/31/24	Montana-Dakota Utilities
Dennis Lu	12/31/23	Manitoba Hydro
Derek Vonada	12/31/22	Sunflower Electric Power Cooperative
Derrick Schlangen	12/31/23	Great River Energy
Glenn Bryson	12/31/24	American Electric Power
Greg Hill	12/31/22	Nebraska Public Power District
Josh Erdmann	12/31/24	Xcel Energy
Matt Boersema	12/31/22	Western Farmers Electric
Ryan Einer	12/31/23	Oklahoma Gas & Electric
Sarah Marshall	12/31/24	Alliant Energy
Scott Paramore	12/31/24	Kansas City Board of Public Utilities
Terry Fett	12/31/23	Central Iowa Power Cooperative
OPEN MINNESOTA	12/31/22	N/A
OPEN DAKOTAS	12/31/22	N/A

PRS Key Responsibilities

- Develop, maintain, and implement regional procedures as needed that address the requirements of NERC PRC standards.
- Annually review the MRO summary of Misoperations to identify Lessons Learned and communicate these lessons with MRO membership.
- Trend the Event Analysis reports submitted to MRO for the purpose of identifying misoperations that are causing, or increasing the severity of, these events. Through the PRS, work with the Entities involved with these events to assure that the misoperations are effectively identified and mitigated. Assure that any protection-related Lessons Learned of value to the industry are prepared and submitted to NERC Event Analysis staff.
- Prepare as necessary additional reports/whitepapers that identify methods that can reduce the likelihood or severity of system events or misoperations that can lead to system events.
- Review Remedial Action Schemes (RAS) as necessary to verify protection system functionality and/or assess operability.
- Provide technical input related to system protection and control to MRO.

Meetings

- The MRO PRS will meet quarterly or as necessary, in person or via conference call and/or web meeting.
- Meetings of the PRS are open to public attendance; however, the meeting may be called into closed session by the chair or vice chair. Additional meeting requirements related to agendas and minutes, voting and proxy, and rules of conduct are outlined in MRO Policy and Procedure 3 - Establishment, Responsibilities, and Procedures of Organizational Groups and MRO Representation on NERC Organizational Groups
- Meeting costs incurred by PRS members are reimbursable by MRO according to MRO Policy and Procedure 2 – Expense Reimbursement

Future Meeting Dates

Upcoming PRS Meeting Dates

Meeting/Event	Date
Quarter 1	February 22, 2022
Quarter 2	May 3, 2022
Quarter 3	August 16, 2022
Quarter 4	November 15, 2022

Newsletters

- **Tentative Due Dates:**
  - 03/15/22 (March/April Issue)
  - 05/14/22 (May/June Issue)
  - 07/15/22 (July/August Issue)
  - 09/15/22 (Sept/Oct Issue)
  - 11/15/22 (Nov/Dec Year-End Issue)
  - 02/01/22 (2021 Annual Report)

- **Include: Bio, photo, title and article**

Webinars

- **Topic**
- **Title**
- **Short paragraph describing event**
- **Dates/Times for Dry-run and Webinar**
- **Presenters/Speaker Information**
  - Title
  - Company
  - Best contact number
  - Email
- **Council Support Member**
- **MRO Support Staff**
- **Presentation**

MIDWEST RELIABILITY ORGANIZATION

Event Announcement

MRO PRS to Host High Impact Misoperations Webinar

July 21, 2020 | 1:30 p.m. - 3:00 p.m. Central

Webinar Details

MRO's Protective Relay Subgroup is pleased to announce it is hosting a webinar on High Impact Misoperations. The analysis of misoperations and their role in system disturbances has revealed that certain classes of misoperations have a more severe impact on Bulk Power System reliability than others. The two types of misoperations observed having the most impact are those associated with; i) differential relays, and ii) breaker failure relays. MRO staff, in conjunction with members of the MRO Protective Relay Subgroup, will present some techniques that can help reduce misoperations associated with these two scheme types. In addition, some best practices to ensure thorough commissioning of protection systems is included in this webinar.

Presenters

John Grimm, Principal Engineer, Xcel Energy

Jeff Beasley, Senior Protection and Control Engineer, Grand River Dam Authority

Ryan Einer, Lead P&C Maintenance Engineer, Oklahoma Gas and Electric

Important Links

RAC mailing list: mrorac@mro.net **Please be sure to whitelist**

PRS mailing list: mroprs@mro.net **Please be sure to whitelist**

RAC Public Site: https://www.mro.net/committees/rac/Pages/default.aspx

PRS Public Site: https://www.mro.net/committees/rac/PRS/Pages/default.aspx

Expense Reimbursement: MRO Policy and Procedure 2 – Expense Reimbursement

Member Responsibilities: MRO Policy and Procedure 3- Establishment, Responsibilities

Confidentiality Policy: MRO Policy and Procedure 5 (Confidentiality Policy

MRO Contact Information

MRO Website: http://www.mro.net

Address: 380 St. Peter Street, Suite 800, Saint Paul, MN 55102

Phone: 651-855-1760 (main)

MRO RAC Support Staff

Bryan Clark
Director of Reliability Analysis
Phone: 651-256-5171
Bryan.clark@mro.net

MRO PRS Support Staff

Jake Bernhagen
Senior Systems Protection Engineer
Phone: 651-256-5177
Jake.bernhagen@mro.net

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AGENDA 6

PRS Business

a. Charter Update Discussion

Jake Bernhagen, PRS Technical Liaison

Action

Information

Report

Jake Bernhagen will lead the discussion during the meeting.

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AGENDA 6

PRS Business

b. Other Updates

Jake Bernhagen, PRS Technical Liaison

Action

Information

Report

Jake Bernhagen will lead the discussion during the meeting.

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AGENDA 6

PRS Business

c. PRS Number of Members Discussion

Jake Bernhagen, PRS Technical Liaison

Action

Information

Report

Jake Bernhagen will lead the discussion during the meeting.

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AGENDA 6

PRS Business

d. Action Item List Review

Greg Sessler, PRS Chair

Action

Information

Report

Chair Sessler will lead the discussion during the meeting.

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AGENDA 7

NERC Activities

a. Update on NERC SPCWG

Mark Gutzmann Director, System Protection & Communication Engineering, Xcel Energy

Action
Information

Report

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AGENDA 7

NERC Activities

b. NERC MIDASWG Update

Jake Bernhagen, PRS Technical Liaison

Action
Discussion

Report
Jake Bernhagen will provide an oral report during the meeting.

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AGENDA 7

NERC Activities

c. FERC/NERC Protection System Commissioning Program Review

Max Desruisseaux, Senior Power Systems Engineer

Action
Information

Report
Max Desruisseaux will provide an oral report during the meeting.

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AGENDA 7

NERC Activities

d. Transmission Availability Data System (TADS)

John Grimm, Principal Systems Protection Engineer

Action
Discussion

Report
John Grimm will provide an oral report during the meeting.

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AGENDA 8

Misoperations

a. Q3 2021 Results and Review Discussion

Jake Bernhagen, PRS Technical Liaison

Action
Information

Report
Jake Bernhagen will provide an overview during the meeting.

MIDWEST RELIABILITY ORGANIZATION

MIDAS & Misoperations Q3 PRS Update

By Jake Bernhagen

Q3 2021 Misop Rates

Quarter 3, 2021

Voltage Class	MisOps Count	Ops Count	MRO Rate	NERC Rate
<100kV (BES)	2	22	9.09%	4.23%
100kV	0	0	0.00%	0.00%
115kV	16	189	8.47%	4.37%
138kV	26	227	11.45%	6.53%
161kV	12	111	10.81%	7.45%
230kV	12	85	14.12%	8.81%
345kV	5	100	5.00%	5.46%
500kV	0	6	0.00%	7.50%
HVdc	0	28	0.00%	0.00%
TOTAL	**73**	**768**	**9.51%**	**6.23%**

2021 Misop Rates

Quarter 1 2021

Voltage Class	MisOps Count	Ops Count	Rate	NERC Rate
<100kV (BES)	2	17	11.76%	3.49%
100kV	0	0	0.00%	0.00%
115kV	18	135	13.33%	5.52%
138kV	6	153	3.92%	6.72%
161kV	9	45	20.00%	14.49%
230kV	6	99	6.06%	8.81%
345kV	12	97	12.37%	7.66%
500kV	1	4	25.00%	17.39%
HVdc	0	1	0.00%	0.00%
TOTAL	**54**	**551**	**9.80%**	**7.17%**

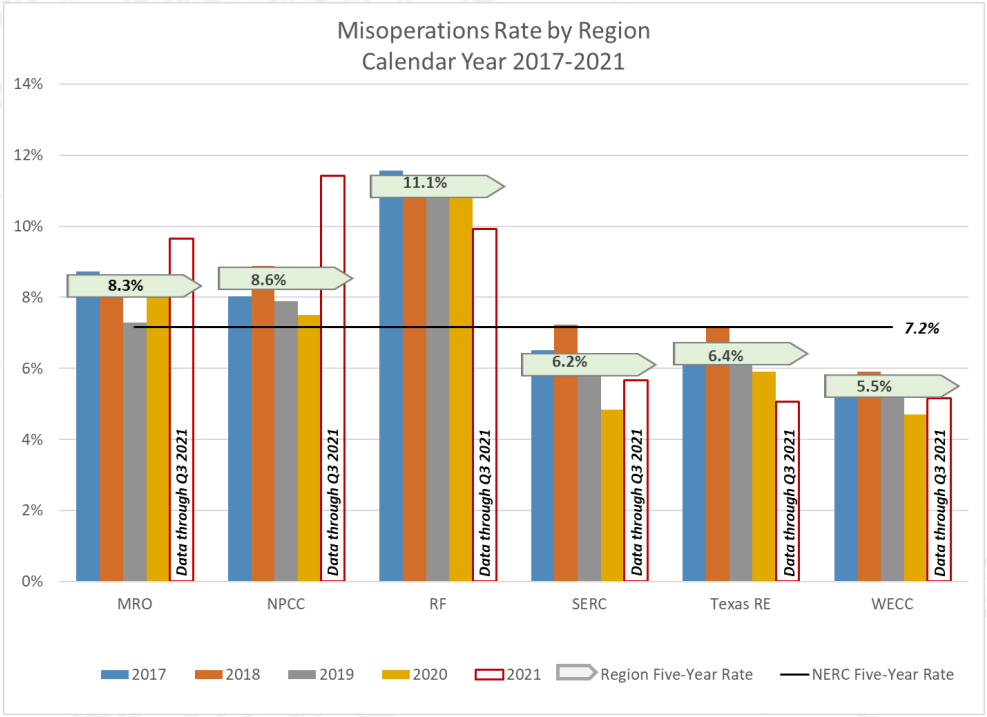
Quarter 2, 2021

Voltage Class	MisOps Count	Ops Count	Rate	NERC Rate
<100kV (BES)	4	18	22.22%	5.19%
100kV	0	0	0.00%	0.00%
115kV	16	186	8.60%	6.66%
138kV	21	269	7.81%	6.90%
161kV	14	103	13.59%	11.04%
230kV	15	99	15.15%	9.37%
345kV	3	87	3.45%	6.74%
500kV	0	6	0.00%	12.62%
HVdc	0	4	0.00%	0.00%
TOTAL	**73**	**772**	**9.46%**	**7.50%**

Quarter 3, 2021

Voltage Class	MisOps Count	Ops Count	Rate	NERC Rate
<100kV (BES)	2	22	9.09%	4.23%
100kV	0	0	0.00%	0.00%
115kV	16	189	8.47%	4.37%
138kV	26	227	11.45%	6.53%
161kV	12	111	10.81%	7.45%
230kV	12	85	14.12%	8.81%
345kV	5	100	5.00%	5.46%
500kV	0	6	0.00%	7.50%
HVdc	0	28	0.00%	0.00%
TOTAL	**73**	**768**	**9.51%**	**6.23%**

ERO Misop Rates



Operations Comparison

2021

Thru Q3

Voltage Class	Ops Count
<100kV (BES)	57
100kV	0
115kV	510
138kV	649
161kV	259
230kV	283
345kV	284
500kV	16
HVdc	33
TOTAL	**2091**

2017 – 2020

Thru Q3

Voltage Class	2020	2019	2018	2017	Avg
<100kV (BES)	43	70	76	78	67
100kV	5	0	0	0	1
115kV	616	736	826	756	734
138kV	704	951	854	1010	880
161kV	341	370	342	424	369
230kV	304	327	335	315	320
345kV	336	526	441	431	434
500kV	11	4	3	10	7
HVdc	56	46	35	36	43
TOTAL	**2416**	**3030**	**2912**	**3060**	**2855**

Misoperations Comparison

2021

Thru Q3

Voltage Class	MisOps Count
<100kV (BES)	8
100kV	0
115kV	50
138kV	53
161kV	35
230kV	33
345kV	20
500kV	1
HVdc	0
TOTAL	**200**

2017 – 2020

Thru Q3

Voltage Class	2020	2019	2018	2017	Avg
<100kV (BES)	1	5	4	4	4
100kV	0	0	0	0	0
115kV	53	58	60	67	60
138kV	58	53	77	66	64
161kV	42	32	42	53	42
230kV	23	26	33	28	28
345kV	31	39	30	41	35
500kV	3	1	1	1	2
HVdc	1	1	2	0	1
TOTAL	**212**	**215**	**249**	**260**	**234**

Questions?

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AGENDA 8

Misoperations

b. Technical Discussions

i. Failure Modes and Mechanisms Task Force

Richard Hackman, NERC

Action
Information

Report
Richard Hackman will provide an overview during the meeting.

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Examining Cold Weather Generator Failures using a Failure Modes & Mechanisms Approach

Plus: Cold Weather Prep Resources

Rick Hackman
February 7, 2022

RELIABILITY | RESILIENCE | SECURITY




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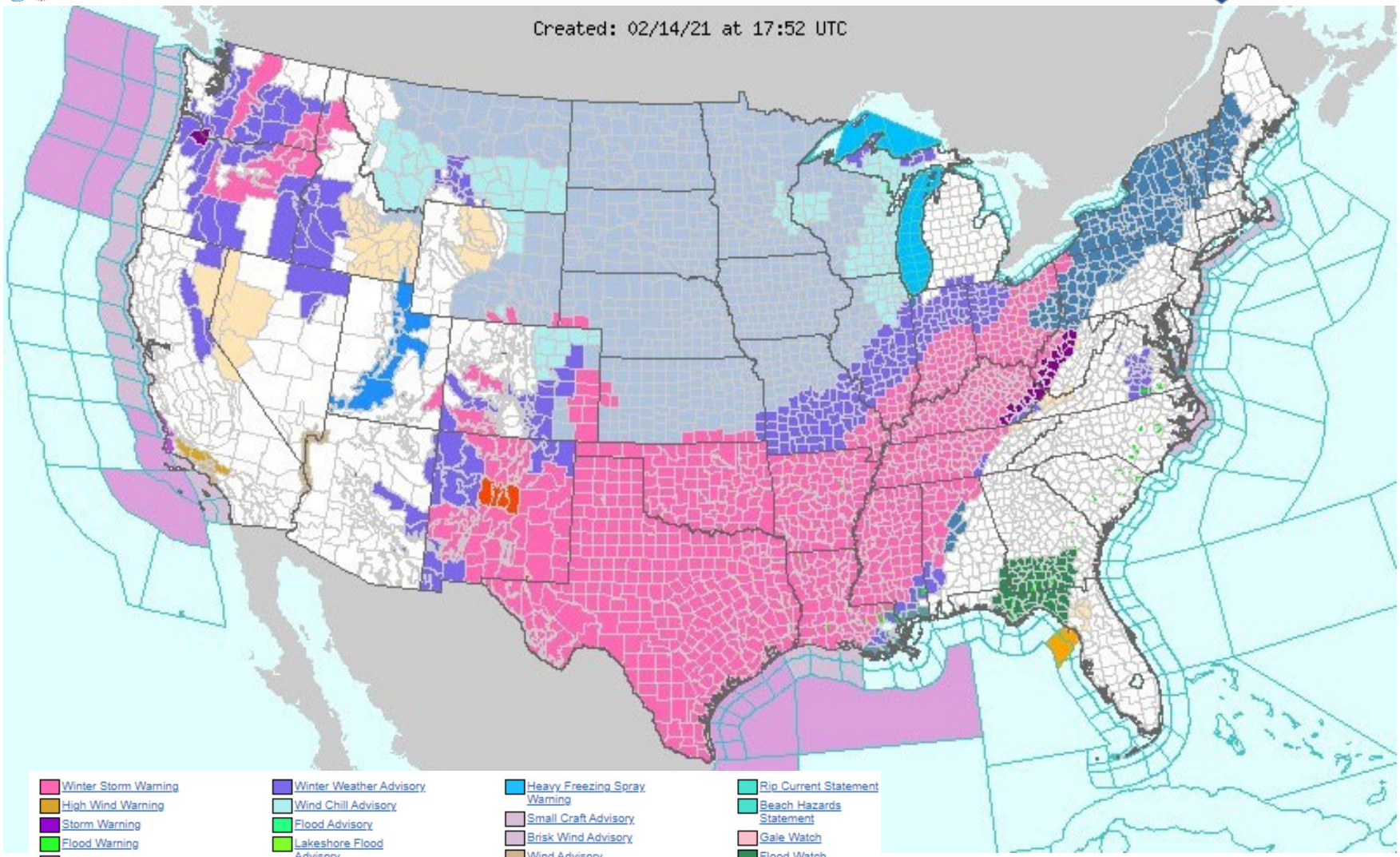
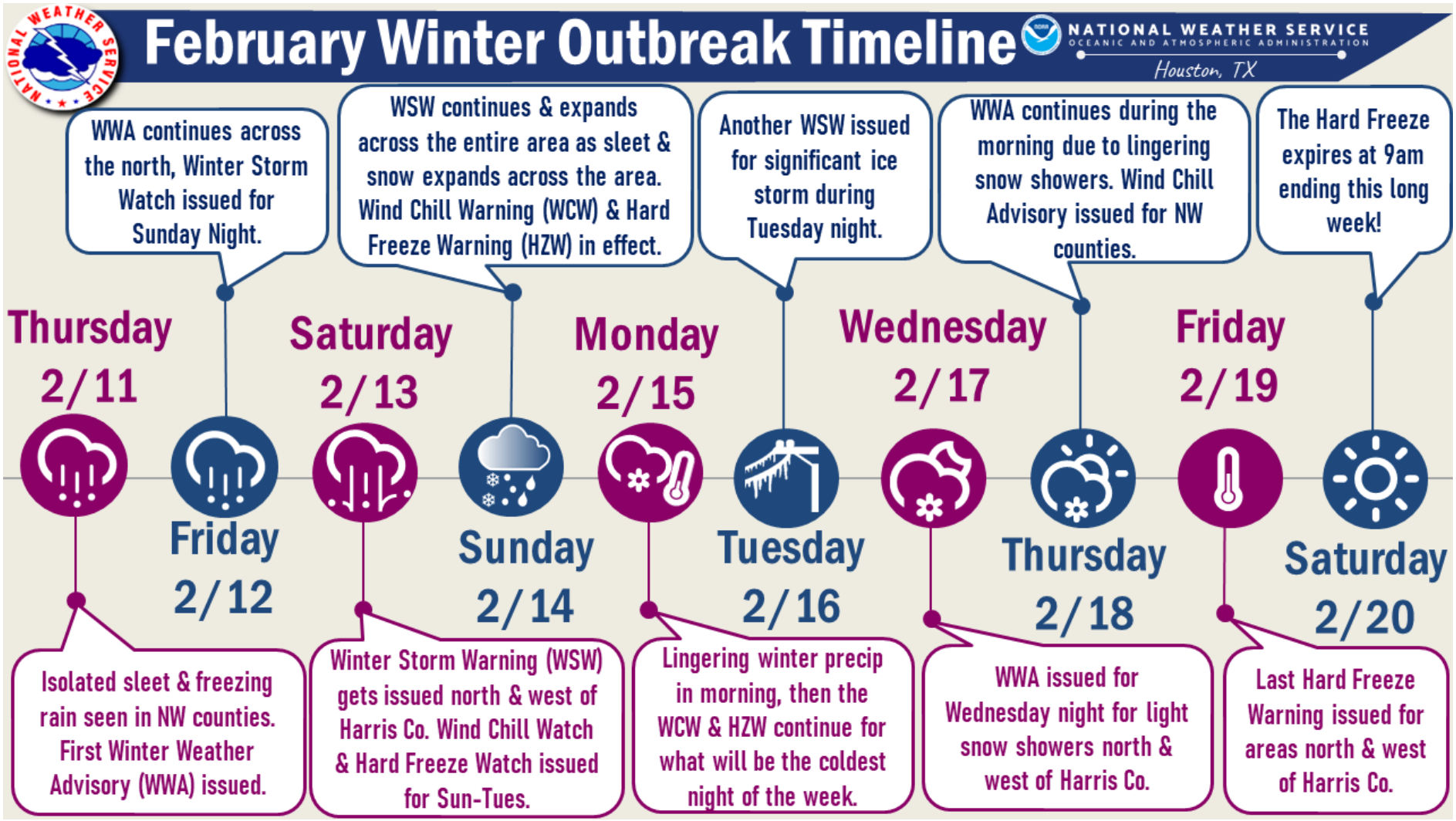
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

February 2021 Cold Weather Event

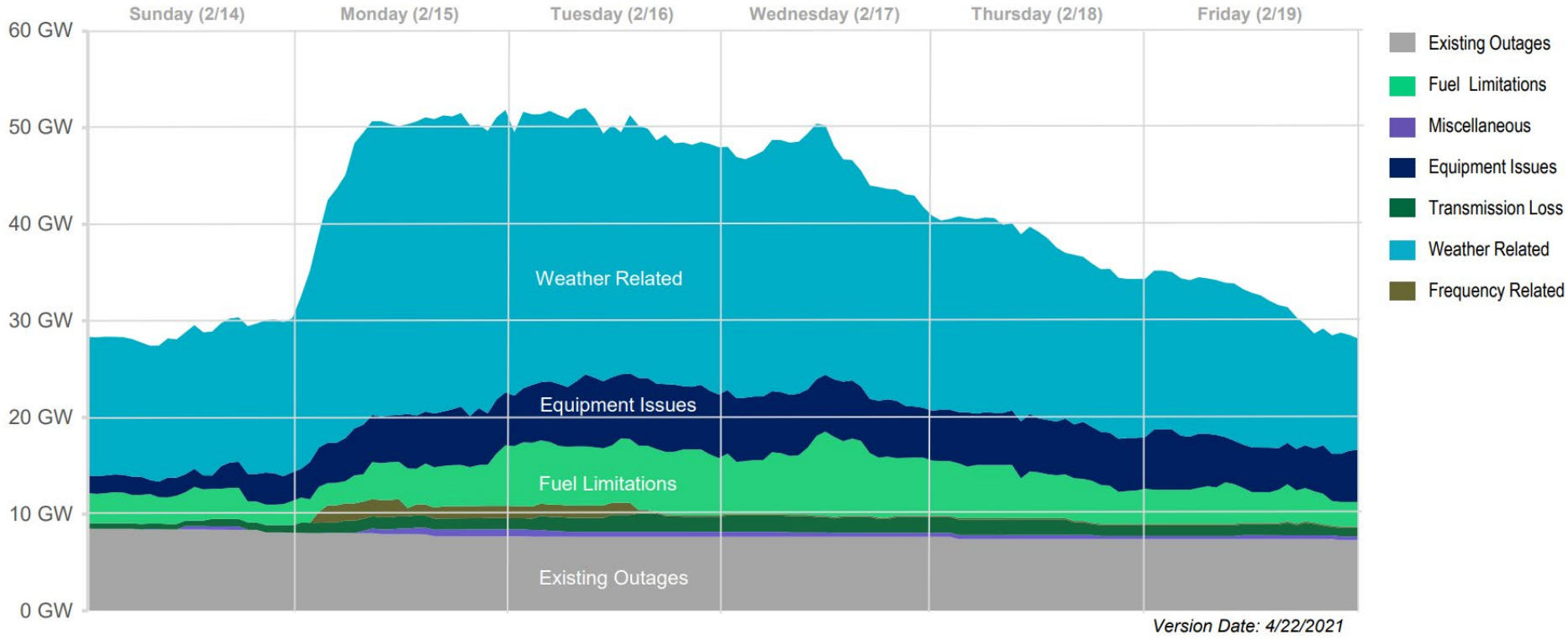


February 2021 Cold Weather Event



ERCOT Report on Generation loss

Net Generator Outages and Derates by Cause (MW)
February 14 – 19, 2021

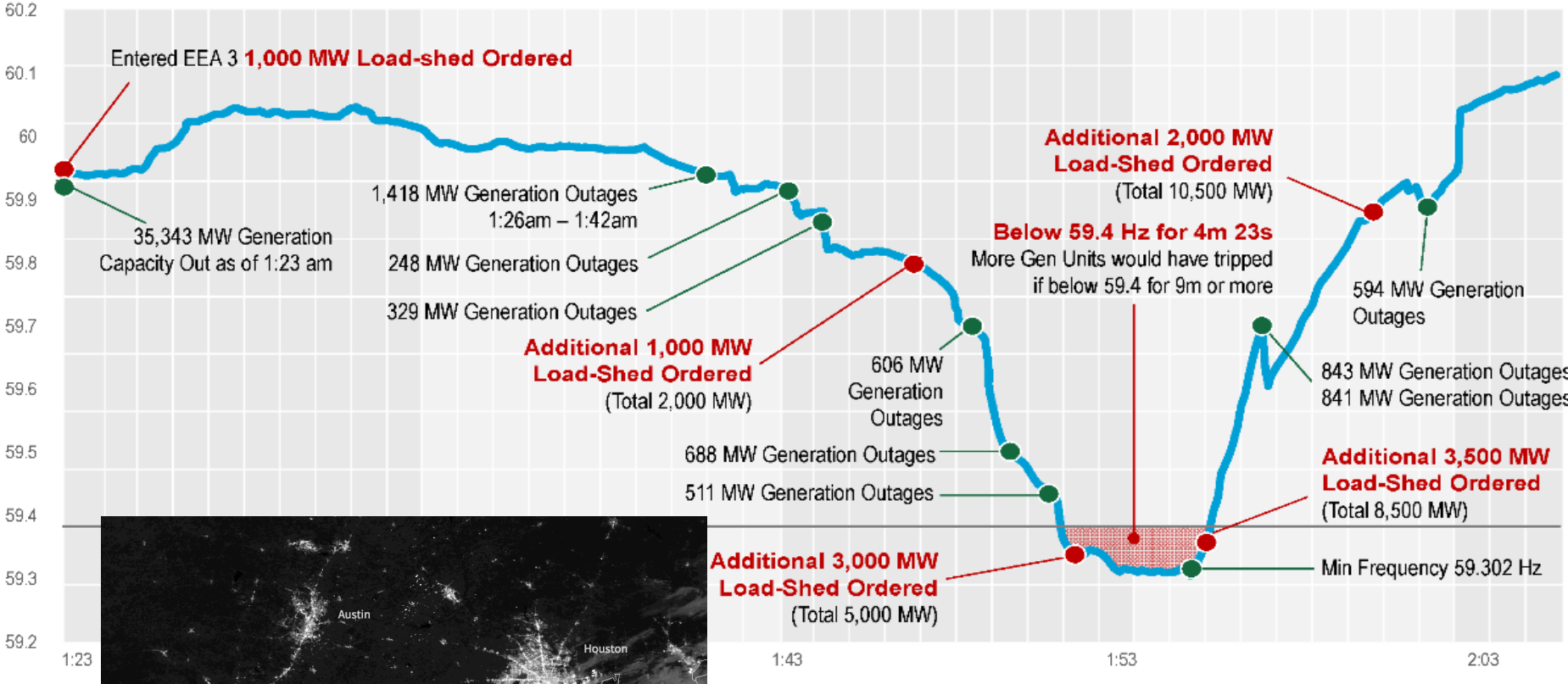


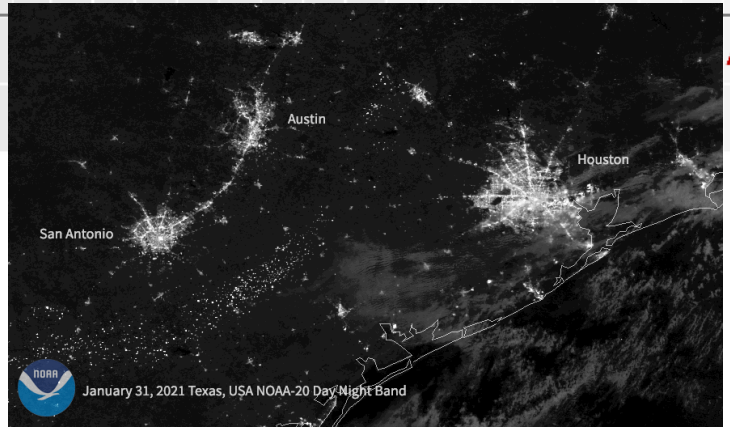
Net generator outages at the beginning of each hour on February 14-19, 2021, by cause category.

ercot

Early Morning 2/15/2021

Rapid Decrease in Generation Causes Frequency Drop

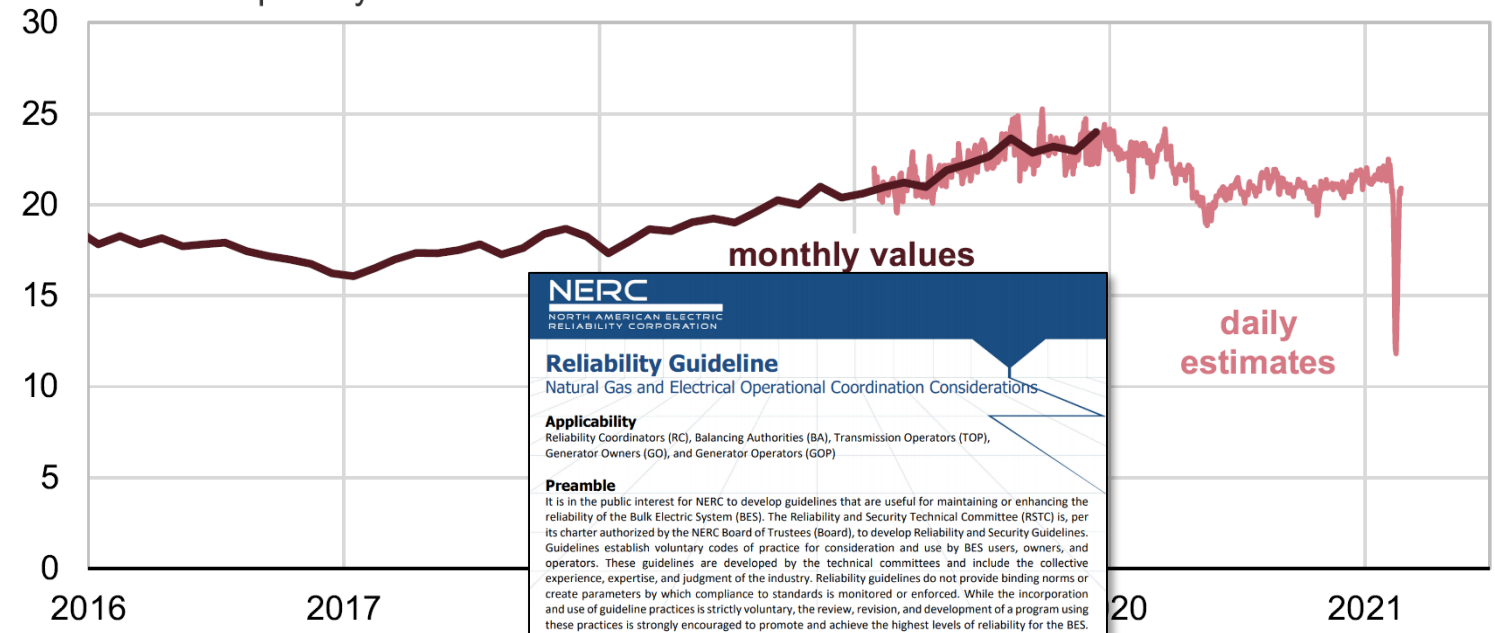




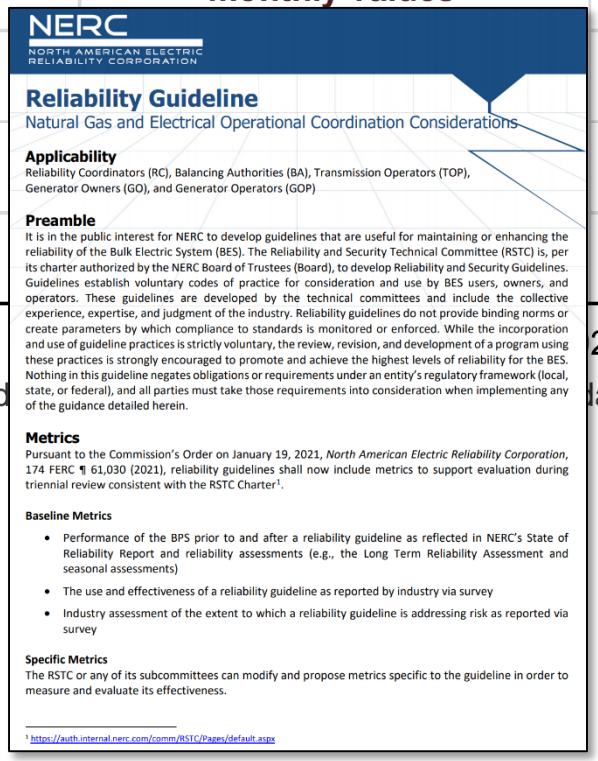
February 2021 Cold Weather Event

Texas natural gas production fell by almost half during recent cold snap

Texas dry natural gas production (Jan 2016–Feb 2021)
billion cubic feet per day



Source: U.S. Energy Information Ad … daily estimates from IHS Markit



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Reliability Guideline
Natural Gas and Electrical Operational Coordination Considerations

Applicability
Reliability Coordinators (RC), Balancing Authorities (BA), Transmission Operators (TOP), Generator Owners (GO), and Generator Operators (GOP)

Preamble
It is in the public interest for NERC to develop guidelines that are useful for maintaining or enhancing the reliability of the Bulk Electric System (BES). The Reliability and Security Technical Committee (RSTC) is, per its charter authorized by the NERC Board of Trustees (Board), to develop Reliability and Security Guidelines. Guidelines establish voluntary codes of practice for consideration and use by BES users, owners, and operators. These guidelines are developed by the technical committees and include the collective experience, expertise, and judgment of the industry. Reliability guidelines do not provide binding norms or create parameters by which compliance to standards is monitored or enforced. While the incorporation and use of guideline practices is strictly voluntary, the review, revision, and development of a program using these practices is strongly encouraged to promote and achieve the highest levels of reliability for the BES. Nothing in this guideline negates obligations or requirements under an entity's regulatory framework (local, state, or federal), and all parties must take those requirements into consideration when implementing any of the guidance detailed herein.

Metrics
Pursuant to the Commission's Order on January 19, 2021, *North American Electric Reliability Corporation*, 174 FERC ¶ 61,030 (2021), reliability guidelines shall now include metrics to support evaluation during triennial review consistent with the RSTC Charter[1].

Baseline Metrics

- Performance of the BPS prior to and after a reliability guideline as reflected in NERC's State of Reliability Report and reliability assessments (e.g., the Long Term Reliability Assessment and seasonal assessments)
- The use and effectiveness of a reliability guideline as reported by industry via survey
- Industry assessment of the extent to which a reliability guideline is addressing risk as reported via survey

Specific Metrics
The RSTC or any of its subcommittees can modify and propose metrics specific to the guideline in order to measure and evaluate its effectiveness.

[1] https://auth.internal.nerc.com/comm/RSTC/Pages/default.aspx

https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Gas_Electric_Guideline.pdf

Cold Weather Information Resources
Prior to the February 2021 Event

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NERC Information Resources on Cold Weather Preparation and BPS Impacts

(as of 2/11/2021)

NERC has been collecting and sharing information on cold weather preparation and BPS impacts for years via Webinars, Special Reports, Lessons Learned, Failure Modes & Mechanisms, and other resources.

Version 3 of the Generating Unit Winter Weather Readiness Reliability Guideline was approved by the RSTC at the end of 2020. The changes between versions 2 and 3 were discussed in the 2020 Winter Weather Webinar.

Here are links to some cold weather resources:

Reports on major BPS-impacting Cold Weather events

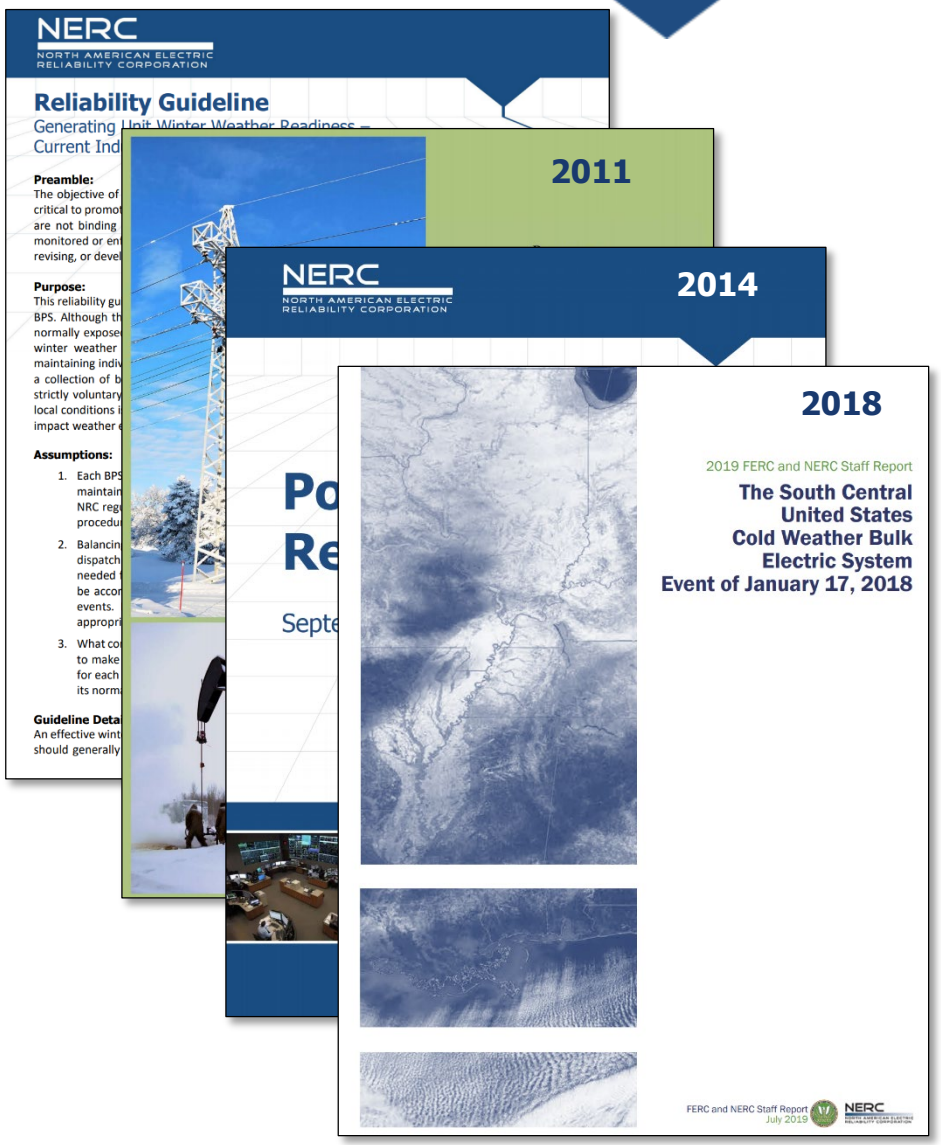
- Outages and Curtailments during the Southwest Cold Weather Event of February 1-5, 2011
- Winter Weather Readiness for Texas Generators, (2011)
- January 2014 Polar Vortex Review
- The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018 (There are a number of 'sound practices' from the industry, starting on page 100.)
- Other Cold Weather Reports and Training Materials can be found on this site.

Cold weather related Lessons Learned:

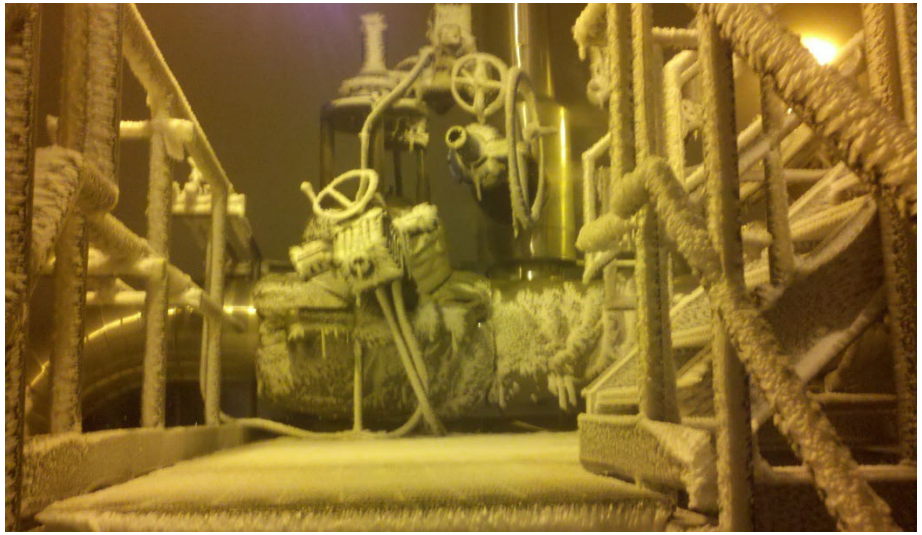
- LL20110902 Adequate Maintenance and Inspection of Generator Freeze Protection
- LL20110903 Generating Unit Temperature Design Parameters and Extreme Winter Conditions
- LL20111001 Plant Instrument & Sensing Equipment Freezing Due to Heat Trace & Insulation Failures
- LL20120101 Plant Onsite Material and Personnel Needed for a Winter Weather Event
- LL20120102 Plant Operator Training to Prepare for a Winter Weather Event
- LL20120103 Transmission Facilities and Winter Weather Operations
- LL20120901 Wind Farm Winter Storm Issues
- LL20120902 Transformer Oil Level Issues During Cold Weather
- LL20120903 Winter Storm Inlet Air Duct Icing
- LL20120904 Capacity Awareness During an Energy Emergency Event
- LL20120905 Gas and Electricity Interdependency
- LL20180702 Preparing Circuit Breakers for Operation in Cold Weather (also 2018 Webinar w/FMM)
- LL20200601 Unanticipated Wind Generation Cutoffs during a Cold Weather Event
- LL20201101 Cold Weather Operation of SF6 Circuit Breakers

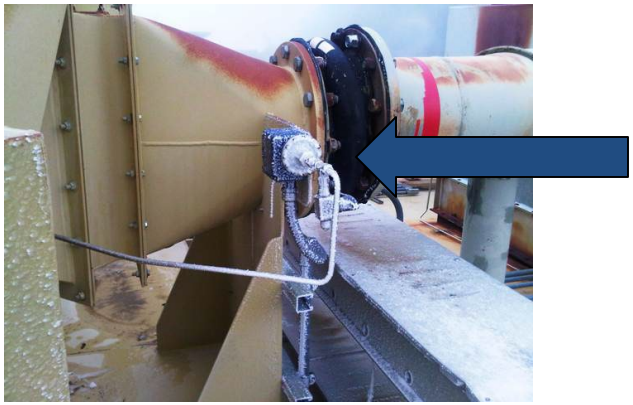
Winter Weather Webinars from 2012 – 2020 can be found on this site.

Annual Winter Reliability Assessments 2003/2004 thru 2019/2020 can be found on this site.

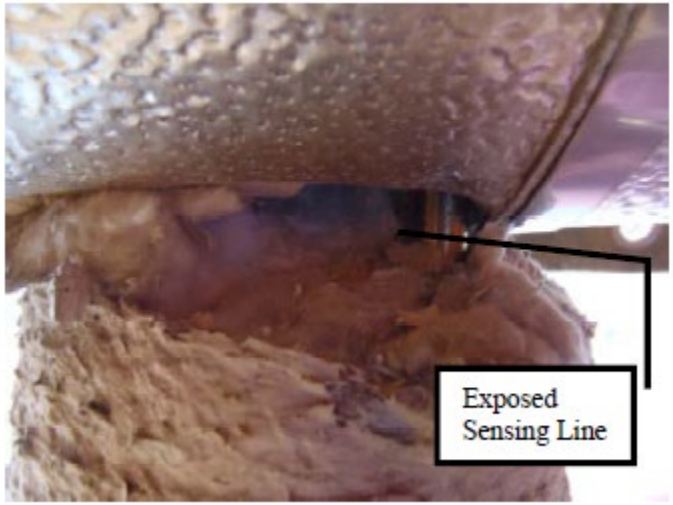


Pictures from 2011 Cold Weather Event Training Package

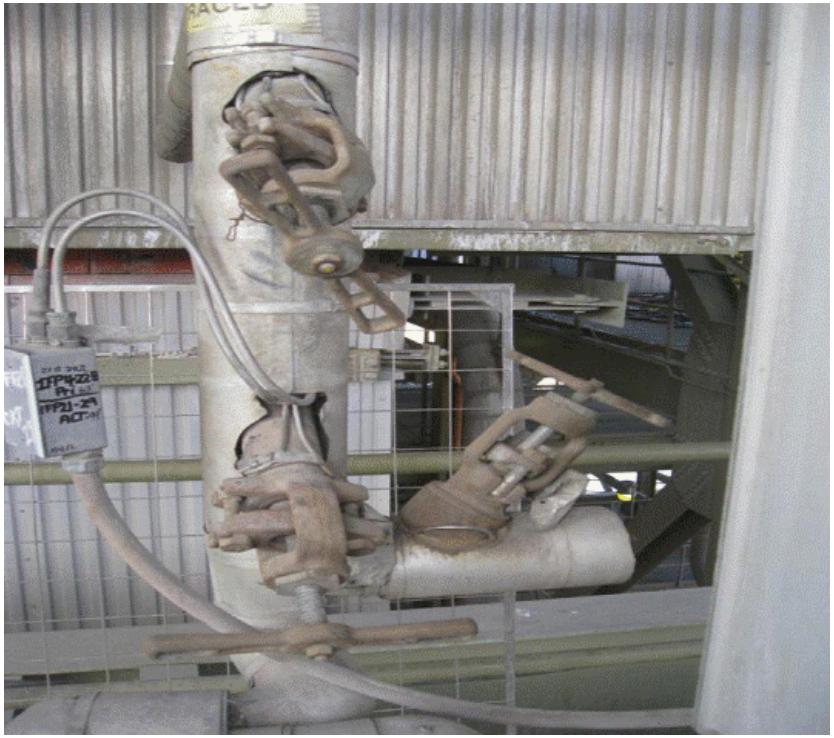




Pictures from 2011 Cold Weather Event Training Package



Gap in insulation



Exposed valves emerge from thermal insulation and are not heat traced.

Pictures from 2011 Cold Weather Event Training Package

Frozen Valves:
Inspect and maintain thermal insulation on all units.

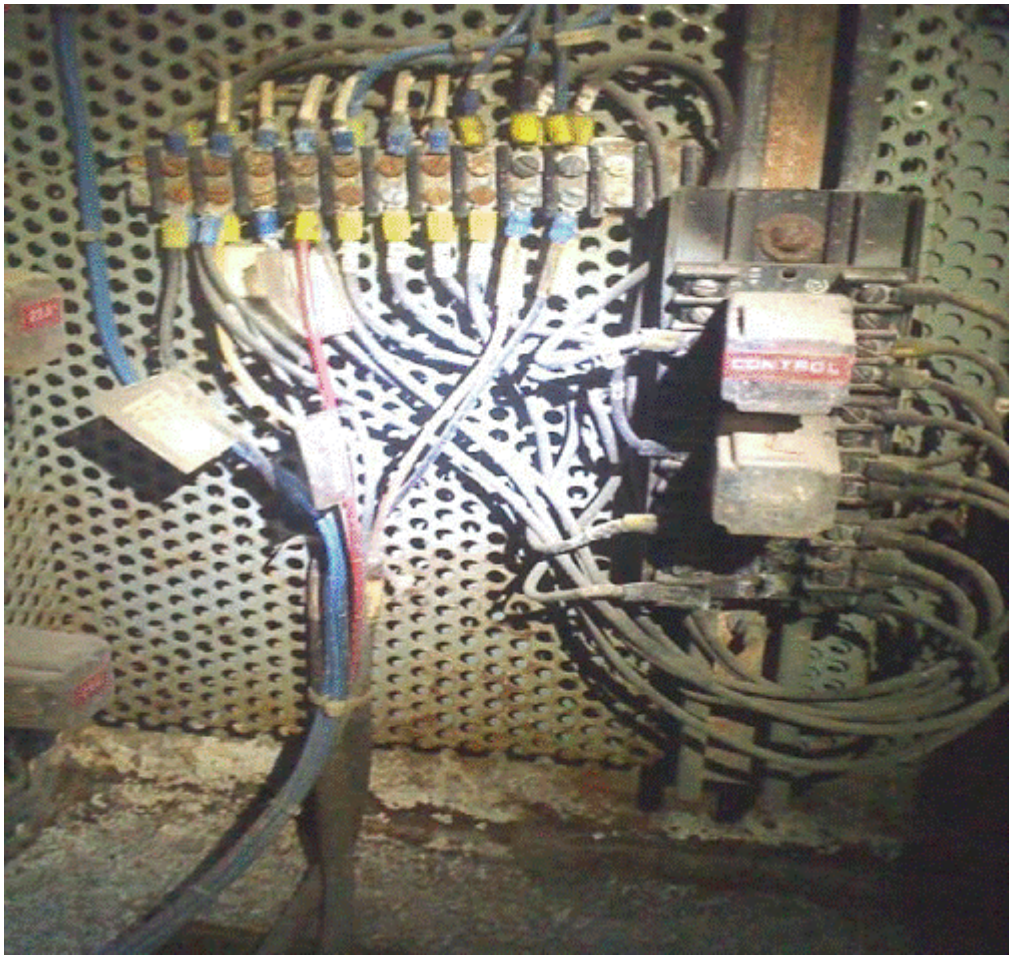
Removal of insulating blanket in summer, failure to reinstall for winter.

Pictures from 2011 Cold Weather Event Training Package

Add Insulation blankets and Heat Tracing

Pictures from 2011 Cold Weather Event Training Package

Corroded Freeze Protection Panel

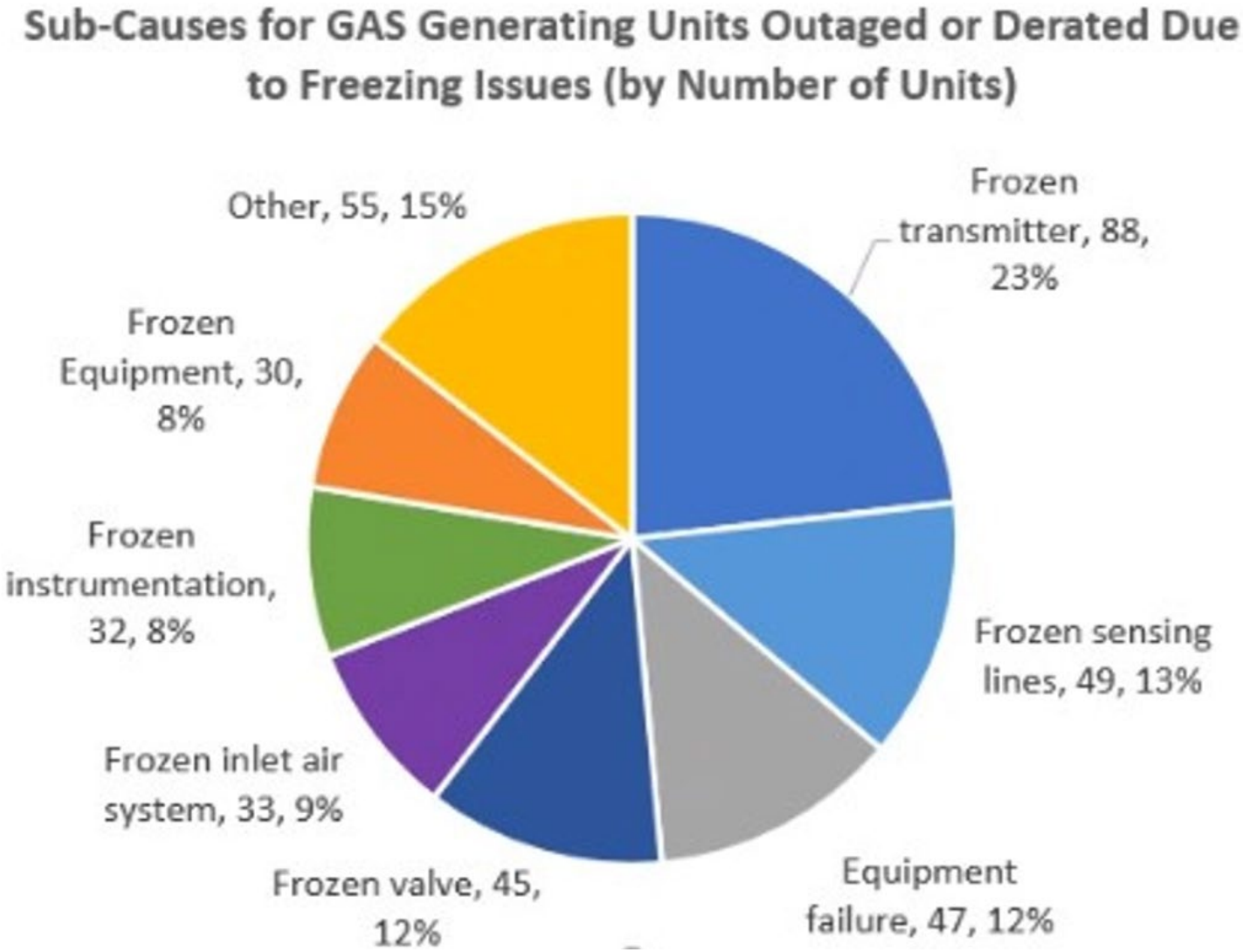


Heat Tracing does no good without power or a way to turn it on

FERC - NERC - Regional Entity Staff Report

FERC - NERC - Regional Entity Staff Report: The February 2021 Cold Weather Outages in Texas and the South Central United States

FERC/NERC ERO Report Identified Gas Generator Cold Weather Issues



NERC
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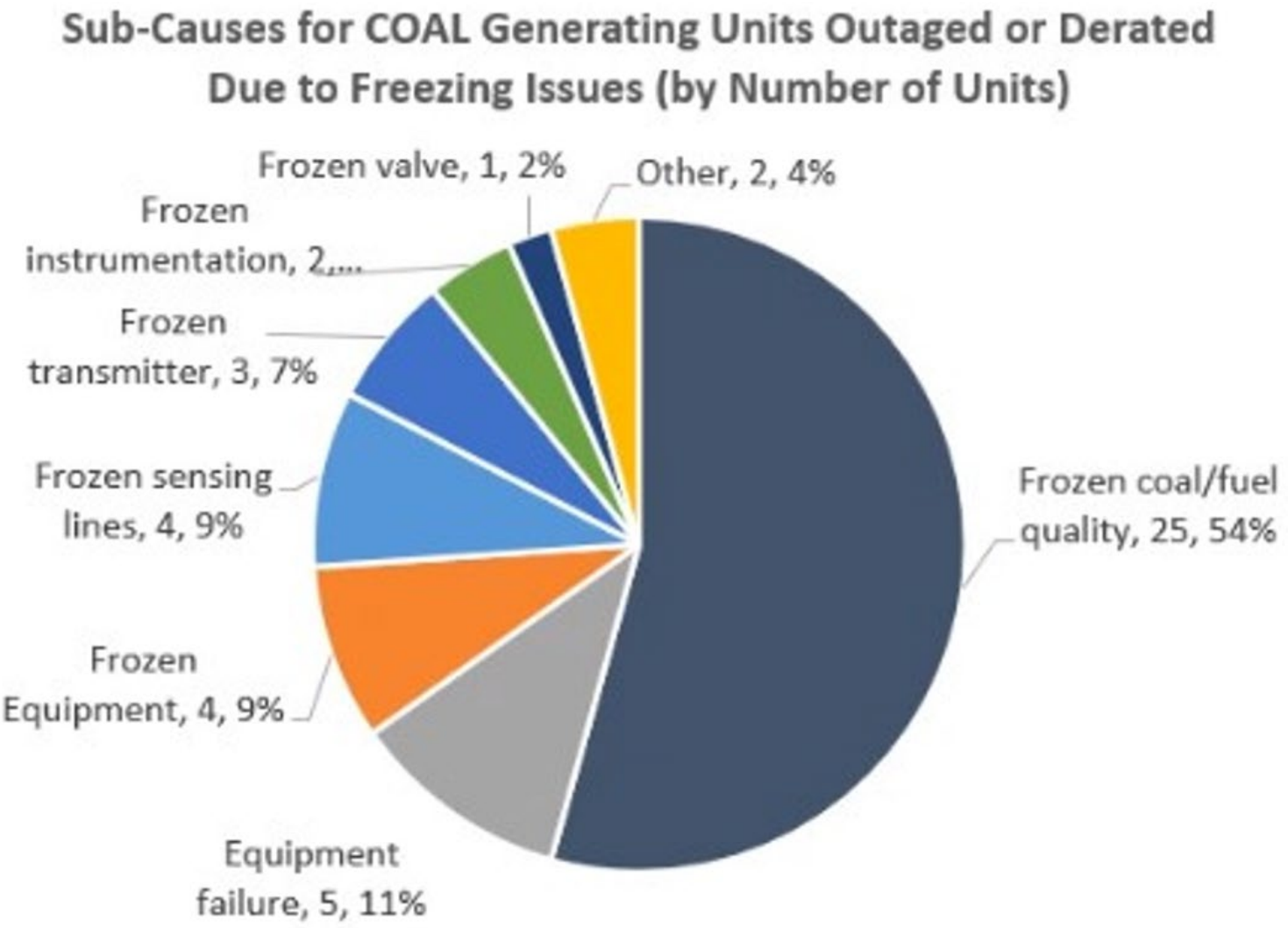
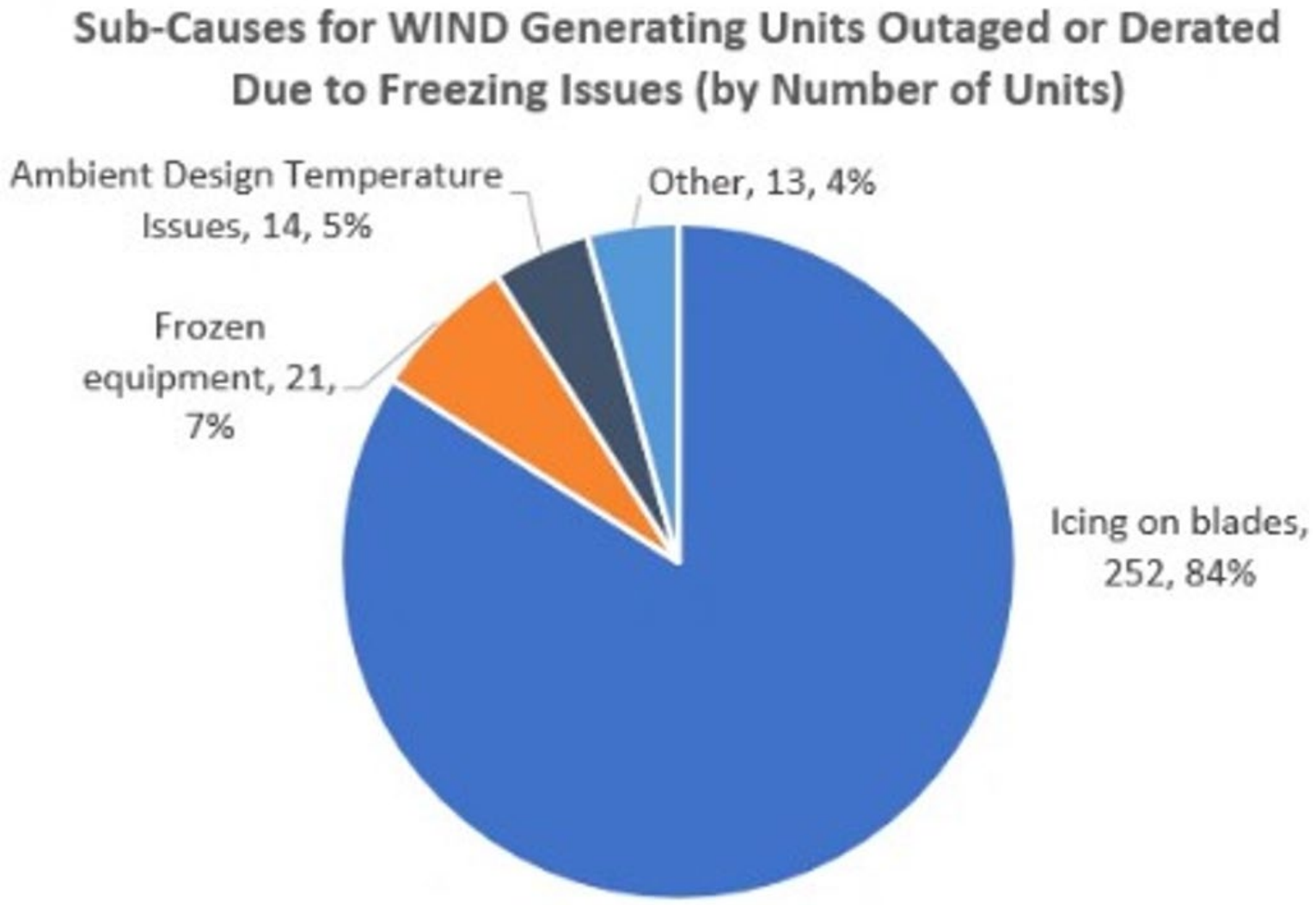
FERC/NERC ERO Report Identified Coal Generator Cold Weather Issues



FERC/NERC ERO Report Identified Coal Generator Cold Weather Issues



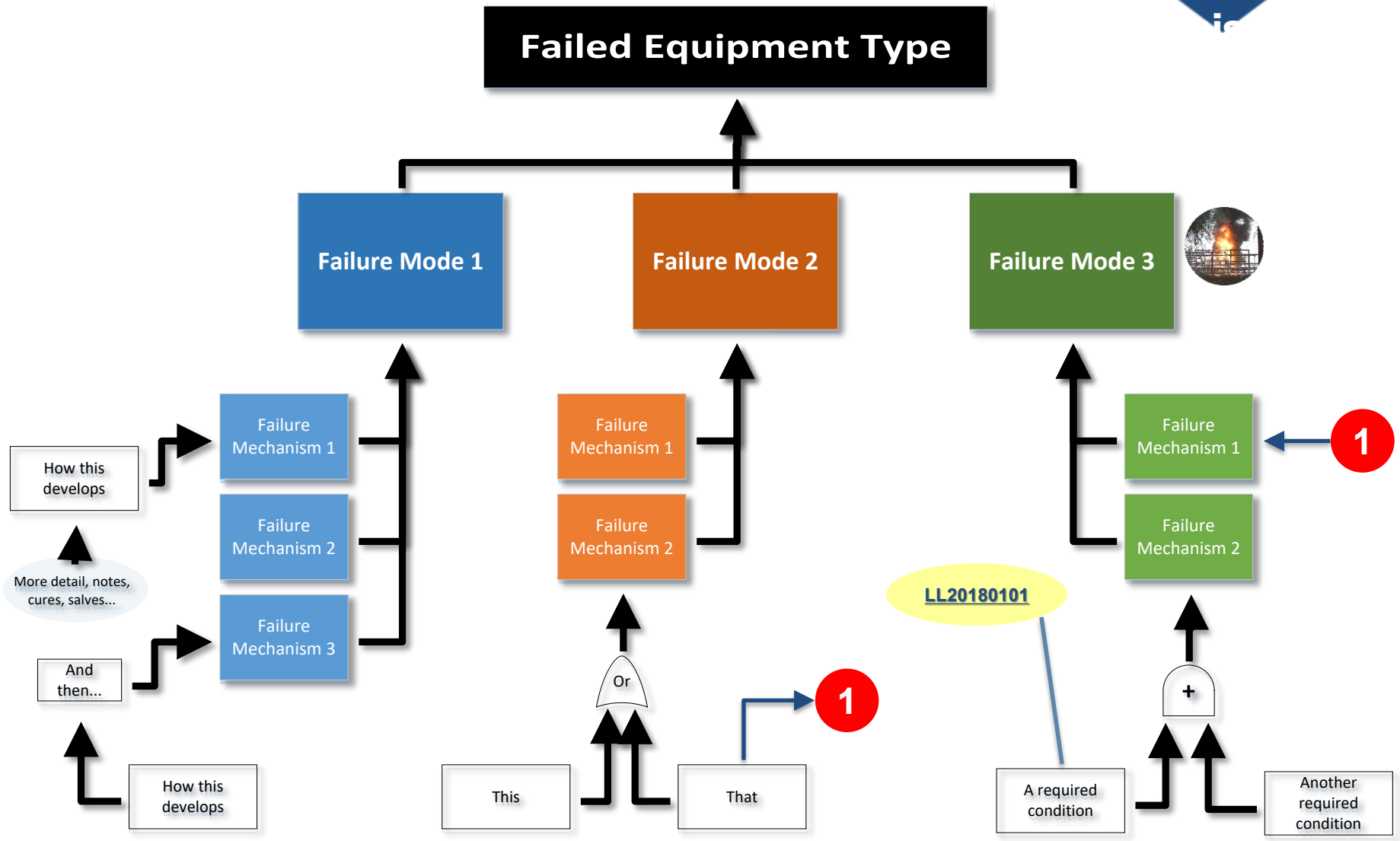
Failure Modes and Mechanisms

Video on Failure Modes & Mechanisms https://vimeopro.com/nerclearning/cause-coding/video/208745179

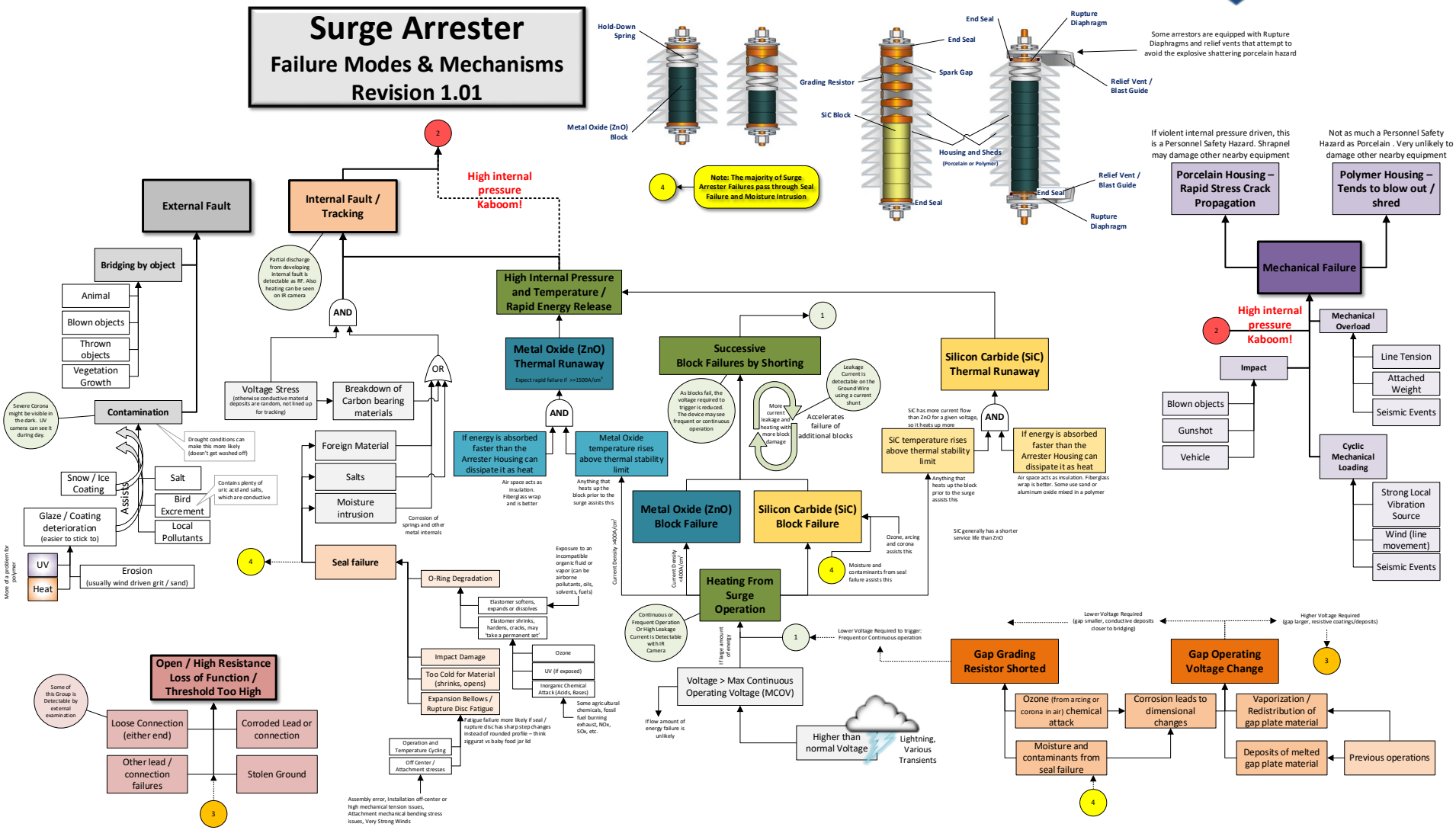
Failure Modes and Mechanisms

- **Failure Modes** are what gets your attention
- **Failure Mechanisms** are how the equipment gets going on the path to a failure
  - Equipment Failures have logical cause-and-effect relationships behind them.
  - Physical Evidence Examination and Root Cause Analysis can reveal what Failure Mechanisms were involved.
  - Aging is not a 'cause.' It is just a catch-all term for slow moving Failure Mechanisms.
  - Failure Mechanisms are detectable. Many can be stopped, or at least slowed down so they can be corrected before causing a failure.

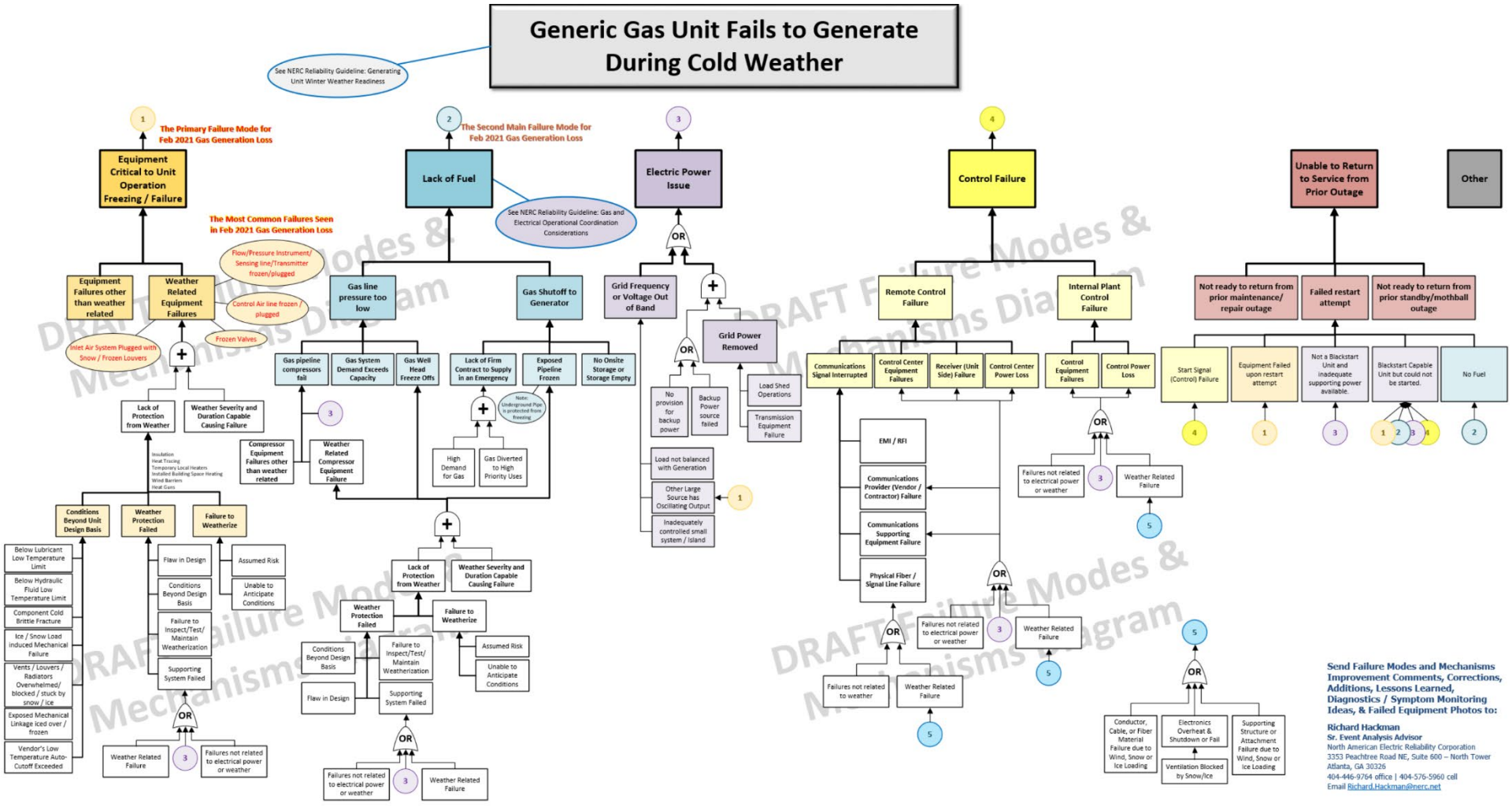
Generic Failure Modes and Mechanisms Layout



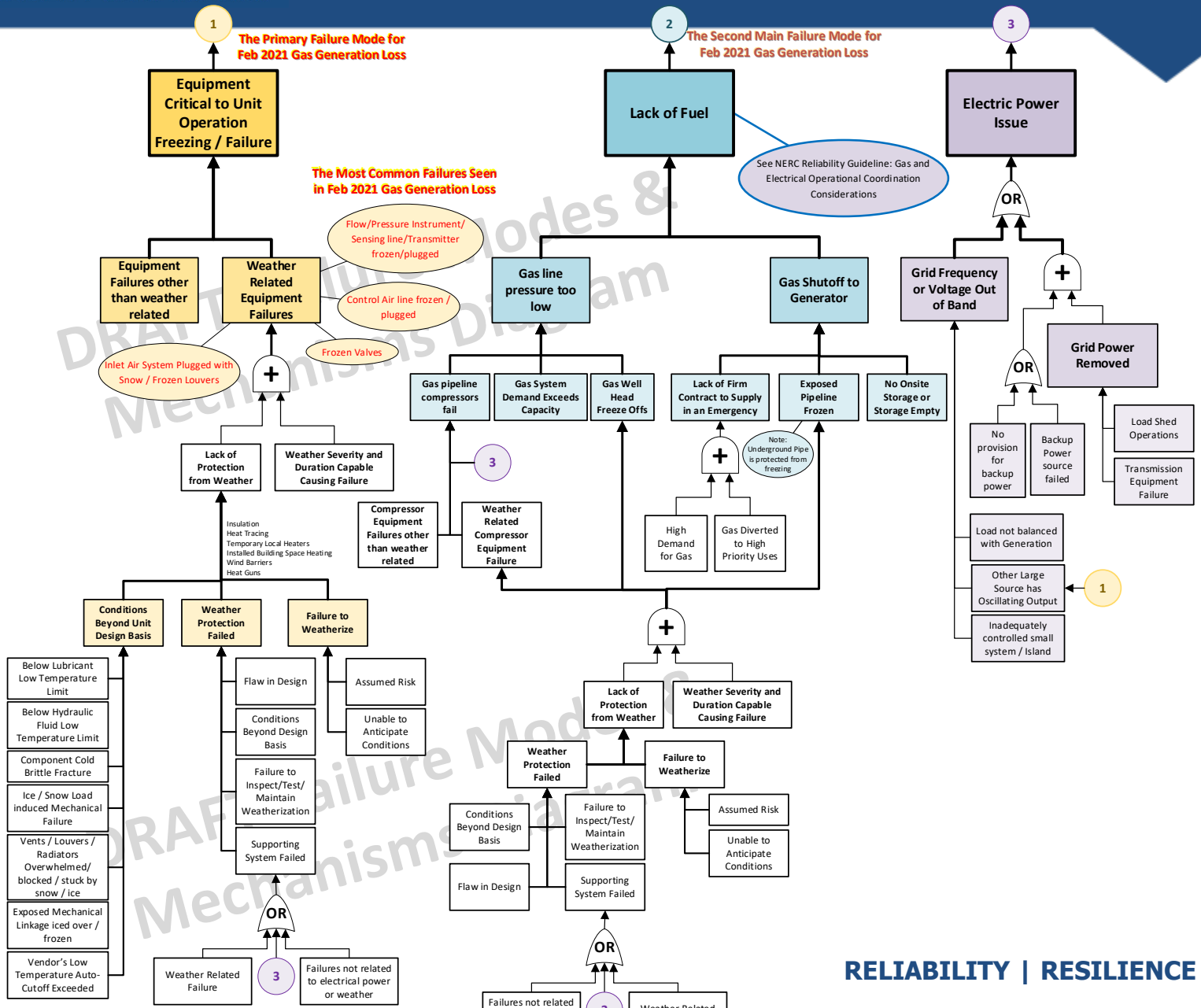
Sample Failure Modes and Mechanisms Diagram



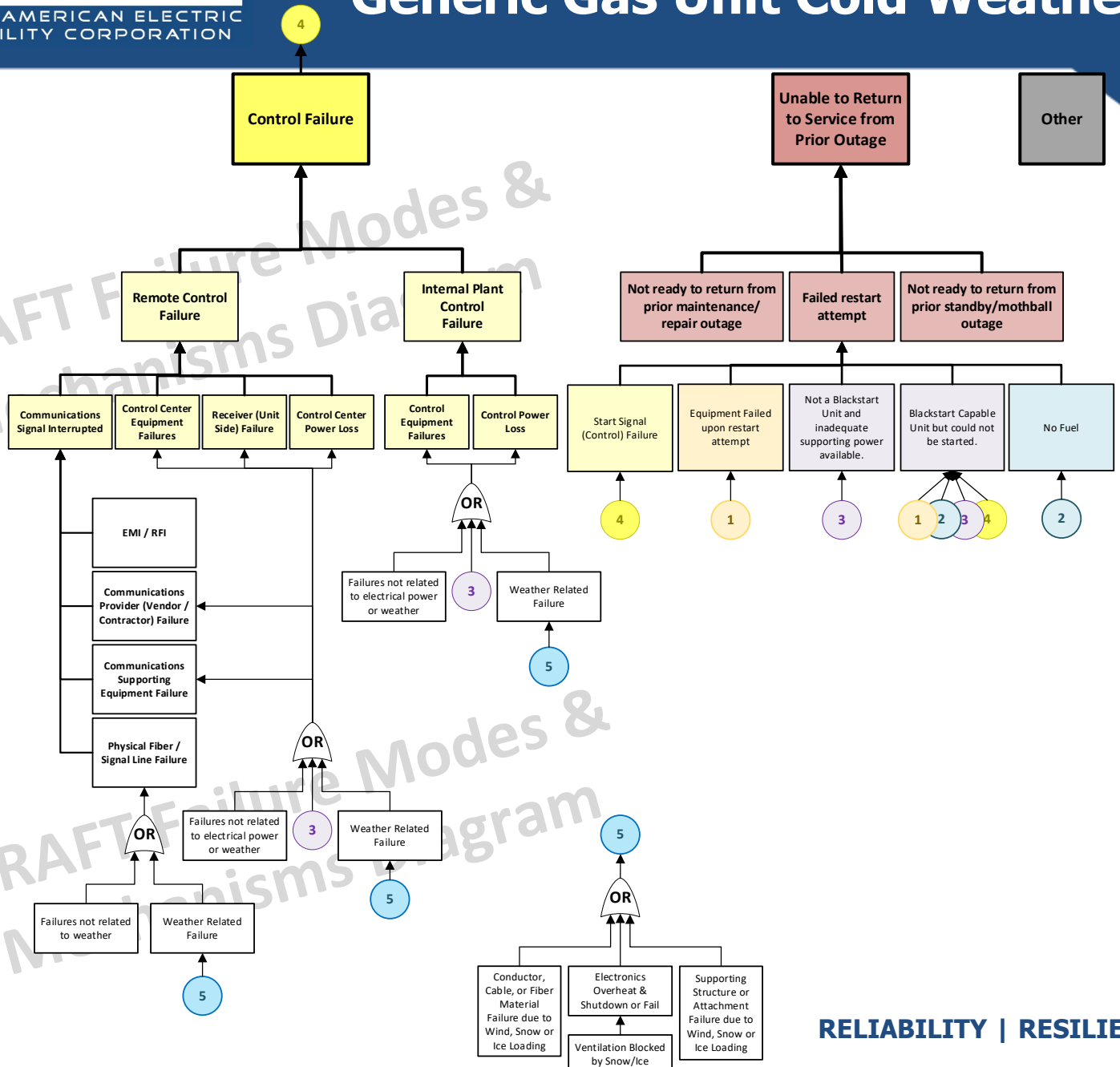
Generic Gas Unit Cold Weather Issues



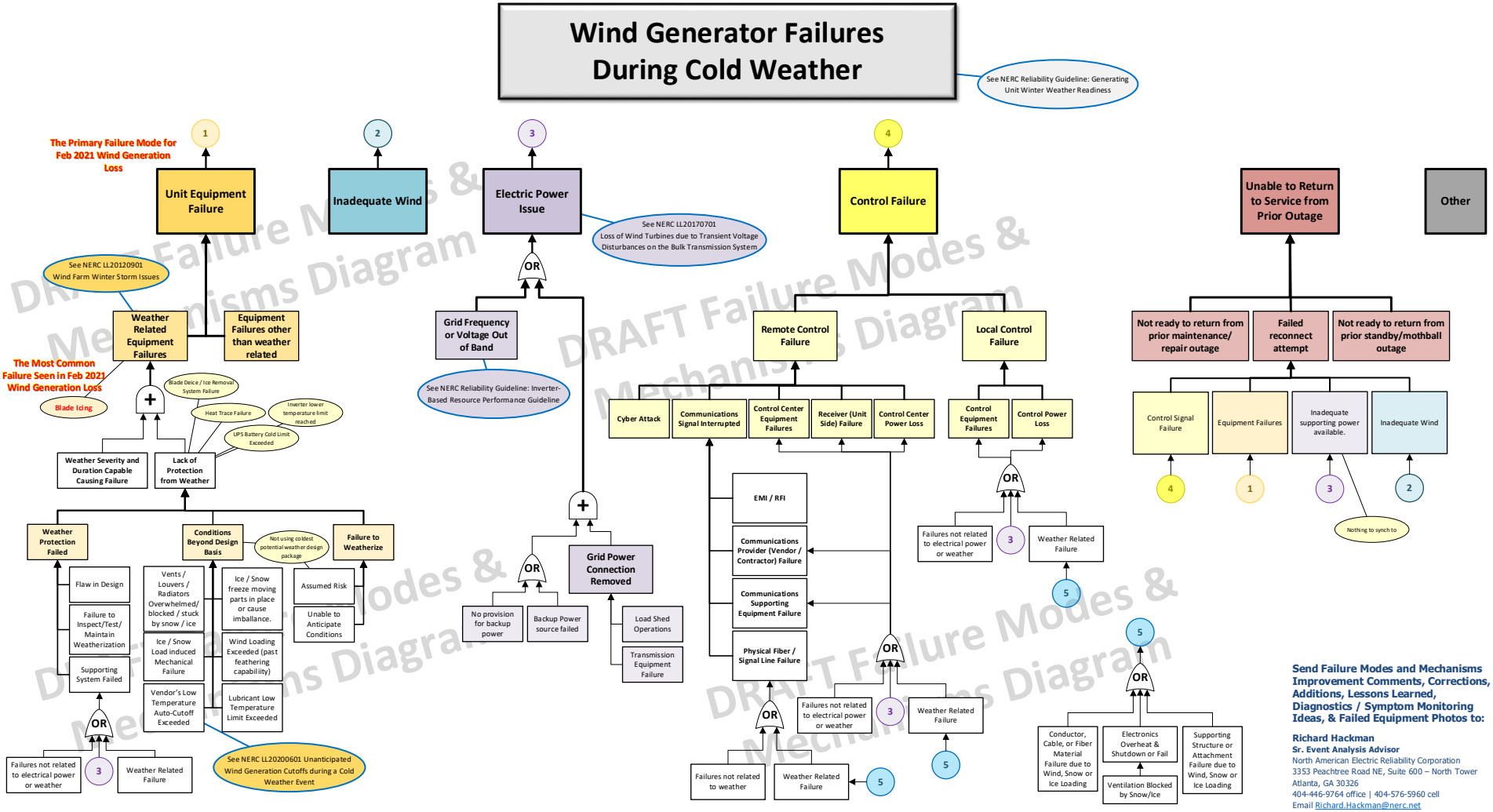
Generic Gas Unit Cold Weather Issues



Generic Gas Unit Cold Weather Issues



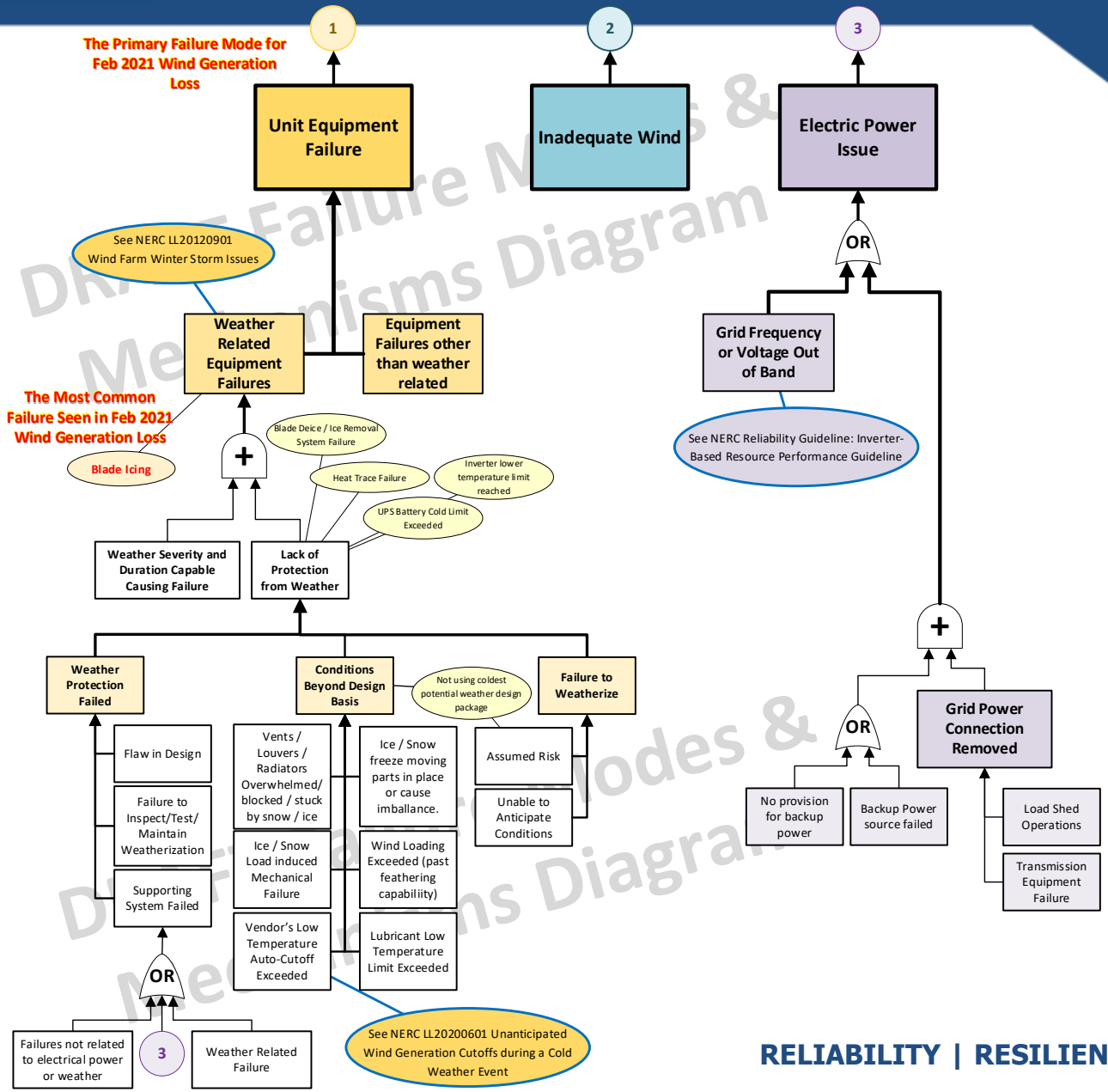
Wind Generator Cold Weather Issues



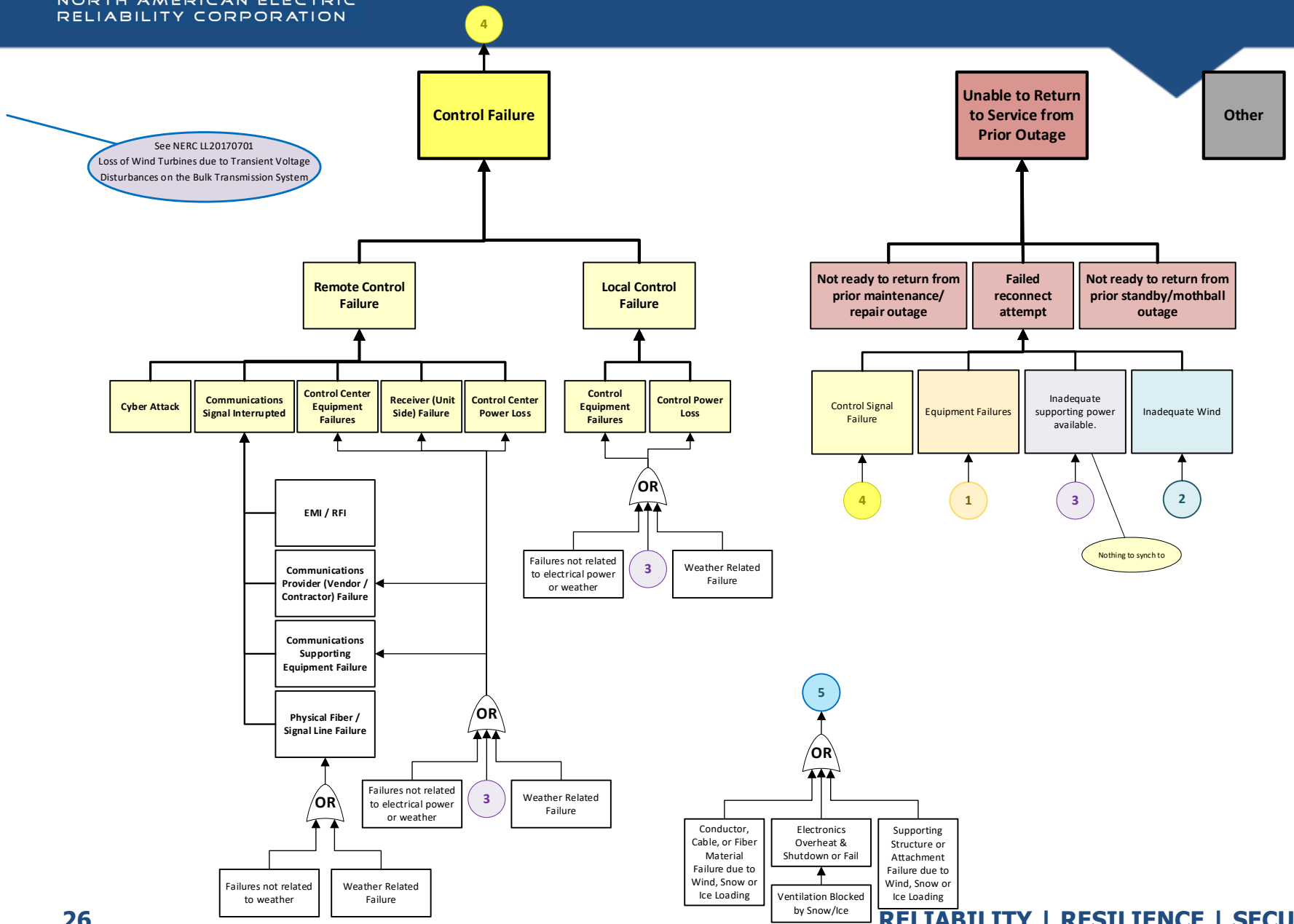
Send Failure Modes and Mechanisms Improvement Comments, Corrections, Additions, Lessons Learned, Diagnostics / Symptom Monitoring Ideas, & Failed Equipment Photos to:

Richard Hackman
Sr. Event Analysis Advisor
North American Electric Reliability Corporation
3353 Peachtree Road NE, Suite 600 – North Tower
Atlanta, GA 30326
404-446-9764 office | 404-576-5960 cell
Email Richard.Hackman@nerc.net

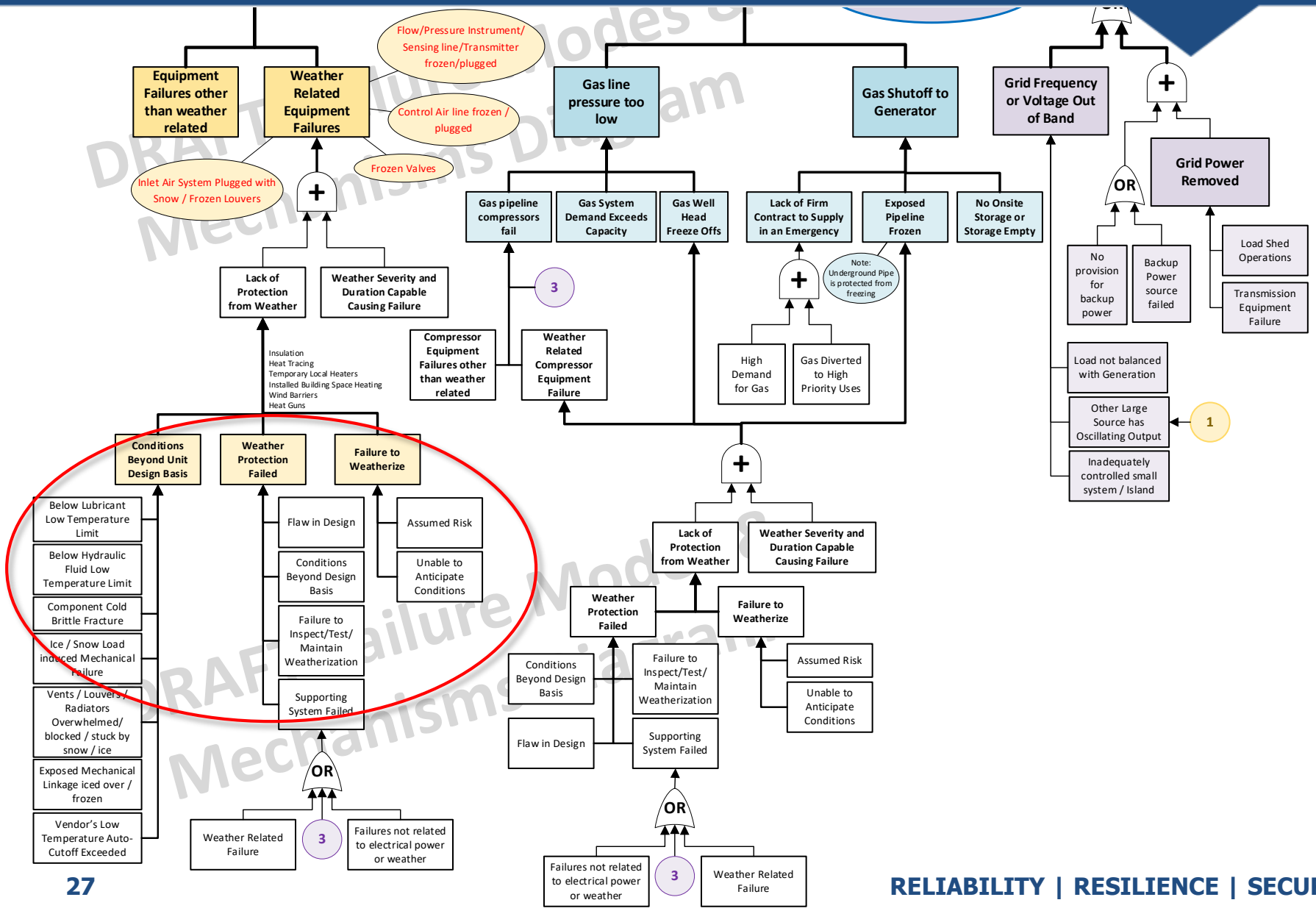
Wind Generator Cold Weather Issues



Wind Generator Cold Weather Issues



Common Causes of Cold Weather Issues



Current References

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

NERC Information Resources (as of 11/22/2021) on Cold Weather Preparation and BPS Impacts

NERC has collected and shared information on cold weather preparation and BPS impacts for years via Webinars, Special Reports, Lessons Learned, Failure Modes & Mechanisms, and other resources.

Here are links to some cold weather resources:

Reports on major BPS-impacting Cold Weather events

- Outages and Curtailments during the Southwest Cold Weather Event of February 1-5, 2011
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- January 2014 Polar Vortex Review
- The South Central United States Cold Weather Bulk Electric System Event of January 17, 2018 (There are a number of 'sound practices' from the industry, starting on page 100.)
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- FERC - NERC - Regional Entity Staff Report: The February 2021 Cold Weather Outages in Texas and the South Central United States
- Other Cold Weather Reports and Training Materials can be found on this site.

Cold weather related Lessons Learned:

- LL20110902 Adequate Maintenance and Inspection of Generator Freeze Protection
- LL20110903 Generating Unit Temperature Design Parameters and Extreme Winter Conditions
- LL20111001 Plant Instrument & Sensing Equipment Freezing Due to Heat Trace & Insulation Failures
- LL20120101 Plant Onsite Material and Personnel Needed for a Winter Weather Event
- LL20120102 Plant Operator Training to Prepare for a Winter Weather Event
- LL20120103 Transmission Facilities and Winter Weather Operations
- LL20120901 Wind Farm Winter Storm Issues
- LL20120902 Transformer Oil Level Issues During Cold Weather
- LL20120903 Winter Storm Inlet Air Duct Icing
- LL20120904 Capacity Awareness During an Energy Emergency Event
- LL20120905 Gas and Electricity Interdependency
- LL20180702 Preparing Circuit Breakers for Operation in Cold Weather (also 2018 Webinar w/FMM)
- LL20200601 Unanticipated Wind Generation Cutoffs during a Cold Weather Event
- LL20201101 Cold Weather Operation of SF6 Circuit Breakers

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RELIABILITY | RESILIENCE | SECURITY

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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reliability Guideline

Natural Gas and Electrical Operational Coordination Considerations

Applicability

Reliability Coordinators (RC), Balancing Authorities (BA), Transmission Operators (TOP), Generator Owners (GO), and Generator Operators (GOP)

Preamble

It is in the public interest for NERC to develop guidelines that are useful for maintaining or enhancing the reliability of the Bulk Electric System (BES). The Reliability and Security Technical Committee (RSTC) is, per its charter authorized by the NERC Board of Trustees (Board), to develop Reliability and Security Guidelines. Guidelines establish voluntary codes of practice for consideration and use by BES users, owners, and operators. These guidelines are developed by the technical committees and include the collective experience, expertise, and judgment of the industry. Reliability guidelines do not provide binding norms or create parameters by which compliance to standards is monitored or enforced. While the incorporation and use of guideline practices is strictly voluntary, the review, revision, and development of a program using these practices is strongly encouraged to promote and achieve the highest levels of reliability for the BES. Nothing in this guideline negates obligations or requirements under an entity's regulatory framework (local, state, or federal), and all parties must take those requirements into consideration when implementing any of the guidance detailed herein.

Metrics

Pursuant to the Commission's Order on January 19, 2021, *North American Electric Reliability Corporation*, 174 FERC ¶ 61,030 (2021), reliability guidelines shall now include metrics to support evaluation during triennial review consistent with the RSTC Charter[1].

Baseline Metrics

- Performance of the BPS prior to and after a reliability guideline as reflected in NERC's State of Reliability Report and reliability assessments (e.g., the Long Term Reliability Assessment and seasonal assessments)
- The use and effectiveness of a reliability guideline as reported by industry via survey
- Industry assessment of the extent to which a reliability guideline is addressing risk as reported via survey

Specific Metrics

The RSTC or any of its subcommittees can modify and propose metrics specific to the guideline in order to measure and evaluate its effectiveness.

[1] https://auth.internal.nerc.com/comm/RSTC/Pages/default.aspx

https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Gas_Electric_Guideline.pdf

Questions and Answers

Richard Hackman
Sr. Event Analysis Advisor
North American Electric Reliability Corporation
3353 Peachtree Road NE, Suite 600 – North Tower
Atlanta, GA 30326
404-446-9764 office | 404-576-5960 cell
Email Richard.Hackman@nerc.net
NERC Lessons Learned webpage

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

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MIDWEST RELIABILITY ORGANIZATION

380 St. Peter St, Suite 800
Saint Paul, MN 55102
www.MRO.net
651-855-1760

AGENDA 8

Misoperations

b. Technical Discussions

ii. Out of Step Tripping

Kevin Jones, Xcel Energy

Action
Information

Report
Kevin Jones will provide an overview during the meeting.

Xcel Energy Out-Of-Step Settings Philosophy

Presented by Kevin W. Jones, P.E.
Consulting Engineer, System Protection Engineering

Presented To: MRO Protective Relay Subgroup

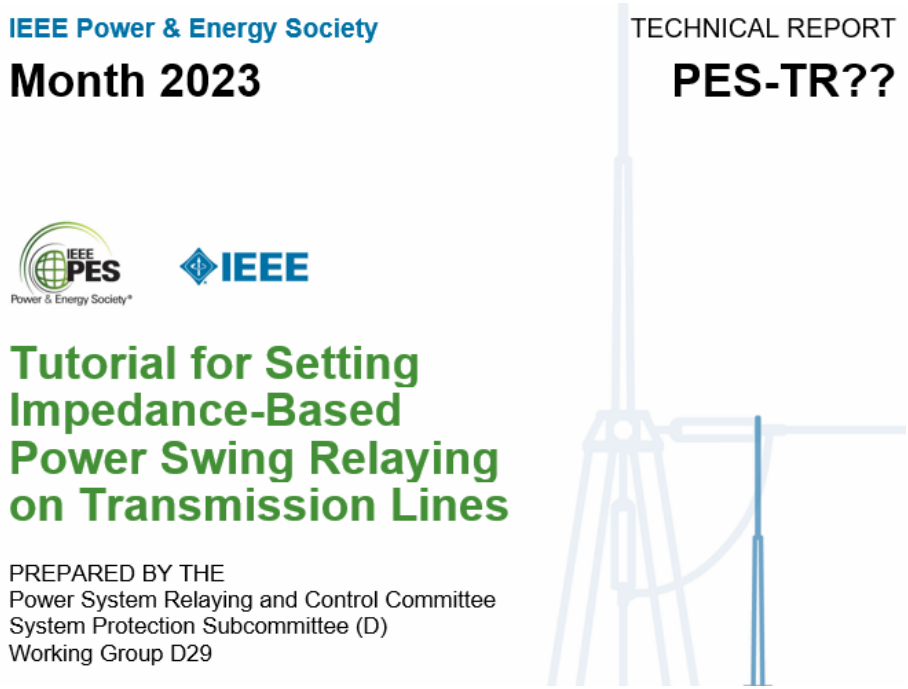
February 22, 2022

Outline

- SEL 400 Series Swing Center Voltage (SCV) PSB Settings
- SEL 400 Series SCV OST Settings
- SEL 311 Series Customized Out-Of-Step Tripping (OST)

Xcel Energy's Philosophy Guidance

- **IEEE Power System Relaying and Control Committee Working Group D29**

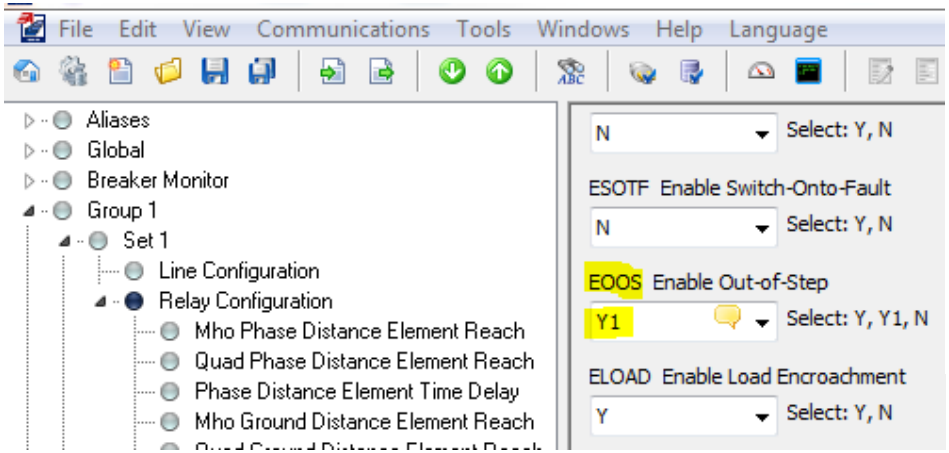


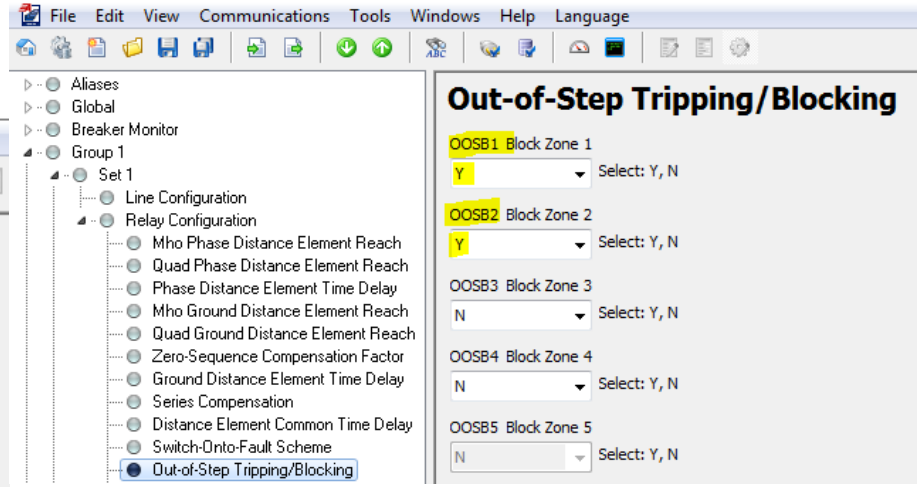
Working Groups

WG	Name	Chair	Vice Chair	Scope
D28	(PC37.230): Guide for Protective Relay Applications to Distribution Lines	Brian Boysen	Claire Patti	To review and revise C37.230-2007, "Guide for Protective Relay Applications to Distribution Lines" to correct errors and address additional distribution line protection related topics.
D29	Tutorial on Setting Impedance-Based Power Swing Blocking and Out-Of-Step Tripping Functions on Transmission Lines	Kevin Jones	Normann Fischer	Create a tutorial on setting impedance-based power swing blocking and out-of-step tripping functions related to transmission line applications. Specific relay settings examples will be provided. Other methods of detecting out-of-step conditions that exist will be summarized and referenced, but will not be discussed in detail.

SEL 400 Series SCV PSB Settings

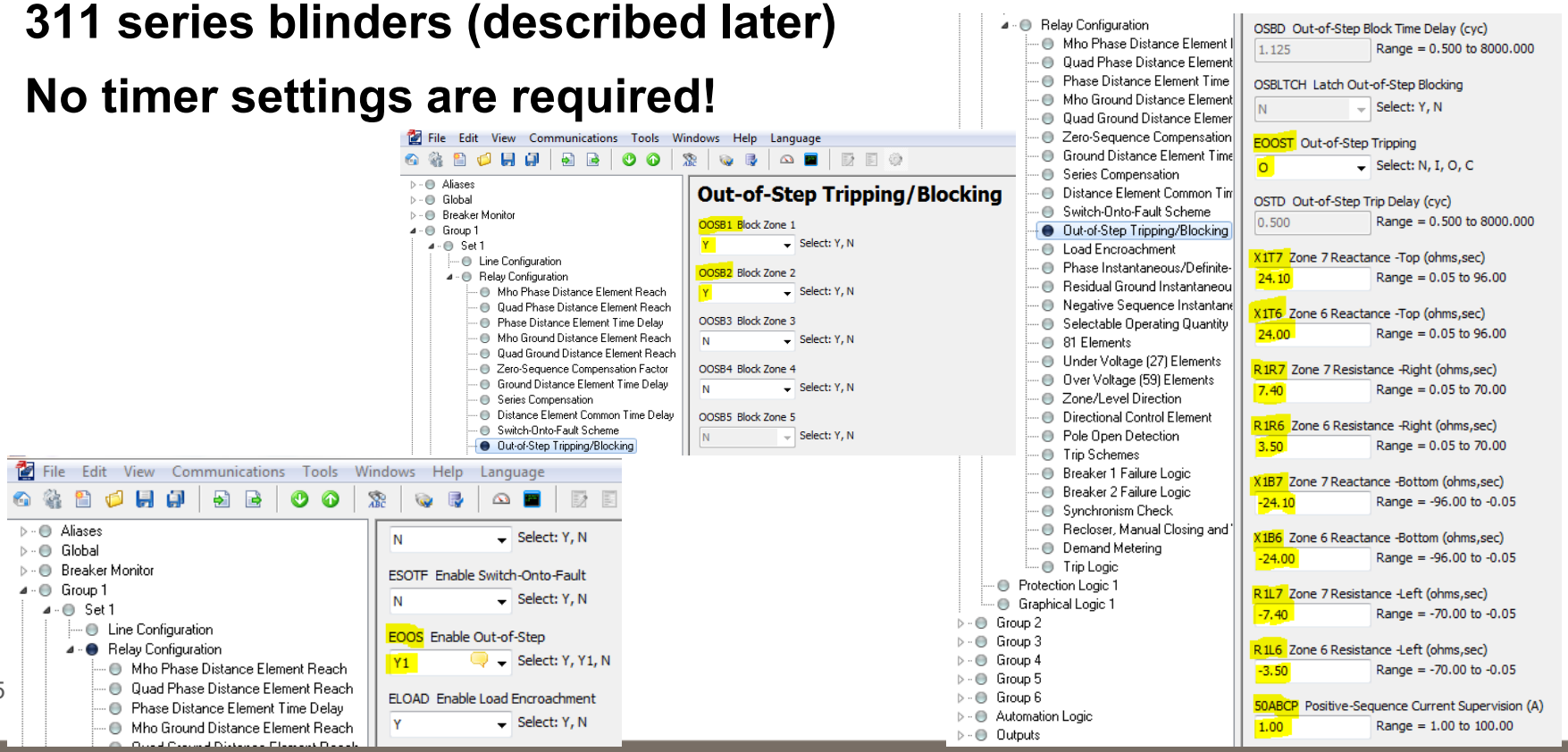
- **PSB Settings at remote ends of OST lines with SEL 400 series relays need to be changed to use SCV to be compatible with SCV OST settings**
- **Only 3-settings will typically be needed: EOOS = Y1, OOSB1 = Y, OOSB2 = Y**
- **That's it!!!**





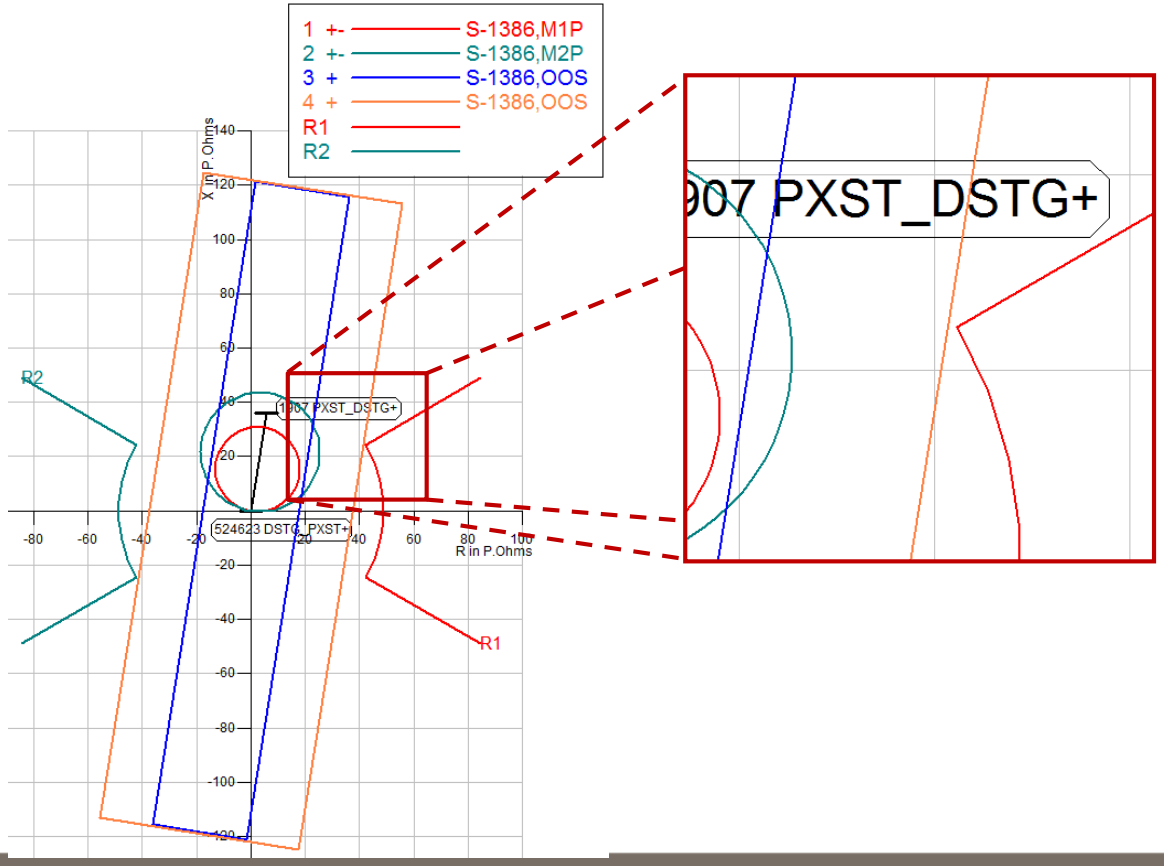
SEL 400 Series SCV OST Settings

- **SCV OST settings are a little more difficult**
- **In addition to PSB settings, 4-reactance and 4-resistance blinders need to be set, EOOST = O (TOWO), 50ABCP = 1.00**
- **The reactance and resistance blinders are set the same as the SEL 311 series blinders (described later)**
- **No timer settings are required!**



SEL 311/400 Series Blinder Settings

- **Set outer resistance blinders just inside the NERC PRC-023 load region**
- **Start with conductor limit – use maximum power transfer if conductor limit won't work**



SEL 311/400 Series Blinder Settings

- **Set inner resistance blinders between 120 – 150 degree system angle**
  - **Use maximum generation profile, excluding adjacent wind farms**
  - **This ensures compliance with NERC PRC-026**
- **Set such that the calculated slip rate is at least 2.5 – 3.0 Hz with a target of 3.0 Hz**
- **OST time delay target range is 2.0 – 2.5 cycles, with absolute minimum of 1.75 cycles**
- **Set outside zone 2 if possible**
- **If not, set outside zone 1 if possible**
- **If not, set at least double the calculated 3-phase, double arc fault impedance**

SEL 311/400 Series Blinder Settings

- **Establish required blinder setting to achieve 3.0 Hz slip rate**

```
------------------------------------------------------------------------
            NERC PRC-026-1 Standard Compliance Support
    Plot Power Swing Impedance Trajectories and Compute Slip Rates
------------------------------------------------------------------------

Distance element:  30375 DIST "OOS" Zone 7
The protected branch is from 524623 DSTG_PXST to 1907 PXST_DSTG, Ckt 2.

Local source impedance:        5.50543 + j 35.0778 Ohms  (   35.507 @  81.08 )
Remote source impedance:       0.56343 + j 6.98161 Ohms  (    7.004 @  85.39 )
Line impedance:                5.78586 + j 36.0961 Ohms  (   36.557 @  80.89 )
Total system impedance:        11.8547 + j 78.1555 Ohms  (   79.049 @  81.38 )
```

Get system source impedances by running CAPE Plot_Swing_Curve macro

Convert source impedances to amps to input into “Gene Henneberg” spreadsheet

$$I_S = \frac{230{,}000}{\sqrt{3} \cdot 35.507 \angle 81.08°} = 3{,}739.84 \angle -81.08\ Amps$$

$$I_R = \frac{230{,}000}{\sqrt{3} \cdot 7.004 \angle 85.39°} = 18{,}959.25 \angle -85.39\ Amps$$

SEL 311/400 Series Blinder Settings

- **Input line and source impedance data into OOS spreadsheet:**

4										R
5			Frequency =	60	Hz					0.0
6			CT Ratio =	400					Warrington	1.1
7			PT Ratio =	2000					R1	1.2
8			V_base =	230	kV				R2	0.2
9			Weak Bus Equivalent Source Voltage Ratio =	0.70	per unit at source or receiving bus					0.0
10			Target Minimum Swing Rate =	1800	° / second **trip or block**				Blackburn	1.1
11			Estimated Minimum Actual Swing Rate =	50	° / second, **block when OOS tripping is used**				R3	1.2
12			Z_base =	5.00					R4	0.5
13										0.0
14	**Line Impedance** (input RL + j XL in primary ohms, use apparent line impedance if the NERC loadability rating method is R1.12a or R1.12b									
15			Line RL + J XL =	5.786	36.096	Primary Ω		RL + j XL =	1.157	7.219	Secondary Ω	
16			Line Z =	36.557	80.89	MAG / ANGLE		Line Z =	7.311	80.9	MAG / ANGLE	
17								Minimum Inner OOS Left/Right Blinder Setting =	0.78	Secondary Ω		
18												
19	**Single-Pole Tripping and Series Compensation**							**Phase Impedance Element Pickup Time**				
20			Is the line single-pole tripped?	N	Y / N, SPT = 1			Maximum SIR =	0.97		
21			Series Compensation =	0.0%	of line reactance			Maximum Impedance Element Pickup =	1.76	cycles	
22								Minimum OSBD Timer =	2.25	cycles	
23											
24											
25	**System Equivalents and Transfer Impedances. Fault duties are in primary amps /angle. Transfer impedances are in primary ohms, R + j X.**										
26	**(N)**	Maximum Generation, System Intact, Sub-Transient X_d									
27			**Source Bus Equivalent**			**Receiving Bus Equivalent**			**System Transfer Impedance** (input R + j X in prima		
28			I f =	3739.84	-81.08	I f =	18959.25	-85.39	T	Rtr + j Xtr =	999999.000	999999.000	1414
29			Z f =	35.507	81.08	Z f =	7.004	85.39	-4.01	ZL + Ztr =	200000.957	200007.019	2828
30			Rf + j Xf =	1.101	7.016	Rf + j Xf =	0.113	1.396		ZT =	1.157	7.219	
31													
32		**Weak Source (Behind) Bus Equivalent**							(S)	**System Transfer Impedance** (input R + j X in prima		
33		**(S)**	I f =	3739.84	-81.08	Primary Amps				Rtr + j Xtr =	999999.000	999999.000	1414
34			Z f =	35.507	81.08	Primary Ω				ZL + Ztr =	200000.957	200007.019	2828
35			Rf + j Xf =	1.101	7.016	Secondary Ω				ZT =	1.157	7.219	
36													
37		**Weak Receiving (Forward) Bus Equivalent**							(R)	**System Transfer Impedance** (input R + j X in prima		
38		**(R)**	I f =	18959.25	-85.39	Primary Amps			T	Rtr + j Xtr =	999999.000	999999.000	141
39			Z f =	7.004	85.39	Primary Ω			-4.01	ZL + Ztr =	200000.957	200007.019	28
40			Rf + j Xf =	0.113	1.396	Secondary Ω				ZT =	1.157	7.219	

SEL 311/400 Series Blinder Settings

- **At the bottom of the spreadsheet, make sure all angles in rows 228 and 230 are between 120 – 150 degrees**

226	Out of Step Angles and Swing Rates			System Intact Testing X Offset = 0 Ω											
227		Maximum Generation, System Intact, Sub-Transient Xd"	OOS Angles			Degrees Difference on the Graph	Calculated swing rate I, (Intact)	Weak Source (Behind) Bus Equivalent	OOS Angles			Degrees Difference on the Graph	Calculated swing rate S, (Source)	Weak Receiving (Forward) Bus Equivalent	OOS Angles			Degrees Difference on the Graph	Calculated swing rate R, (Receiving)
228		Right inner Max =	131.7	Right Max =		38.3	1148	Right inner S =	130.2	Right S =		40.2	1205	Right inner R =	129.9	Right R =		40.2	1206
229		Right outer Max =	93.4					Right outer S =	90.1					Right outer R =	89.7				
230		Left inner Max =	132.8	Left Max =		38.6	1159	Left inner S =	131.0	Left S =		40.6	1217	Left inner R =	131.3	Left R =		40.6	1217
231		Left outer Max =	94.1	Inner Transit Angle =			96	Left outer S =	90.4	Inner Transit Angle =			99	Left outer R =	90.8	Inner Transit Angle =			99

ng Rates		System Intact Testing X Offset = 0 Ω		
ım Generation, ı Intact, Sub- nt Xd"	OOS Angles		Degrees Difference on the Graph	Calculated swing rate I, (Intact)
Right inner Max =	131.7	Right Max =	38.3	1148
Right outer Max =	93.4			
Left inner Max =	132.8	Left Max =	38.6	1159
Left outer Max =	94.1	Inner Transit Angle =		96

Weak Source (Behind) Bus Equivalent	OOS Angles		Degrees Difference on the Graph	Calculated swing rate S, (Source)
Right inner S =	130.2	Right S =	40.2	1205
Right outer S =	90.1			
Left inner S =	131.0	Left S =	40.6	1217
Left outer S =	90.4	Inner Transit Angle =		99

Weak Receiving (Forward) Bus Equivalent	OOS Angles		Degrees Difference on the Graph	Calculated swing rate R, (Receiving)
Right inner R =	129.9	Right R =	40.2	1206
Right outer R =	89.7			
Left inner R =	131.3	Left R =	40.6	1217
Left outer R =	90.8	Inner Transit Angle =		99

SEL 311/400 Series Blinder Settings

- **At the bottom of the spreadsheet, make sure all angles in rows 228 and 230 are between 120 – 150 degrees**
- **Check that cell E237 slip rate is at least 1080 degrees per second (1080/360 = 3 Hz)**
- **If not, override the OSTD to 2.00 cycles**

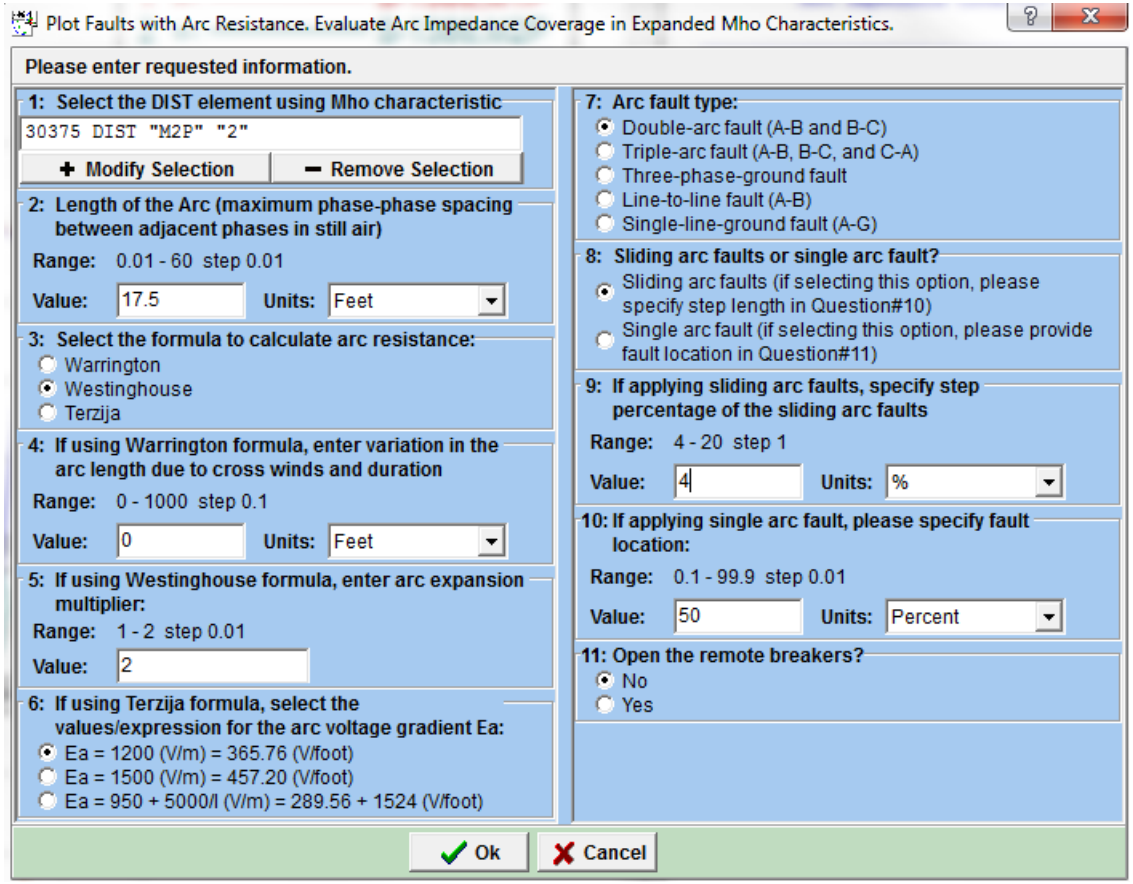
233	SEL Transmission Relay (321, 311, 421, 411L) Out-of-Step Timers and Related		
234	Out of Step Timer =	0.03750	second
235	Relay: SEL 311	2.250	cycles
236	**OSTD Trip Timer =**	2.250	cycles
237	Minimum Out of Step Swing Rate =	1020.5	° / secor
238	**OSBD** Block Timer =	81.000	cycles (
239	OSB Unblocked for 3-phase fault, UBOSBD =	0.500	cycles (
240	Minimum or User **UBOSBF** (Blackburn/Warrington) =	2.00	2.0
241	Maximum safe UBOSBF multiplier value =	7	7
242	(-) sequence ($3I_2$) detects unbalanced faults, 50Q1P = 50QUBP ≥	1.00	<= 50AE
243	User Unblock Delay for unbalanced faults, 67Q1D = UBD range	5.750	11.
244	Actual Out of Step Blocking Swing Rate =	50.0	° / secor

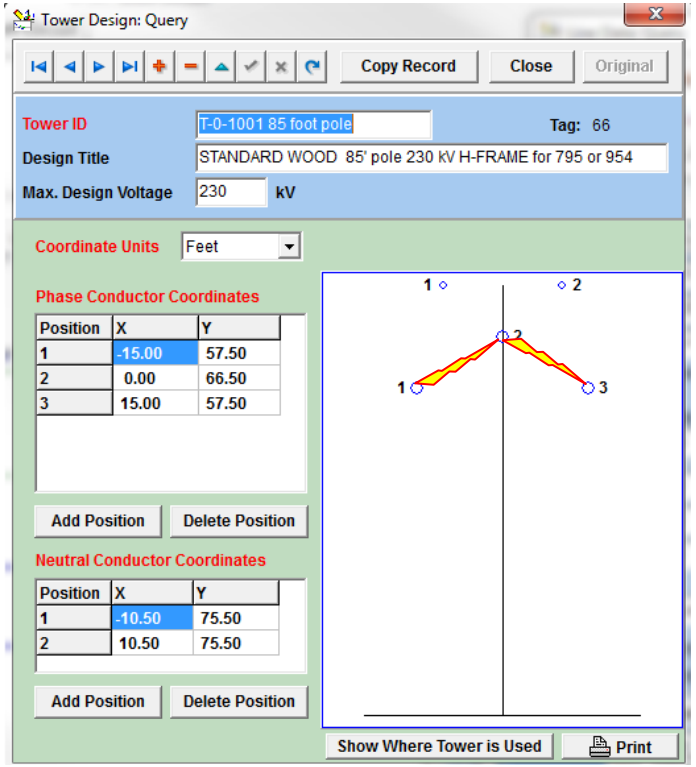
Swing rate too low, so override OSTD timer to 2.00 cycles

233	SEL Transmission Relay (321, 311, 421, 411L) Out-of-Step Timers and Related Settings									
234	Out of Step Timer =	0.03750	second	Based on minimum of all Swing Characteristics						
235	Relay: SEL 311	2.250	cycles						**User Over-ride OSTD**	
236	**OSTD Trip Timer =**	2.000	cycles =	0.03333	second				Trip/Block Timer =	2.00
237	Minimum Out of Step Swing Rate =	1148.0	° / second (trip or block applications)			Calculated swing rate below the desired swing rate.				(cycles)
238	**OSBD** Block Timer =	72.000	cycles (blocking time is effectively limited by the maximum unblock timer							
239	OSB Unblocked for 3-phase fault, UBOSBD =	0.500	cycles (adaptive relay setting)			Blackburn	Warrington		**User Over-ride UBOSBF**	
240	Minimum or User **UBOSBF** (Blackburn/Warrington) =	2.00	2.00	Outside Arc Resistance =		0.49	0.77	Ω	UBOSBF Multiplier =	2.00
241	Maximum safe UBOSBF multiplier value =	6	6	Inside Inner Blinder =		2.53	2.53	Ω		(1 - 10)
242	(-) sequence ($3I_2$) detects unbalanced faults, 50Q1P = 50QUBP ≥	1.00	<= 50ABC or use lower value from L-L and L-G fault study						Minimum 3-Ø UB Time =	10.250
243	User Unblock Delay for unbalanced faults, 67Q1D = UBD range	5.250	10.25	cycles, range between minimum and match the UBOSBF timer						
244	Actual Out of Step Blocking Swing Rate =	56.3	° / second (blocking only for OOS Trip applications)							

SEL 311/400 Series Blinder Settings

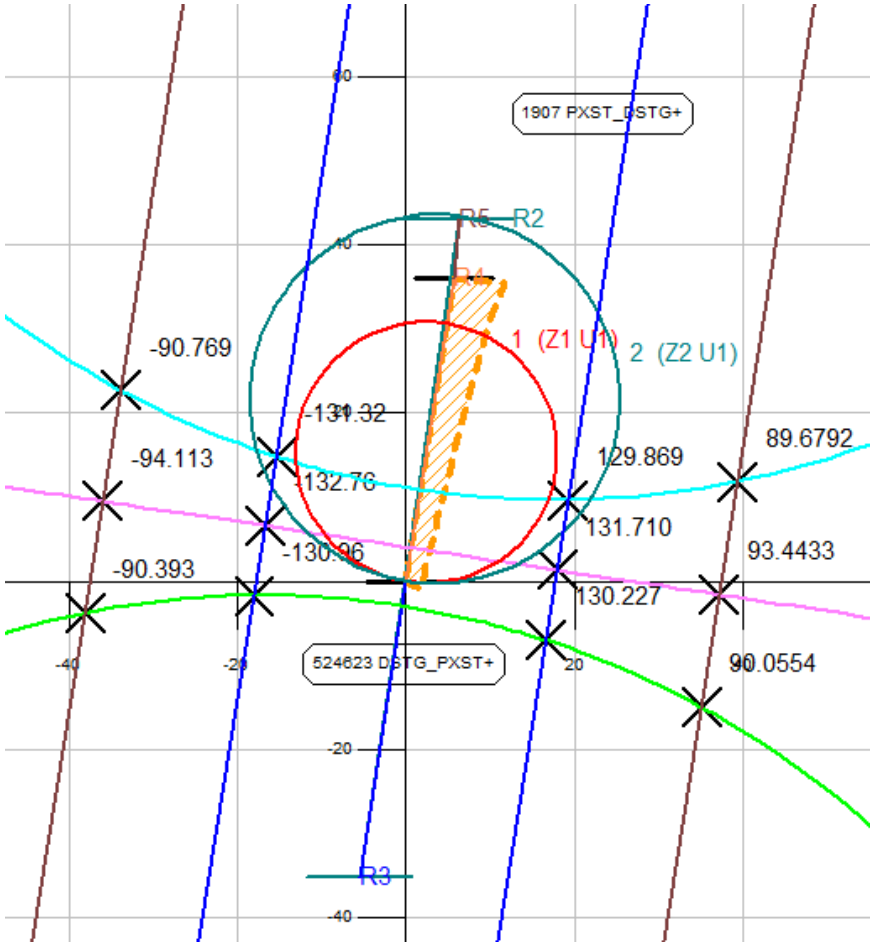
- **In CAPE, run plot_faults_with_arc_resistance macro**





SEL 311/400 Series Blinder Settings

- **In CAPE, run plot_faults_with_arc_resistance macro**
- **Make sure that the arcing zone doesn't come close to the inner resistance blinder!**



SEL 311/400 Series Blinder Settings

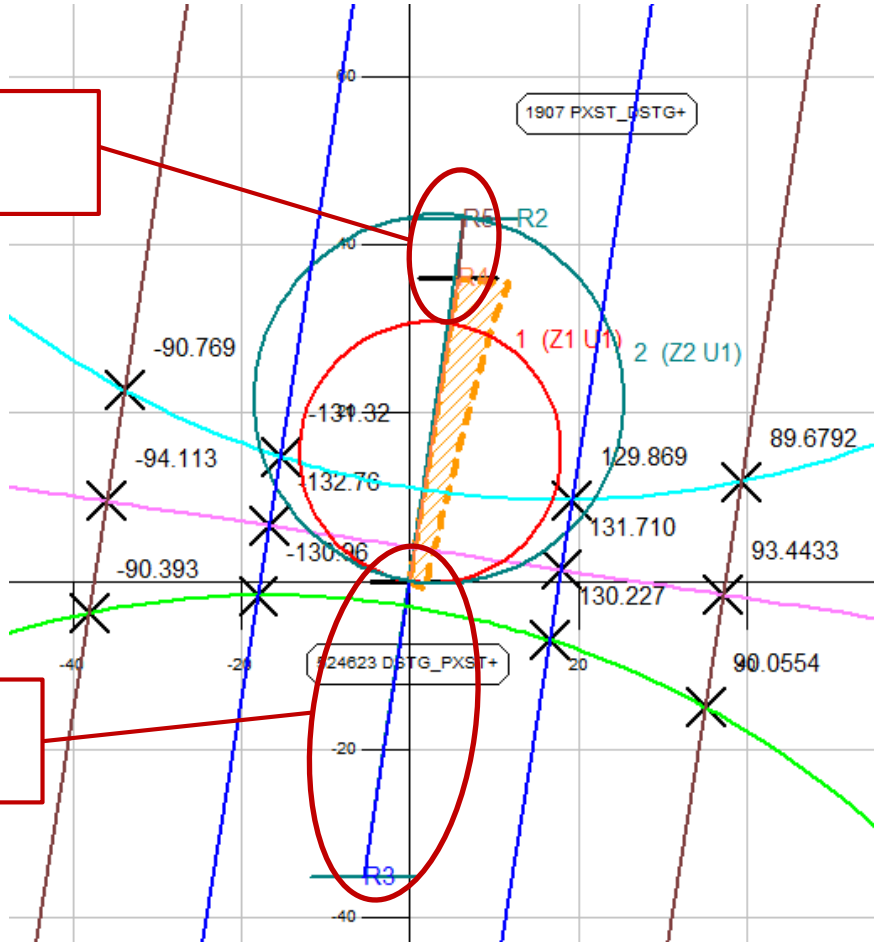
- Start at the end that has the weakest (largest) source impedance and weaken the system to the worst case single or double loop feed (this will typically be the worst case), but at very least worst N-2 condition (at the voltage level of OST relay)
- If at a power plant, consider all generation OUT as N-0
- Do the same for the other end
- Use Plot_Swing_Curve macro in CAPE coordination graphics
- Set reactance blinders far enough north and south so that under extreme weak source, the entire power swing corridor will go through all four resistance blinders (using maximum generation) with ample margin (at least 2 – 3 ohms secondary) for worst case system conditions
- Set top and bottom inner reactance blinders to mirror each other
- Set the outer top and bottom reactance blinders to inner +/- 0.1 ohms (secondary)

SEL 311/400 Series Blinder Settings

- **Reactance blinder settings example – Deaf Smith to Plant X 230 kV:**

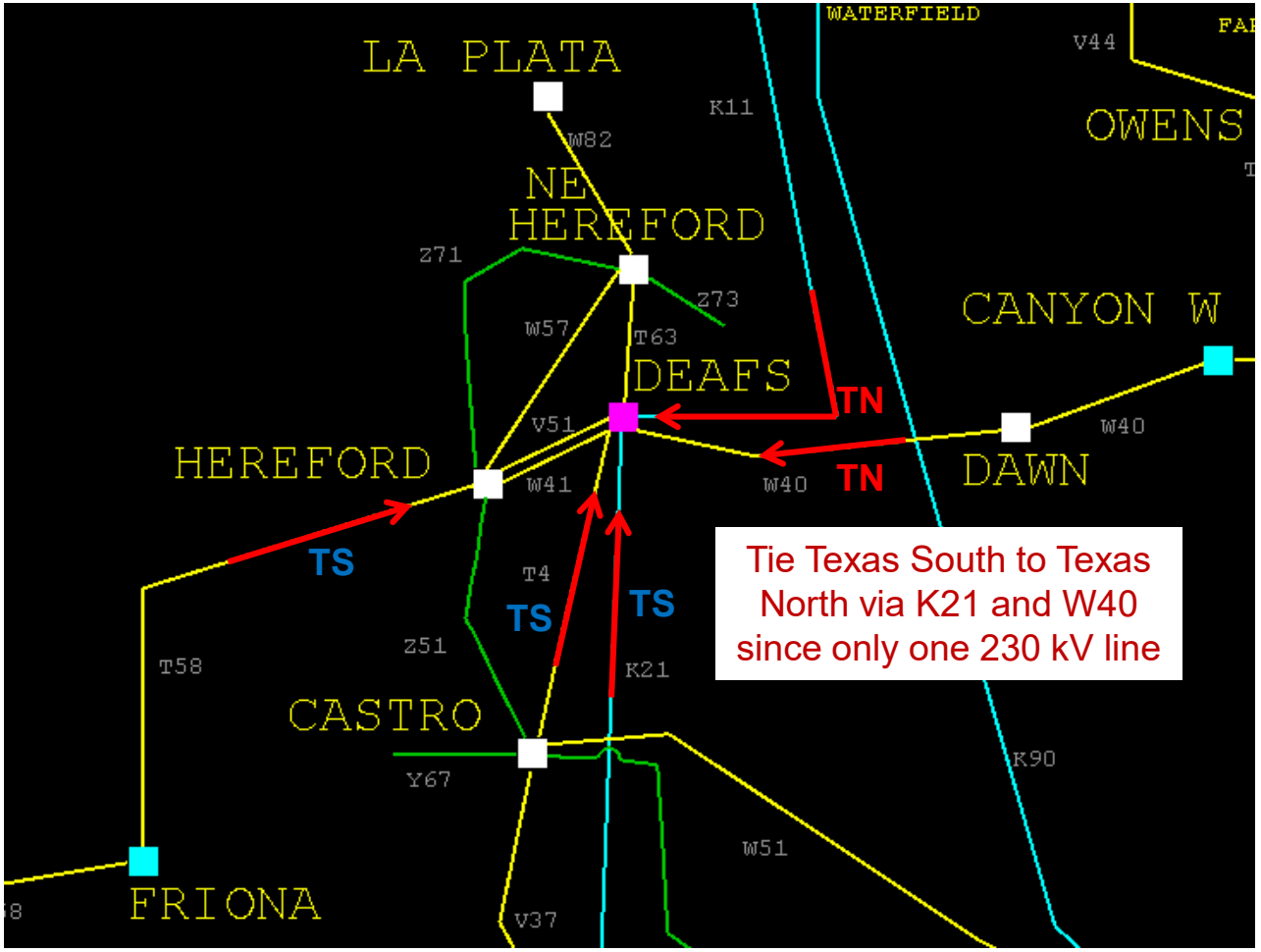
Strong source

Start at the weak source



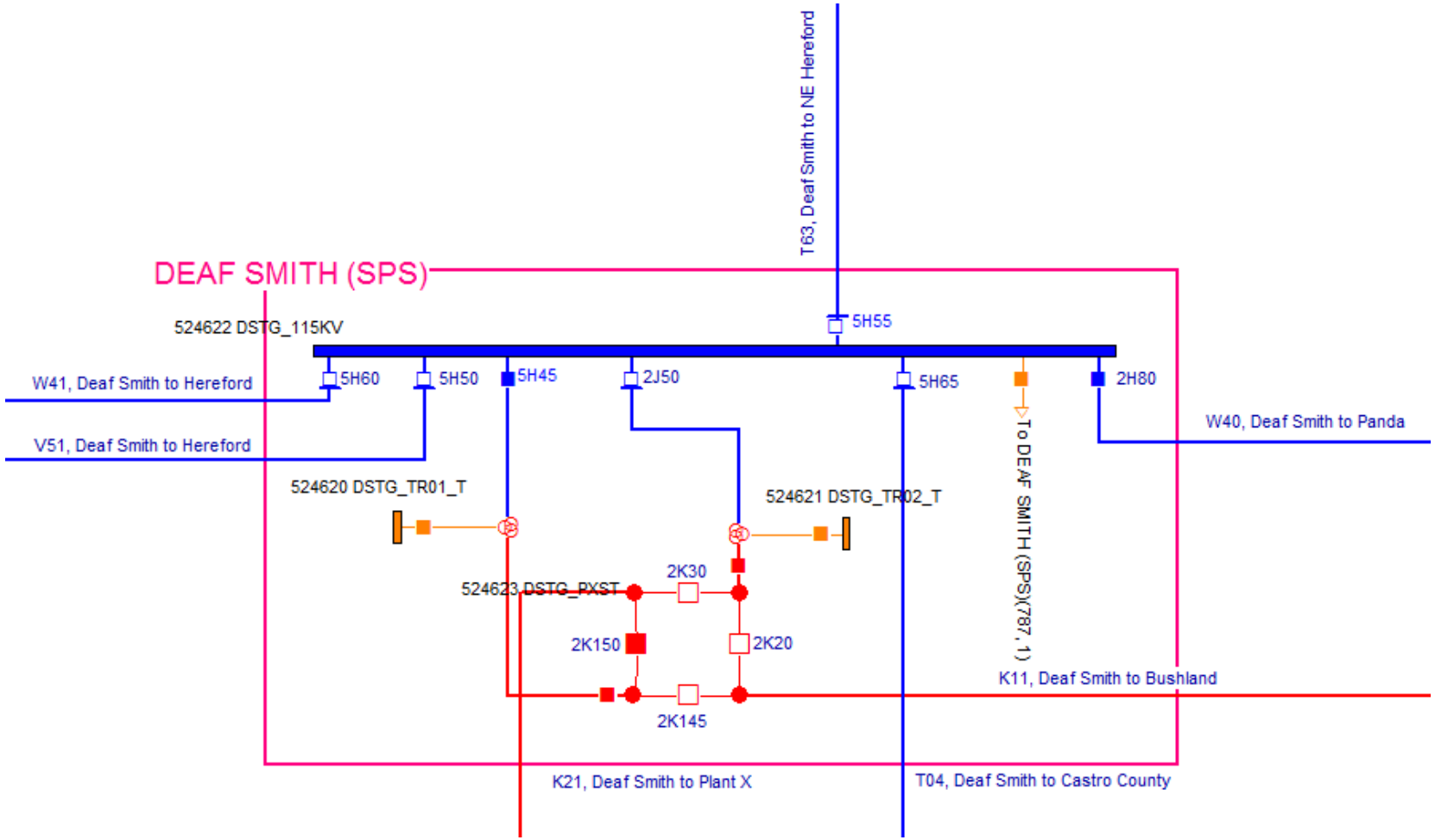
SEL 311/400 Series Blinder Settings

- **Reactance blinder settings example – Deaf Smith to Plant X 230 kV:**



SEL 311/400 Series Blinder Settings

- **Reactance blinder settings example – Deaf Smith to Plant X 230 kV:**

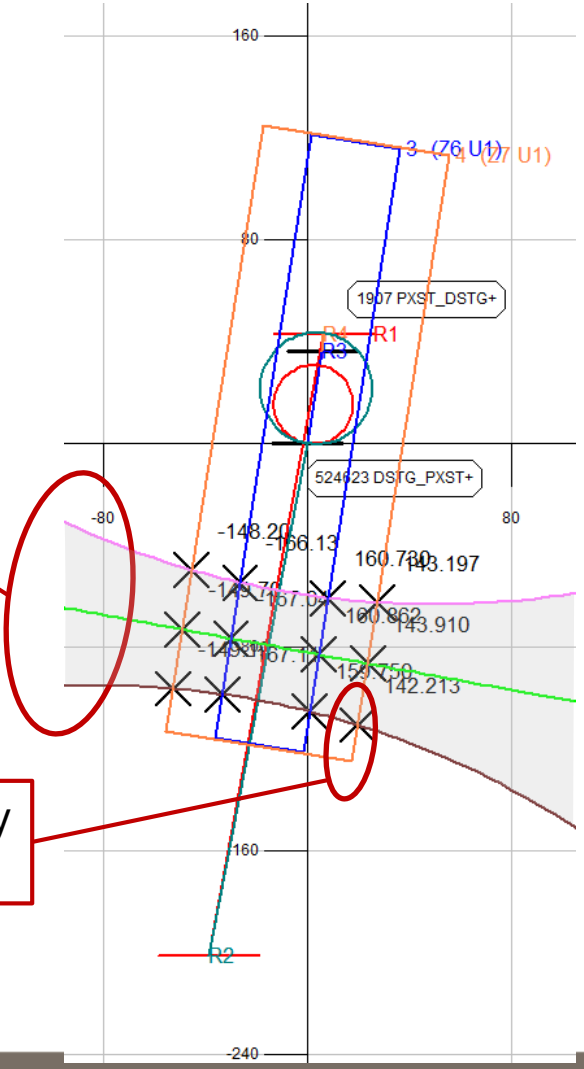


SEL 311/400 Series Blinder Settings

- **Reactance blinder settings example – Deaf Smith to Plant X 230 kV:**

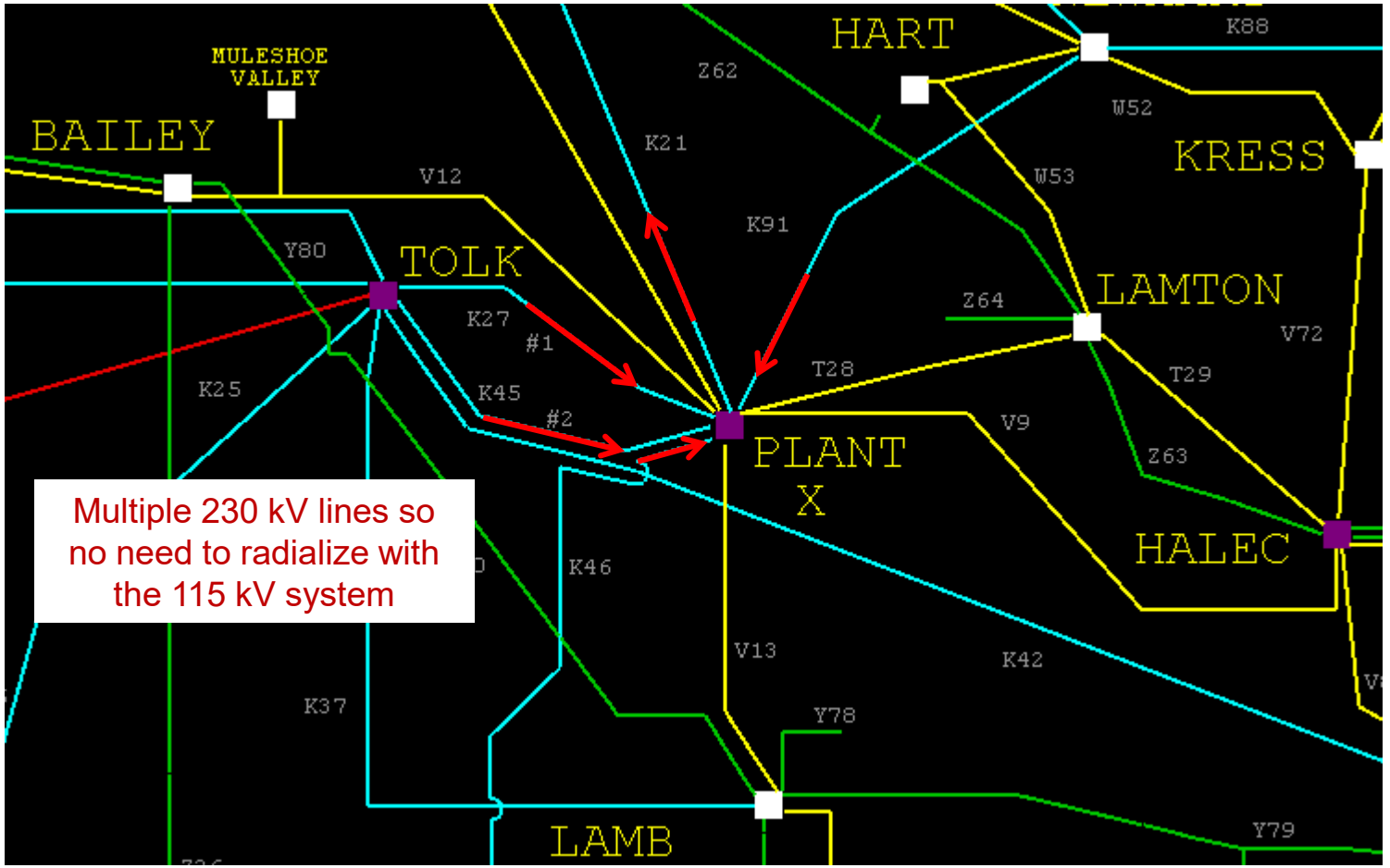
Ensure that the entire power swing corridor passes through all four resistance blinders with ample margin

Margin should be at least 2 – 3 ohms secondary (10 – 15 ohms primary, in this example)



SEL 311/400 Series Blinder Settings

- **Reactance blinder settings example – Deaf Smith to Plant X 230 kV:**



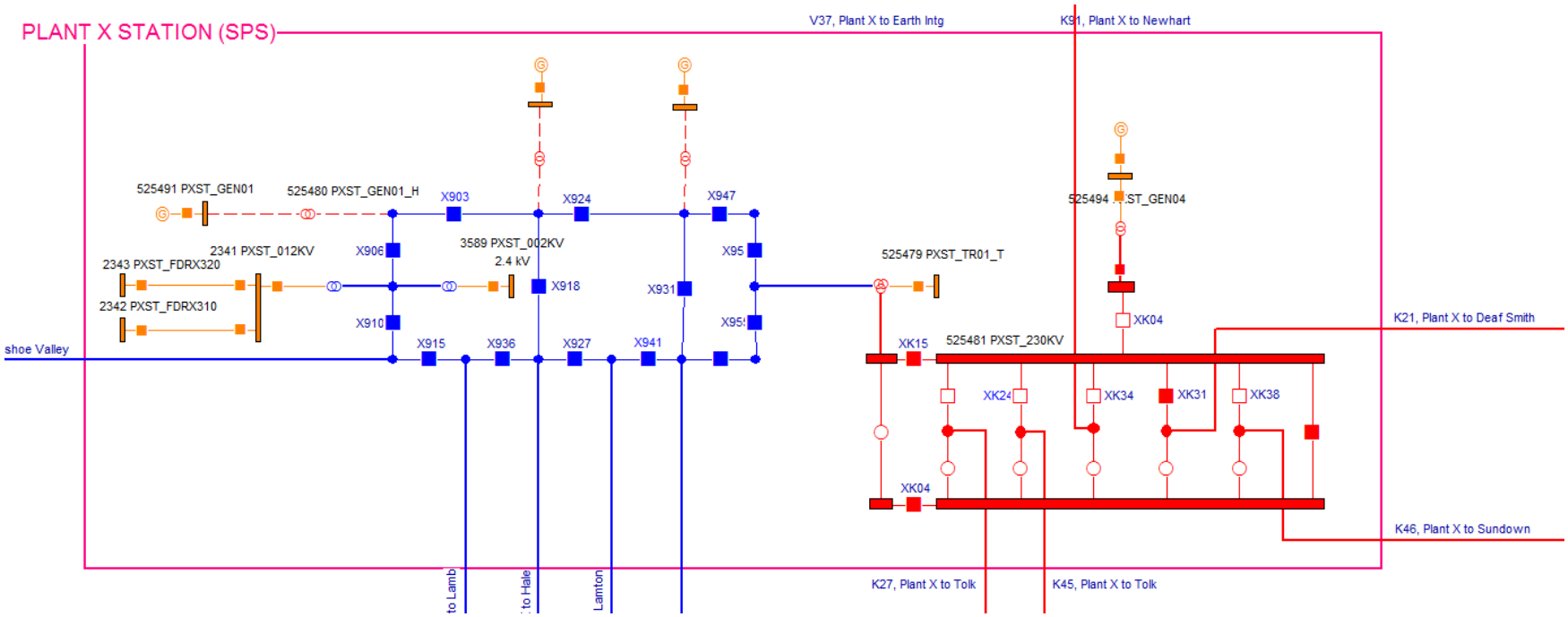
SEL 311/400 Series Blinder Settings

- **Reactance blinder settings example – Deaf Smith to Plant X 230 kV:**
- **Weak source is the 230/115 kV auto at Plant X**

```
================================================================================================================================================
THREE_PHASE at bus "1903 PXST_230KV"
------------------------------------------------------------------------------------------------------------------------------------------------
Substation PLANT X STATION (SPS)              Area  526 SPS          Zone   1505 SPS-CNPL
Bus   1903 PXST_230KV    DP                 Base kV  230.00 Ph-Ph (  132.79 @0 deg A-Gnd)      Prefault 1.000 V (p.u.)   @    0.00
                            + seq                 - seq                 0 seq / 3Io                A phase          B phase          C phase
                         ---------------   ---------------   ---------------   ---------------   ---------------   ---------------
Voltage (p.u.)         > 0.00000 @   0.0    0.00000 @   0.0    0.00000 @   0.0  | 0.00000 @   0.0    0.00000 @   0.0    0.00000 @   0.0
Voltage (kV) Ph-Gnd    > 0.00000 @   0.0    0.00000 @   0.0    0.00000 @   0.0  | 0.00000 @   0.0    0.00000 @   0.0    0.00000 @   0.0

Thevenin (R, X)(p.u.)> 0.00106,0.01189    0.00135,0.01196    0.00205,0.01416
Thevenin (R, X)(Ohms)> 0.56112,6.28830    0.71177,6.32469    1.08603,7.49080

Fault Currents (Amps)> 21033.5 @ -84.9    0.00000 @   0.0    0.00000 @   0.0  | 21033.5 @ -84.9    21033.5 @ 155.1    21033.5 @  35.1

Line Currents (Amps) total from >
DEAF SMITH (SPS)  Line:  PXST_DSTG_K21_230KV
524623 DSTG_PXST      2 1610.50 @ -81.6    0.00000 @   0.0    0.00000 @   0.0  | 1610.50 @ -81.6    1610.50 @ 158.4    1610.50 @  38.4
NEWHART (SPS)  Line:  NEHT_PXST_K91_230KV
   407 NEHT_PXST      2 2131.32 @ -82.1    0.00000 @   0.0    0.00000 @   0.0  | 2131.32 @ -82.1    2131.32 @ 157.9    2131.32 @  37.9
SUNDOWN (SPS)  Line:  PXST_SNDW_K46_230KV
  1738 SNDW_PXST      2 2107.06 @ -82.4    0.00000 @   0.0    0.00000 @   0.0  | 2107.06 @ -82.4    2107.06 @ 157.6    2107.06 @  37.6
TOLK STATION (SPS)  Line:  TKST_PXST_K45_230KV, TKST_PXST_K27_230KV
  1801 TKST_PXST      2 5317.85 @ -86.8    0.00000 @   0.0    0.00000 @   0.0  | 5317.85 @ -86.8    5317.85 @ 153.2    5317.85 @  33.2
  1796 TKST_PXST      1 5528.71 @ -82.8    0.00000 @   0.0    0.00000 @   0.0  | 5528.71 @ -82.8    5528.71 @ 157.2    5528.71 @  37.2


N-Circuit Transformer Terminal Currents (Amps) total from >
PLANT X STATION (SPS): GEN04 Bus   1910 Ckt  1   Tap  230.00 kV @0 * 1.0 @0 Solidly grounded
Windings at  1910 PXST_GEN04_H    H  Y  230.0kV @   0 deg
             525494 PXST_GEN04    X  D  19.00kV @ -30 deg
Wdg H  Connection Y    2428.90 @ -89.1    0.00000 @   0.0    0.00000 @   0.0  | 2428.90 @ -89.1    2428.90 @ 150.9    2428.90 @  30.9

PLANT X STATION (SPS): TR01  Bus   1901 Ckt  1   Tap  230.00 kV @0 * 1.0 @0 Solidly grounded
Windings at  1901 PXST_BANK1_H    H  A  230.0kV @   0 deg
             1282 PXST_TR01_H     X  A  115.0kV @   0 deg
             525479 PXST_TR01_T   Y  D  13.20kV @ -30 deg
Wdg H  Connection A    1934.25 @ -88.8    0.00000 @   0.0    0.00000 @   0.0  | 1934.25 @ -88.8    1934.25 @ 151.2    1934.25 @  31.2
Autotransformer Current (3I0 A ground to neutral) 0.000000 @   0.0
```

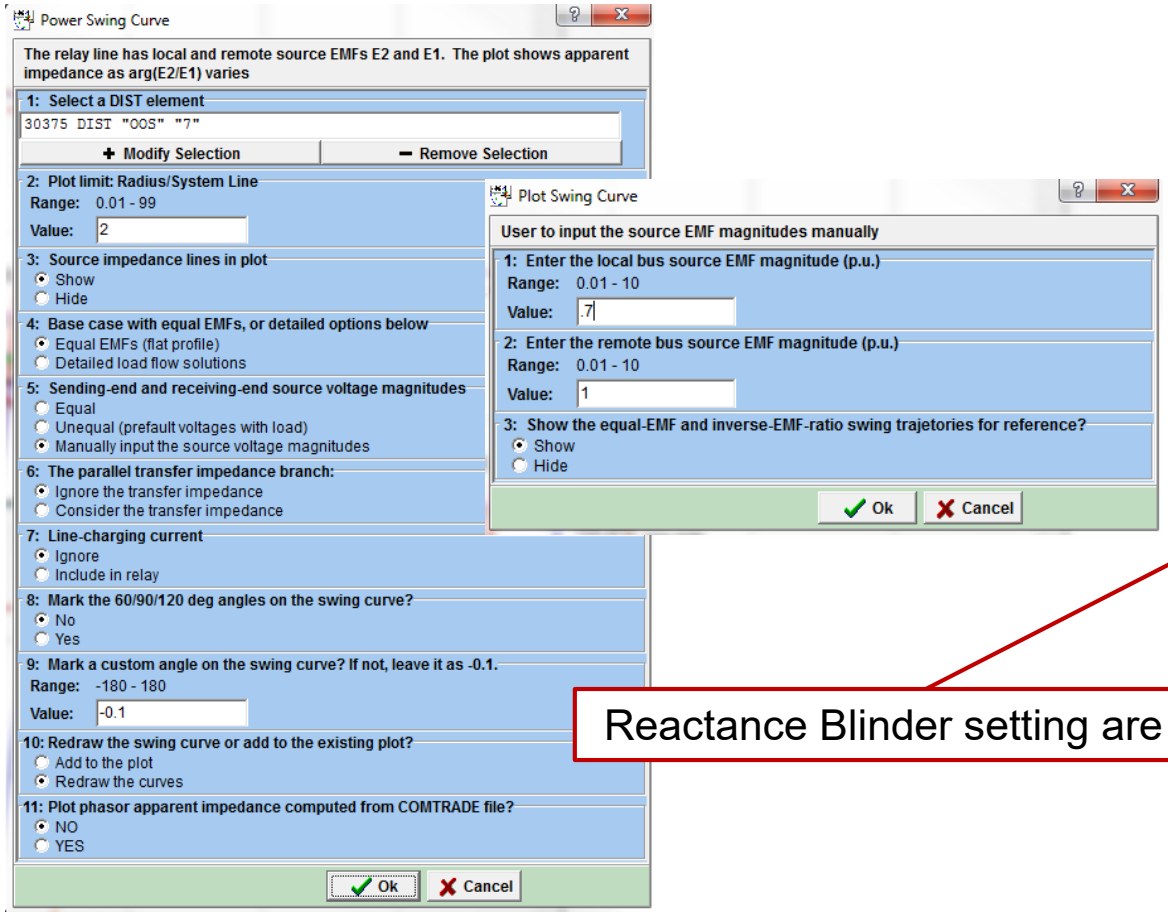
SEL 311/400 Series Blinder Settings

- **Reactance blinder settings example – Deaf Smith to Plant X 230 kV:**
- **Outage all generation and 230 kV lines, except line to Deaf Smith**
- **Run Plot_Swing_Curve macro to see if blinder settings are OK**

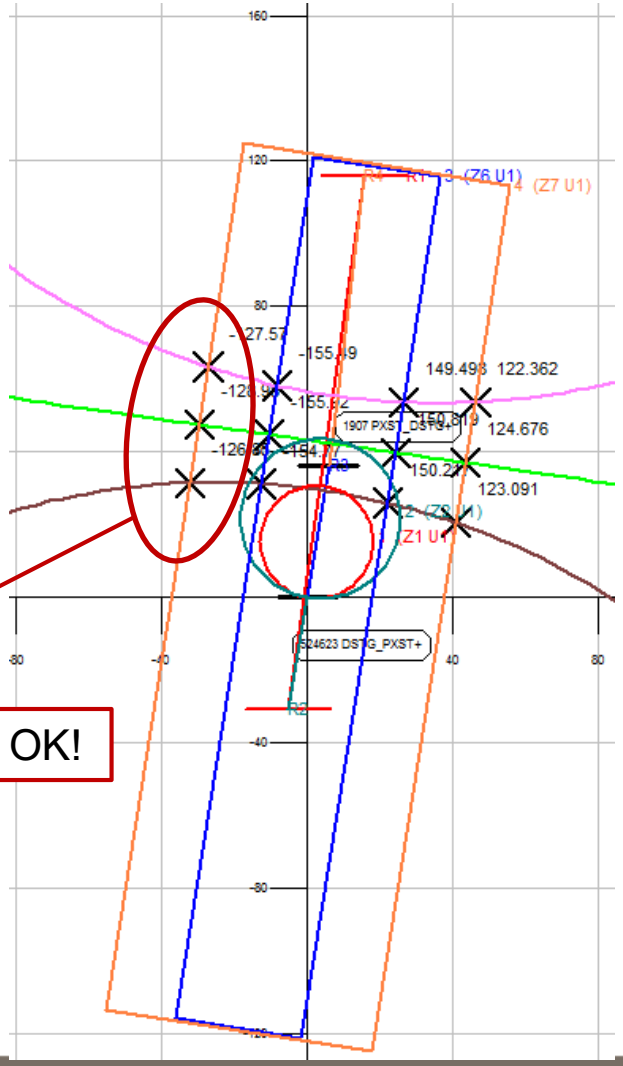


SEL 311/400 Series Blinder Settings

- **Reactance blinder settings example – Deaf Smith to Plant X 230 kV:**



Reactance Blinder setting are OK!

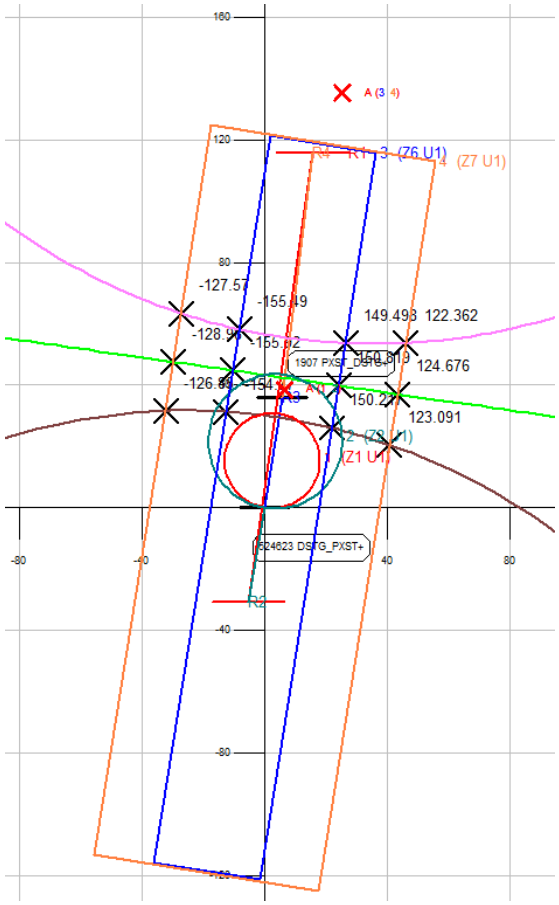


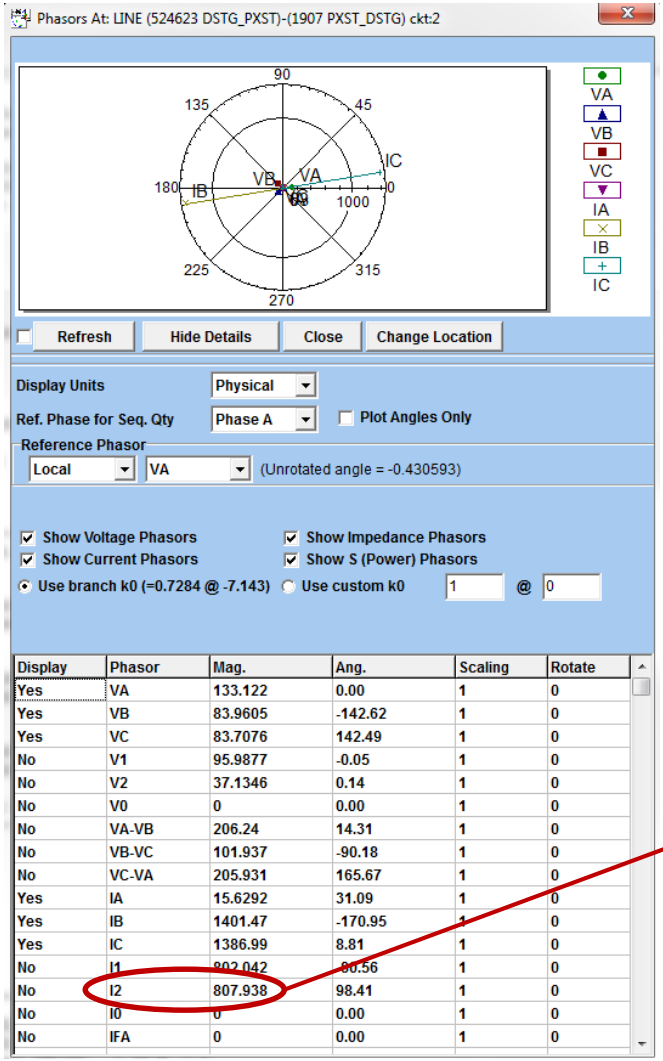
SEL 311 Current Supervision Settings

- **50Q2P – Typically set to 1 amp secondary if CTR is at least 240:1**
  - **Must be set sensitive enough to pick up for a phase-to-phase fault that is seen by the reactance blinders at the end of their reach**
- **50G4P – Typically set to 1 amp secondary if CTR is at least 240:1**
  - **Must be set sensitive enough to pick up for a SLG fault that is seen by the reactance blinders at the end of their reach**

SEL 311 Current Supervision Settings

- **50Q2P Check for LL fault at Plant X 230 kV bus:**



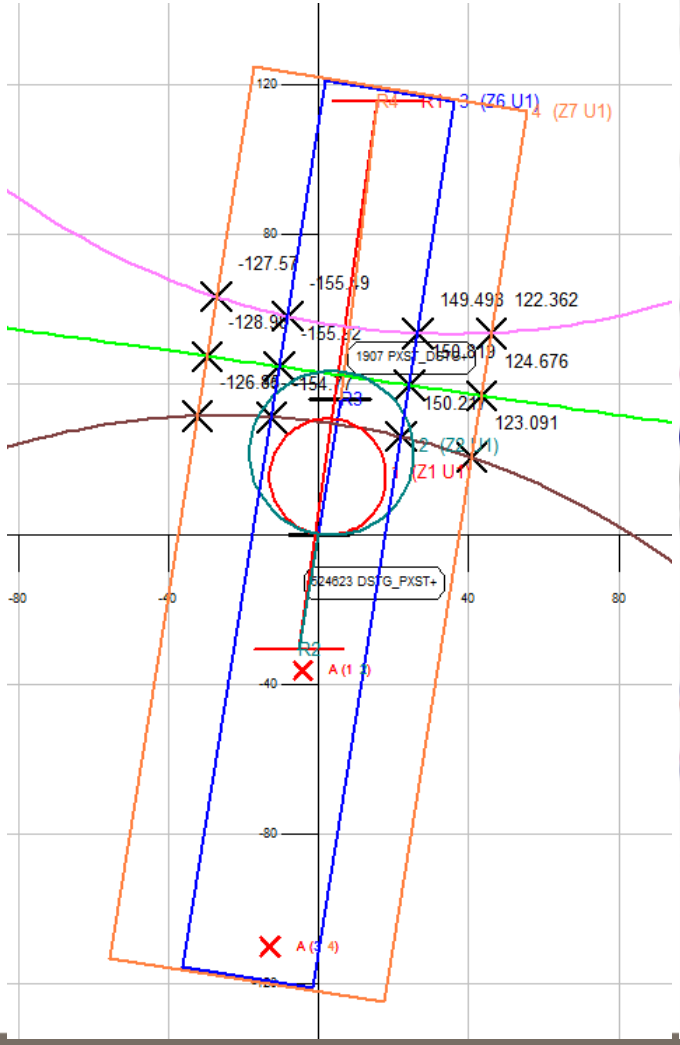


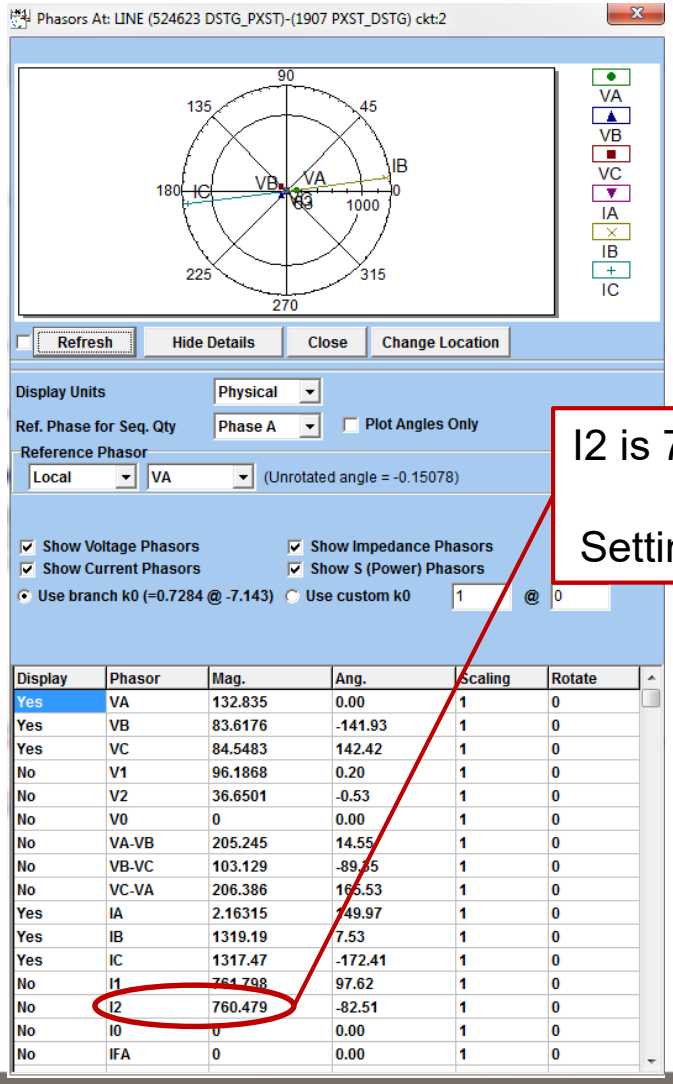
Display	Phasor	Mag.	Ang.	Scaling	Rotate
Yes	VA	133.122	0.00	1	0
Yes	VB	83.9605	-142.62	1	0
Yes	VC	83.7076	142.49	1	0
No	V1	95.9877	-0.05	1	0
No	V2	37.1346	0.14	1	0
No	V0	0	0.00	1	0
No	VA-VB	206.24	14.31	1	0
No	VB-VC	101.937	-90.18	1	0
No	VC-VA	205.931	165.67	1	0
Yes	IA	15.6292	31.09	1	0
Yes	IB	1401.47	-170.95	1	0
Yes	IC	1386.99	8.81	1	0
No	I1	802.042	-80.56	1	0
No	I2	807.938	98.41	1	0
No	I0	0	0.00	1	0
No	IFA	0	0.00	1	0

I2 is 808/240 = 3.36 amps secondary

SEL 311 Current Supervision Settings

- **50Q2P Check for LL fault at Bushland 230 kV bus:**



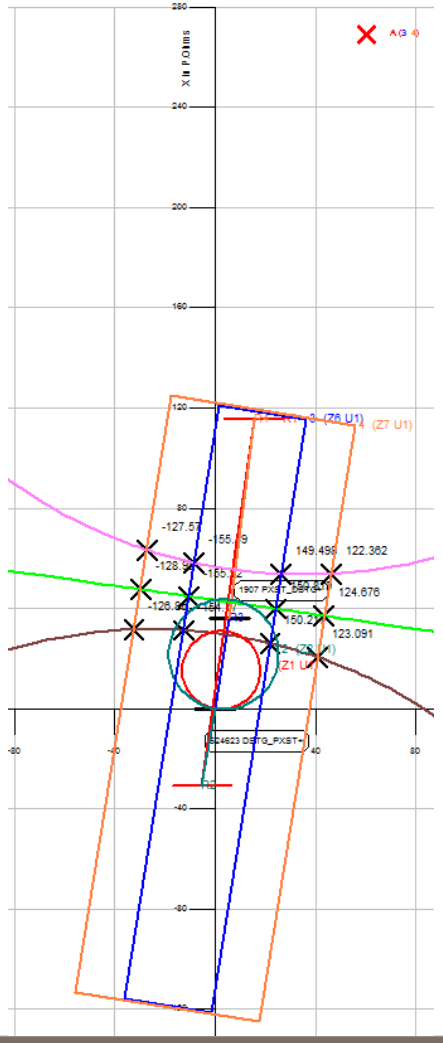


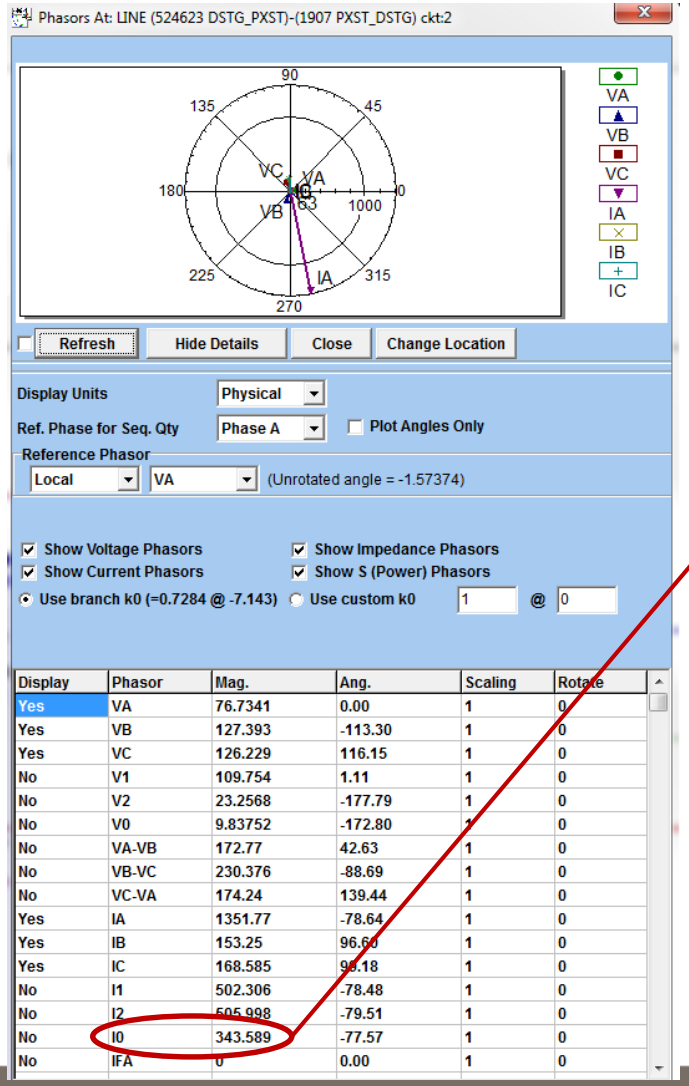
Display	Phasor	Mag.	Ang.	Scaling	Rotate
Yes	VA	132.835	0.00	1	0
Yes	VB	83.6176	-141.93	1	0
Yes	VC	84.5483	142.42	1	0
No	V1	96.1868	0.20	1	0
No	V2	36.6501	-0.53	1	0
No	V0	0	0.00	1	0
No	VA-VB	205.245	14.55	1	0
No	VB-VC	103.129	-89.35	1	0
No	VC-VA	206.386	165.53	1	0
Yes	IA	2.16315	-49.97	1	0
Yes	IB	1319.19	7.53	1	0
Yes	IC	1317.47	-172.41	1	0
No	I1	761.798	97.62	1	0
No	I2	760.479	-82.51	1	0
No	I0	0	0.00	1	0
No	IFA	0	0.00	1	0

I2 is 760/240 = 3.16 amps secondary
Setting of 1 – 2 amps OK

SEL 311 Current Supervision Settings

- **50G4P Check for LG fault at Plant X 230 kV bus:**



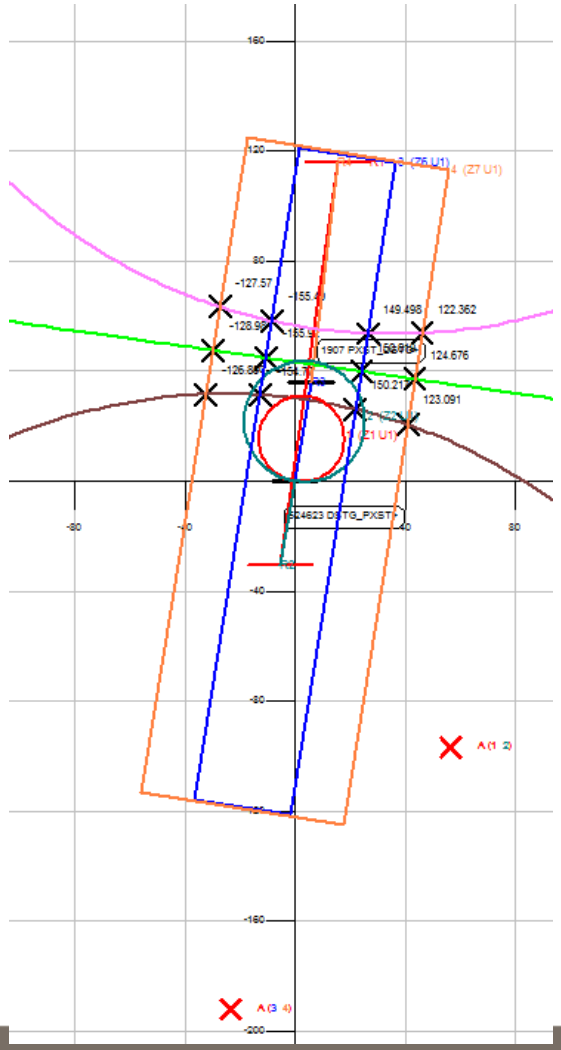


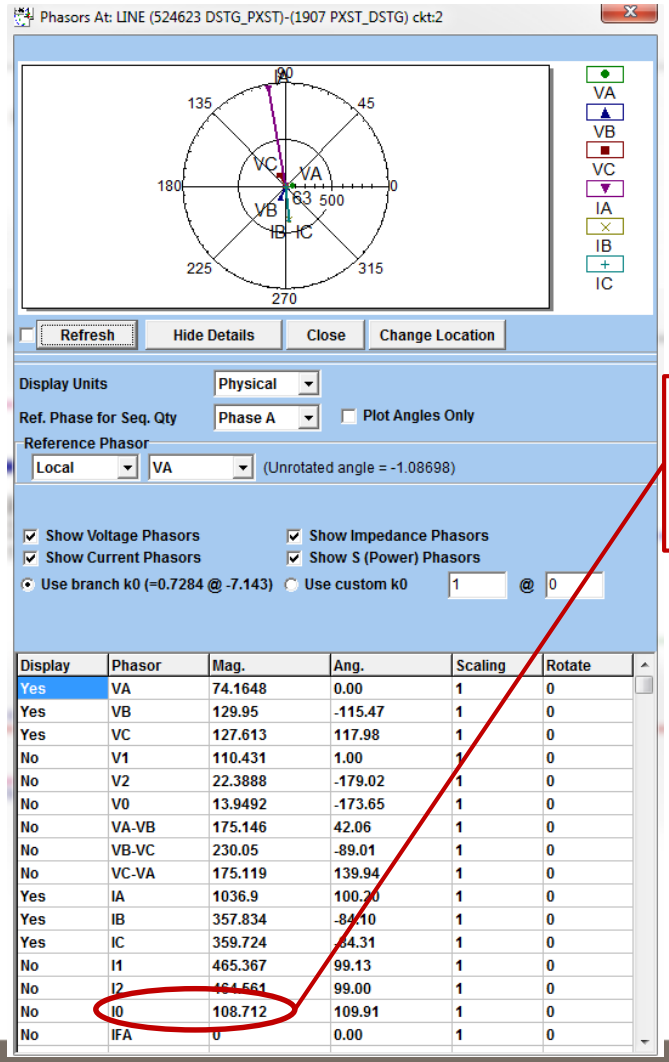
Display	Phasor	Mag.	Ang.	Scaling	Rotate
Yes	VA	76.7341	0.00	1	0
Yes	VB	127.393	-113.30	1	0
Yes	VC	126.229	116.15	1	0
No	V1	109.754	1.11	1	0
No	V2	23.2568	-177.79	1	0
No	V0	9.83752	-172.80	1	0
No	VA-VB	172.77	42.63	1	0
No	VB-VC	230.376	-88.69	1	0
No	VC-VA	174.24	139.44	1	0
Yes	IA	1351.77	-78.64	1	0
Yes	IB	153.25	96.60	1	0
Yes	IC	168.585	99.18	1	0
No	I1	502.306	-78.48	1	0
No	I2	505.998	-79.51	1	0
No	I0	343.589	-77.57	1	0
No	IFA	0	0.00	1	0

3I0 is 1031/240 = 4.30 amps secondary

SEL 311 Current Supervision Settings

- **50G4P Check for LG fault at Bushland 230 kV bus:**





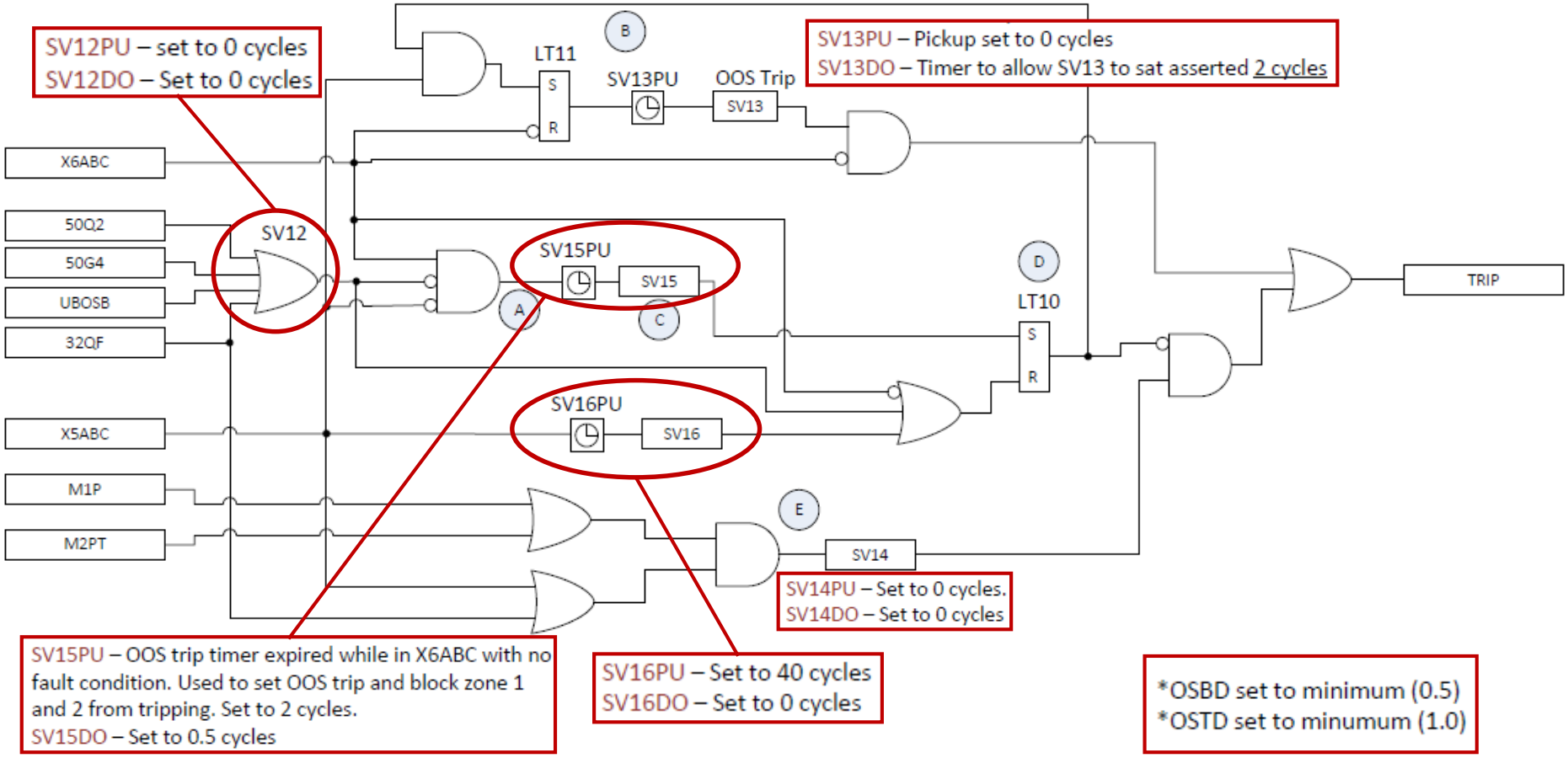
Display	Phasor	Mag.	Ang.	Scaling	Rotate
Yes	VA	74.1648	0.00	1	0
Yes	VB	129.95	-115.47	1	0
Yes	VC	127.613	117.98	1	0
No	V1	110.431	1.00	1	0
No	V2	22.3888	-179.02	1	0
No	V0	13.9492	-173.65	1	0
No	VA-VB	175.146	42.06	1	0
No	VB-VC	230.05	-89.01	1	0
No	VC-VA	175.119	139.94	1	0
Yes	IA	1036.9	100.20	1	0
Yes	IB	357.834	-84.10	1	0
Yes	IC	359.724	34.31	1	0
No	I1	465.367	99.13	1	0
No	I2	464.561	99.00	1	0
No	I0	108.712	109.91	1	0
No	IFA	0	0.00	1	0

3I0 is 326/240 = 1.36 amps secondary
Setting of 1 amp OK

SEL 311 Settings Summary

SEL-311 Logic and Timer Settings:

Logic Modification version 2.3 to Conventional OSS Settings (FOR SEL-311C)



SEL 311 Settings Summary

- **SEL-311 RDB Supervisor Settings:**

Residual Ground Overcurrent Elements

Residual Ground Overcurrent Element Settings

E50G Enable Residual Ground Overcurrent Elements
4 Select: N, 1-4

Residual Ground Instantaneous Overcurrent Elements

50G1P Level 1 (Amps secondary in 0.01 increments)
OFF Range = 0.050 to 100.000, OFF

50G2P Level 2 (Amps secondary in 0.01 increments)
OFF Range = 0.050 to 100.000, OFF

50G3P Level 3 (Amps secondary in 0.01 increments)
OFF Range = 0.050 to 100.000, OFF

50G4P Level 4 (Amps secondary in 0.01 increments)
1.000 Range = 0.050 to 100.000, OFF

Residual Ground Definite-Time Overcurrent Elements

67G1D Level 1 (cycles in 0.25 increments)
0.00 Range = 0.00 to 16000.00

67G2D Level 2 (cycles in 0.25 increments)
0.00 Range = 0.00 to 16000.00

67G3D Level 3 (cycles in 0.25 increments)
0.00 Range = 0.00 to 16000.00

67G4D Level 4 (cycles in 0.25 increments)
0.00 Range = 0.00 to 16000.00

Negative-Sequence Overcurrent Elements

Negative-Sequence Overcurrent Element Settings

E50Q Enable Negative-Sequence Overcurrent Elements
2 Select: N, 1-4

Negative-Sequence Instantaneous Overcurrent Elements

50Q1P Level 1 (Amps secondary)
1.00 Range = 0.25 to 100.00, OFF

50Q2P Level 2 (Amps secondary)
1.00 Range = 0.25 to 100.00, OFF

50Q3P Level 3 (Amps secondary)
OFF Range = 0.25 to 100.00, OFF

50Q4P Level 4 (Amps secondary)
OFF Range = 0.25 to 100.00, OFF

Negative-Sequence Definite-Time Overcurrent Elements

67Q1D Level 1 (cycles in 0.25 increments)
0.00 Range = 0.00 to 16000.00

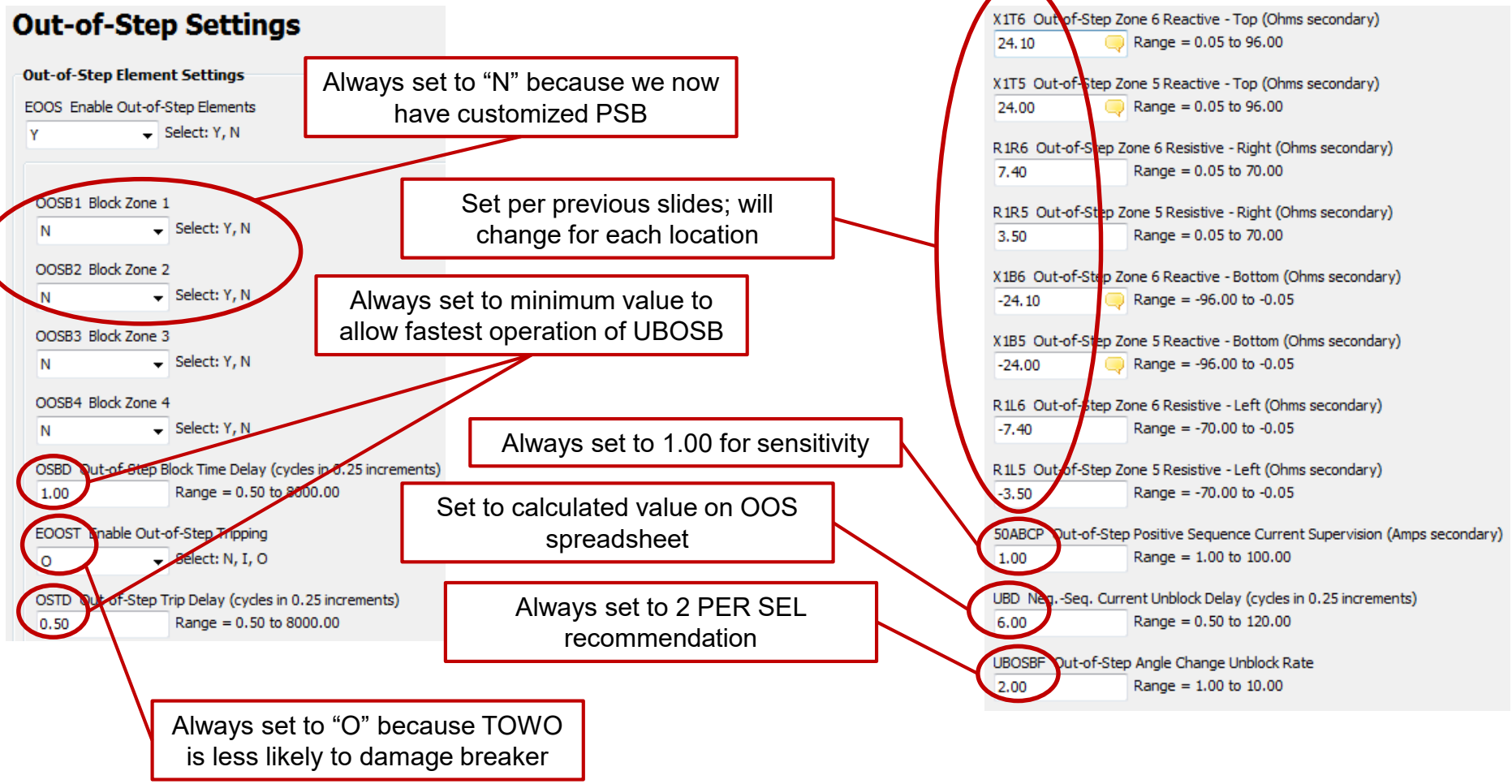
67Q2D Level 2 (cycles in 0.25 increments)
0.00 Range = 0.00 to 16000.00

67Q3D Level 3 (cycles in 0.25 increments)
0.00 Range = 0.00 to 16000.00

67Q4D Level 4 (cycles in 0.25 increments)
0.00 Range = 0.00 to 16000.00

SEL 311 Settings Summary

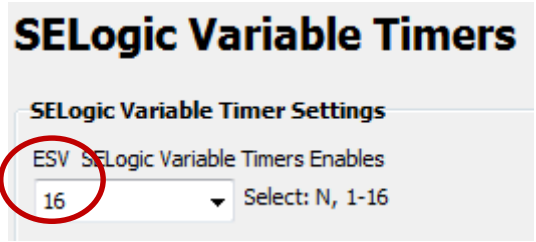
SEL-311 RDB Out-of-Step Settings:



SEL 311 Settings Summary

- **SEL-311 RDB SV Timer Settings:**

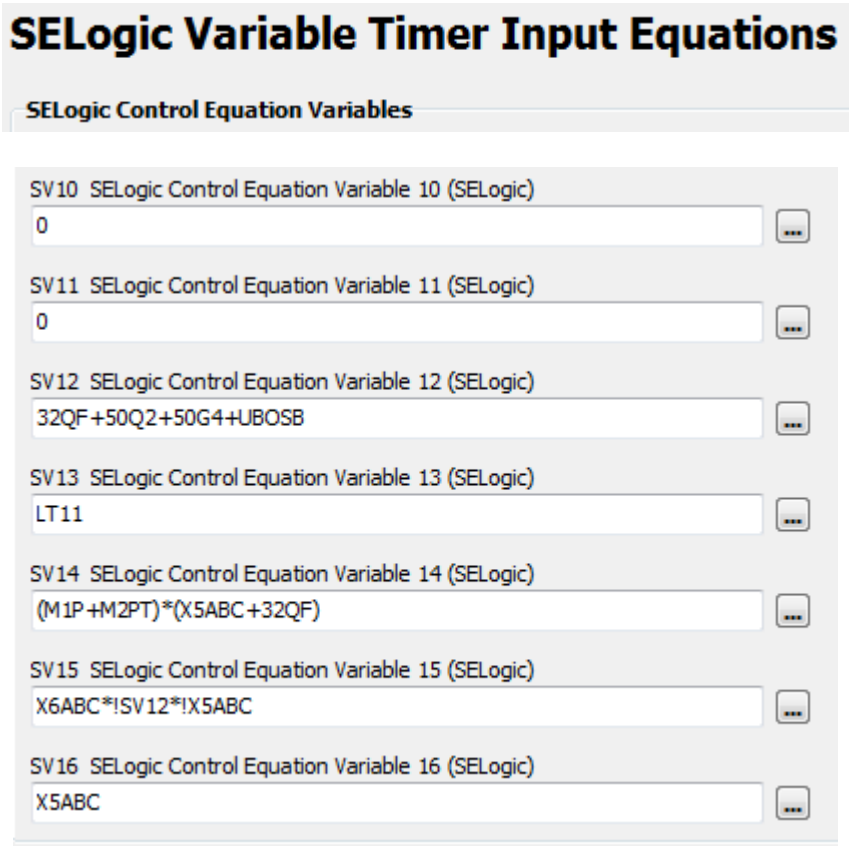
Make sure ALL 16 are enabled!!!



SV10PU SV10 Timer Pickup (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV10DO SV10 Timer Dropout (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV11PU SV11 Timer Pickup (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV11DO SV11 Timer Dropout (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV12PU SV12 Timer Pickup (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV12DO SV12 Timer Dropout (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV13PU SV13 Timer Pickup (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV13DO SV13 Timer Dropout (cycles in 0.25 increments)	2.00	Range = 0.00 to 16000.00	
SV14PU SV14 Timer Pickup (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV14DO SV14 Timer Dropout (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	
SV15PU SV15 Timer Pickup (cycles in 0.25 increments)	2.00	Range = 0.00 to 16000.00	
SV15DO SV15 Timer Dropout (cycles in 0.25 increments)	0.50	Range = 0.00 to 16000.00	
SV16PU SV16 Timer Pickup (cycles in 0.25 increments)	40.00	Range = 0.00 to 16000.00	
SV16DO SV16 Timer Dropout (cycles in 0.25 increments)	0.00	Range = 0.00 to 16000.00	

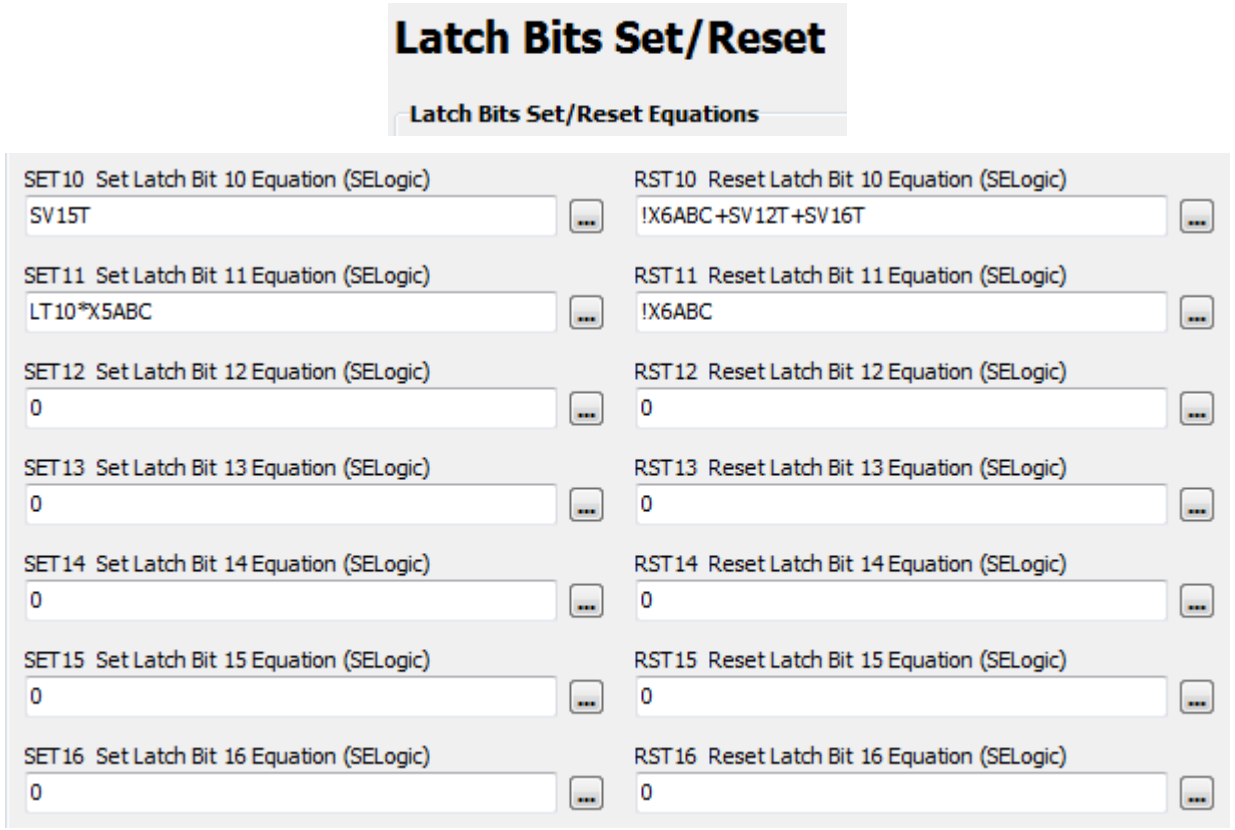
SEL 311 Settings Summary

- **SEL-311 RDB SV Variable Input Equation Settings:**



SEL 311 Settings Summary

- **SEL-311 RDB Latch Bit Settings:**



SEL 311 Settings Summary

- **SEL-311 RDB Trip Equation Settings:**

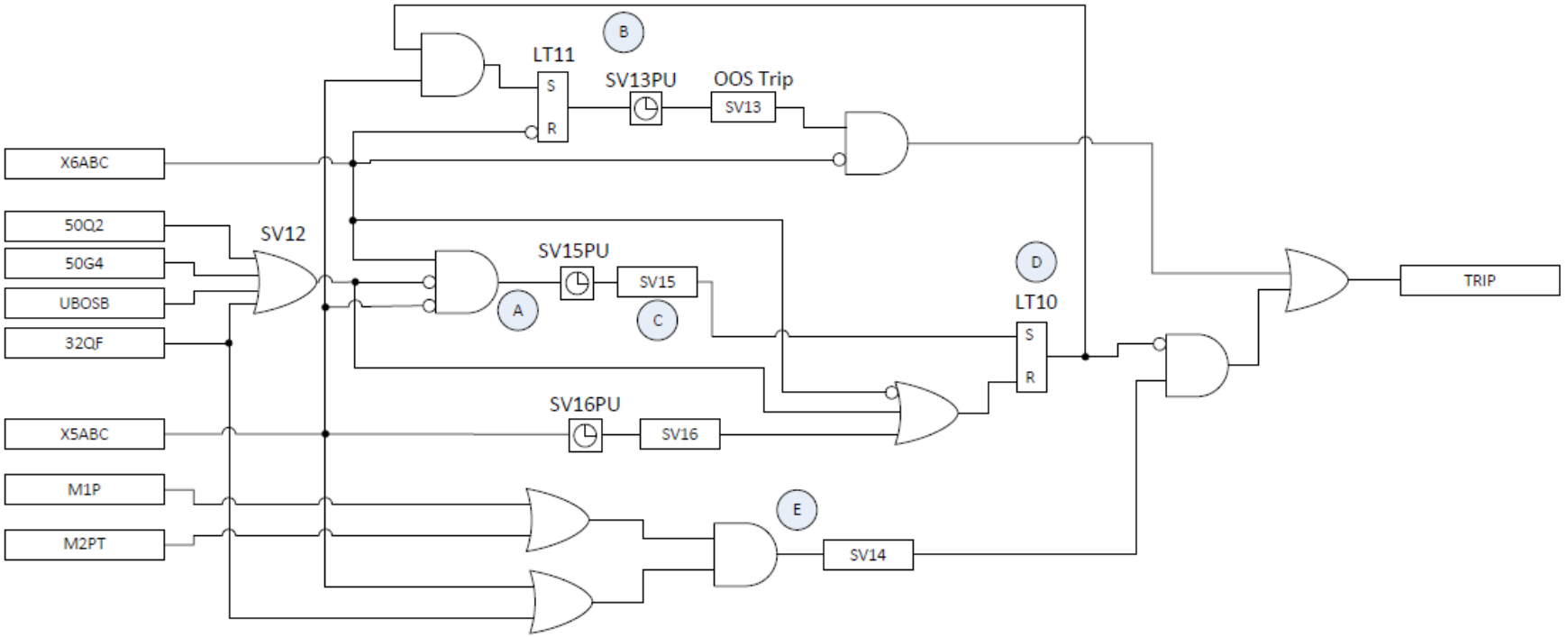
Trip/Communication-Assisted Trip Logic

Trip Logic Equations

TR Other Trip Conditions Equation (SELogic)
(SV14T*!LT10)+(SV13T*!X6ABC)+M4PT+Z1G+Z2GT+51GT+67P2T

TRQUAL Qualified Trip Equation (SELogic)
0

TRCOMM Communications-Assisted Trip Conditions Equation (SELogic)
0



Questions???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AGENDA 8

Misoperations

c. Project Updates

i. Instantaneous Ground Overcurrent

Jake Bernhagen, PRS Technical Liaison

Action
Information

Report
Jake Bernhagen will provide an overview during the meeting.

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AGENDA 9

MRO 2022 Regional Risk Assessment

John Seidel, Principal Technical Advisor

Action
Information

Report
John Seidel will provide an overview during the meeting.

MRO 2022 Regional Risk Assessment

Top risks to the reliable and secure operation of the North American bulk power system in MRO's regional footprint.

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Top Reliability Risks

Uncertainty of Winter Planning Reserve Margins

Analyses of recent system events indicate that actual system conditions can and have exceeded forecast winter reserve margins, particularly during cold weather conditions in the south central U.S.

Generation Availability During Severe Cold Weather

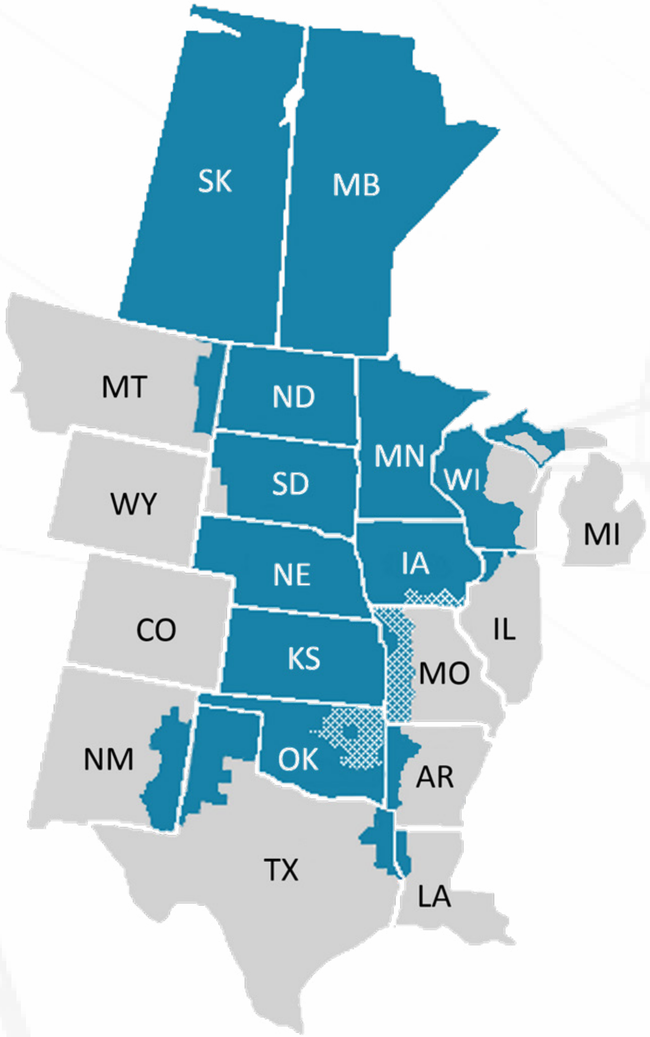
Generation availability assumed during cold weather in the southern U.S. has been shown to be unrealistically high due to a lack of generator winterization and natural gas curtailments.

Lack of Energy Assurance Assessments

The rapidly changing resource mix requires rethinking the way in which generating capacity, energy supply, and load serving needs are studied. Energy assurance will need to be accurately assessed for all hours of the year with increasing reliance on wind and solar as a fuel source.

Bulk Power System Modeling Accuracy

The rapid increase in inverter-based resources, along with the changing characteristics and magnitude of load related to distributed energy resources (DER), is challenging current bulk power models.



Top Security Risks

Supply Chain Compromise

The risk of a cybersecurity event carried out through the vendor supply chain and possibly impacting reliability of the bulk power system remains high.

Insider Threats

The threat of an employee or a contractor using authorized access, wittingly or unwittingly, to do harm to the security of the bulk power system has increased given remote connectivity during the pandemic.

Malware and/or Ransomware

Vulnerability to a malware and/or ransomware attack on the bulk power system continues to increase with modernization and the deployment of new technologies.

More information on these risks along with mitigation recommendations can be found in the full report here: www.mro.net

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AGENDA 10

Event Analysis Report

Jake Bernhagen, PRS Technical Liaison

Action
Information

Report
Jake Bernhagen will provide an overview during the meeting.

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AGENDA 11

2022 Dates

Greg Sessler, PRS Chair

Action

Information

Report

Chair Sessler will provide an overview during the meeting.

	Q1 2022	Q2 2022	Q3 2022	Q4 2022
RAC	4/6*	5/19	8/17	11/16
PRS	2/22	5/3	8/16	11/15
SAC	2/16	6/22*	10/5-10/6	11/9
SACTF	2/9	6/15	10/6	11/2
CMEPAC	2/15	6/7	9/21*	11/10
OGOC	4/6	6/22	9/21	11/30
BOD	4/7	6/23	9/22	12/1

*Joint with OGOC

MRO CONFERENCE DATES 2022	
Q1	**RAM/CIP Conference: March 23, 2022 *virtual**
Q2	**Reliability Conference: May 17-18, 2022 networking reception and conference Kansas City**
Q3	**CMEP: July 25-26, 2022 networking reception and conference**
Q4	**Security Conference: October 4-6, 2022 SAC meeting, training, networking and conference**

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AGENDA 12

PRS Roundtable Discussion

Greg Sessler, PRS Chair

Action
Discussion

Report
Chair Sessler will lead this discussion during the meeting.

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AGENDA 13

Other Business and Adjourn

Greg Sessler, PRS Chair

Action
Discussion

Report
Chair Sessler will lead the discussion during the meeting.

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AGENDA 14

Closed Session

Greg Sessler, PRS Chair

Action
Discussion

Report
Chair Sessler will lead the discussion during the closed session.