MIDWEST RELIABILITY ORGANIZATION

Meeting Agenda

Protective Relay Subgroup (PRS)

June 27, 2023
9:00 am to 3:00 pm central

MRO Corporate Offices, King Conference Center
St. Paul, MN & Webex

Classification: Public

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.**

Classification: Public

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.**

MRO PROTECTIVE RELAY SUBGROUP Q2 MEETING AGENDA

Agenda Item

1 Call to Order and Determination of Quorum
Ryan Einer, PRS Chair
a. Determination of Quorum and Introductions
b. Robert's Rules of Order

2 Standards of Conduct and Antitrust Guidelines
Jake Bernhagen, Manager of Reliability Performance, MRO

3 Safety Briefing
Jake Bernhagen, Manager of Reliability Performance, MRO

4 Chair's Remarks
Ryan Einer, PRS Chair

5 Consent Agenda
Ryan Einer, PRS Chair
a. Approve March 14, 2023 meeting minutes

6 NERC Activities
Jake Bernhagen, Manager of Reliability Performance, MRO
a. Update on NERC SPCWG
Lynn Schroeder, System Protection Engineer, Sunflower Electric Power Corporation
b. NERC MIDASUG Update
Jake Bernhagen, Manager of Reliability Performance, MRO
c. TADS
John Grimm, Principal Systems Protection Engineer, MRO

7 PRS Business
Jake Bernhagen, Manager of Reliability Performance, MRO
a. Updates
b. Action Item List Review
Ryan Einer, PRS Chair

8 2023 Meeting Dates
Ryan Einer, PRS Chair

Break – 10:00 a.m.

9 Commissioning Lessons Learned – Xcel Energy
Les Wolf, Manager, Substation Commissioning Engineering, Xcel Energy

10 Relay Automation Demo
Kasey Borboa, Engineering Manager, Minnkota Power Cooperative

11 Misoperations
Jake Bernhagen, Manager of Reliability Performance, MRO
a. 2023 Update, Review and Discussion
b. Review NERC Lessons Learned
c. 2023 ERO Misoperation Workshop Update

Lunch 12:00 p.m.

12 PRS Member Roundtable
Ryan Einer, PRS Chair

13 Q1 2023 Misoperations Review
Jake Bernhagen, Manager of Reliability Performance, MRO

a. Breakout Sessions

14 Other Business and Adjourn
Ryan Einer, PRS Chair

AGENDA

Call to Order and Determination of Quorum

a. Determination of Quorum

Ryan Einer, Protective Relay Subgroup Chair

Name	Role	Company	Term
Adam Daters	Member	ITC Holdings	12/31/24
Alex Bosgoed	Member	Saskatchewan Power Corporation	12/31/25
Casey Malskeit	Member	Omaha Public Power District	12/31/25
Cody Remboldt	Member	Montana-Dakota Utilities	12/31/24
David Weir	Member	Western Area Power Administration	12/31/25
David Wheeler	Member	Southwestern Public Services Co.	12/31/23
Dennis Lu	**Vice Chair**	Manitoba Hydro	12/31/23
Derrick Schlangen	Member	Great River Energy	12/31/23
Glenn Bryson	Member	American Electric Power	12/31/24
Greg Hill	Member	Nebraska Public Power District	12/31/25
Greg Sessler	Member	American Transmission Company	12/31/23
Jeff Beasley	Member	Grand River Dam Authority	12/31/25
Josh Erdman	Member	Xcel Energy	12/31/24
Lynn Schroeder	Member	Sunflower Electric Power Corporation	12/31/25
Rochelle Trefry	Member	MidAmerican Energy Company	12/31/25
Ryan Einer	**Chair**	Oklahoma Gas & Electric	12/31/23
Sarah Marshall	Member	Alliant Energy	12/31/24
Scott Paramore	Member	Kansas City Board of Public Utilities	12/31/24
Terry Fett	Member	Central Iowa Power Cooperative	12/31/23

Classification: Public

AGENDA

Call to Order and Determination of Quorum

b. Robert's Rules of Order

Ryan Einer, Protective Relay Subgroup 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

Classification: Public

AGENDA

Standards of Conduct and Antitrust Guidelines
Jake Bernhagen, Manager of Reliability Performance, MRO

Standards of Conduct Reminder:

Standards of Conduct prohibit MRO staff, committee, subcommittee, 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.

Classification: Public

AGENDA

Safety Briefing
Jake Bernhagen, Manager of Reliability Performance, MRO

Action
Information

Report
Jake Bernhagen will lead this discussion during the meeting.

Classification: Public

AGENDA

Chair's Remarks
Ryan Einer, Protective Relay Subgroup Chair

Action
Information

Report
Chair Einer will lead this discussion during the meeting.

Classification: Public

AGENDA

Consent Agenda

a. Approve March 14, 2023 meeting minutes

Ryan Einer, Protective Relay Subgroup Chair

Action

Discussion

Report

Chair Einer will lead this discussion during the meeting.

Classification: Public

MIDWEST RELIABILITY ORGANIZATION

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

Draft Minutes of the Protective Relay Subgroup Meeting

Hybrid: St. Paul, MN and Webex

Tuesday, March 14, 2023, 9:00 a.m. to 3:24 p.m. Central

Notice for this meeting was electronically posted to the MRO website on February 14, 2023.
A final agenda, including advanced reading materials, was also posted on March 7, 2023.

1. **Call to Order and Determination of Quorum**

   Protective Relay Subgroup (PRS) Chair Ryan Einer called the meeting to order at 9:00 a.m. Einer welcomed everyone and roundtable introductions were made. Rebecca Schneider, Reliability Analysis Administrator, 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, MRO Manager of Reliability Performance, Jake Bernhagen highlighted MRO's Standards of Conduct, Conflict of Interest, and Antitrust Guidelines.

3. **Safety Briefing**

   Bernhagen gave a safety briefing for in-person attendees which included information regarding emergency exits, evacuation procedures, and the location of the automated external defibrillator (AED).

4. **Chair's Remarks**

   Chair Einer introduced himself and Dennis Lu as this year's PRS chair/vice chair and thanked the previous chair/vice chair for their service and expressed appreciation for their leadership.

5. **New Members' Welcome Presentation**

   Bernhagen provided an overview of the welcome presentation for new members. Bernhagen discussed his new role at MRO and expressed appreciation to the PRS members. Bernhagen also reviewed key PRS responsibilities, the meeting structure including closed sessions, MRO's reimbursement policy for travel costs, and future meeting dates. Bernhagen discussed webinars and potential PRS member participation.

6. **Consent Agenda**

   The PRS reviewed the consent agenda, which included minutes from the December 6, 2022 meeting.

   Upon a motion duly made and seconded, the PRS approved the consent agenda in its entirety.

7. **NERC Activities**

   Update on NERC System Protection and Control Working Group (SPCWG).

   Lynn Schroeder, MRO representative on the NERC SPCWG, provided an update. Schroeder noted the position paper related to FERC Order 881 is in final draft and scheduled for approval in April. The SPCWG is developing a technical reference document to provide industry guidance for impacts of

systems such as 61850 architectures on NERC Protection System definition and related standards. The group is looking for members to help research and write the document. The SPCWG is also reviewing and updating two white papers. The PRC-019 Implementation Guidance has been posted for industry. The next meeting is April 12-13, 2023 in Charlotte, NC.

NERC Misoperation Information Data Analysis System User Group (MIDASUG) Update.

Bernhagen provided an update from the MIDASUG meeting on February 7, 2023. There was discussion around amisoperation impact metric that NERC has been developing with the regions to supplement the misoperation ratio metric. The group also discussed removing the "seconds" field from misoperations reporting times. Bernhagen noted a discussion around potential Section 1600 changes (added fields) related to quantifying misoperations impact. The last item mentioned was MIDAS (virtual) training that would take place in the fall.

Transmission Availability Data System (TADS).

Bernhagen noted challenges with TADS reporting in 2022, and that MRO Principal Systems Protection Engineer, John Grimm, has been working through the reporting issues with the entities.

8. PRS Business

Updates.

Bernhagen noted that a new PRS liaison should be in place by the next meeting in June 2023.

Charter Review

Schneider provided a brief overview of the charter review process. PRS members reviewed the charter. Bernhagen solicited questions and/or feedback from the members. Receiving none, the charter will be submitted to the Reliability Advisory Council (RAC) for approval.

Action Item List Review.

Chair Einer reviewed the action item list and updates were made accordingly. Bernhagen noted volunteer needs and requested members contact him if interested. An action item was added to review the NERC SPCWG white papers with a target date of Q2 2023.

9. 2023 Meeting Dates

Chair Einer reviewed the proposed 2023 meeting dates for the PRS and the other councils and subgroups.

10. Misoperations Measures

Jack Norris, Electrical Engineer, NERC, provided an oral report during the meeting.

Norris explained that the misoperations rate metric was intended to be a simple calculation that provides an aggregate performance measure for NERC and the regions to measure the performance of the grid. Norris shared concerns with the drawbacks of the misoperation rate metric and the purpose of a new metric that takes into account the impact of a misoperation on the bulk electric system. He discussed additional methods of evaluation to refine calculations to better reflect nuances. NERC performed a regional comparison of the current measures. NERC decided to focus on four factors: voltage class, equipment type, cause, and category. Norris explained the factors involved in

impact calculation. NERC used some factors from each regional score – continue to alter based on feedback. Norris shared observations and considerations for the MIDAS User Group.

Bernhagen asked when score will be first used, Norris explained they are hoping to use in State of Reliability Report. Discussion ensued.

11. FERC Order 881 Update and Discussion

Rich Bauer, Associate Principal Engineer, NERC, provided an oral report during the meeting.

Bauer lead a discussion on how FERC Order 881 relates to PRC-023. Bauer recapped the history of the 2003 blackout and how PRC-023 came out of Technical Initiative 8 of Appendix D of the U.S.-Canada PSOTF Final Report on the August 14th, 2003 Blackout. Bauer reviewed the main relay requirements in the PRC-023 Standard. Bauer discussed the impact FERC Order 881 has on entities who do not have seasonal ratings. FERC Order 881 requires Ambient-Adjusted transmission line ratings (AARs) determined at least hourly. These ratings are used for near-term transmission service (10 days to real time). Seasonal line ratings must be calculated using at least four seasons, calculated annually. Emergency ratings must also include AAR calculations.

The purpose of the PRC-023 Standard was to allow for temporary overloads. What is the impact of FERC Order 881A on PRC-023? What is the highest seasonal facility rating? FERC intimated that to be compliant with PRC-023, the settings have to meet the highest anticipated hourly ambient adjusted rating (AAR). The SPCWG is working on a position paper to address this question. A sample of the methodology showed that some entities may see a 20 percent increase in loadability in their transmission line ratings. Discussion ensued.

12. MRO Regional Risk Assessment (RRA)

MRO Principal Technical Advisor, Mark Tiemeier, provided an overview of the 2023 Regional Risk Assessment (RRA).

Tiemeier reviewed the process in developing the Regional Risk Assessment (RRA) and explained the purpose of the report. Tiemeier noted that 17 identified risks were identified in this year's report. Some of the overarching themes included rapid changes in technology, changing resource mix, evolving consumer demand, challenges in forecasting, and the impact of extreme weather. Tiemeier focused on the risks pertaining to protection systems for this meeting. There was discussion around the tightening labor supply and challenges related to hiring and retaining protection engineers. Discussion ensued.

13. Commissioning Lessons Learned – Grand River Dam Authority

Manager, Protection and Control Engineering, Grand River Dam Authority (GRDA) and PRS member, Jeff Beasley, provided an oral report during the meeting. Beasley discussed two specific relay events from January 2023. Beasley shared the changes that were made as a result of the lessons learned and noted the need to improve quality assurance (QA). Beasley invited questions and discussion. Discussion ensued.

Misoperations

2022 Update, Review and Discussion

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

Bernhagen provided an overview of the 2022 misoperations data. There was a marked increase in the number of overall operations compared to the previous year. MRO had 281 misoperations in 2022 with an 8.7 percent misoperation rate, higher than the ERO average. Incorrect settings was the highest cause, followed by relay failures/malfunctions. Bernhagen was concerned with the 125 misoperations categorized as unknown/unexplainable.

2023 ERO Misoperation Workshop Discussion

Bernhagen discussed a potential misoperation workshop in 2023. NERC is kicking off an initiative to host a two-day misoperation workshop. Potential areas of focus for the workshop will likely be misoperations related to human error and incorrect settings. NERC is targeting September as the timeframe for the workshop, and the location has not been determined. Bernhagen noted that PRS members may be contacted as potential presenters. Discussion ensued.

Review NERC Lessons Learned

Bernhagen encouraged entities who have air blast breakers in their system to read the lessons learned published on December 15, 2022.

14. Q4 2022 Misoperations Review

Breakout Sessions

The PRS members reviewed the fourth quarter 2022 misoperations in breakout sessions both in-person and via Webex. Discussion ensued.

15. PRS Roundtable Discussion

Chair Einer invited member participants to share other relevant industry observations. Topics discussed included, breaker failure timer settings.

16. Other Business and Adjourn

Having no further business to discuss, the meeting was adjourned at 3:24 p.m.

Prepared by: Rebecca Schneider, Reliability Analysis Administrator
Reviewed and Submitted by: Jake Bernhagen, Manager of Reliability Performance

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

Exhibit A – Meeting Attendees

Subgroup Members Present	
Name	**Company**
Ryan Einer, Chair	Oklahoma Gas & Electric
Dennis Lu, Vice Chair	Manitoba Hydro
Adam Daters	ITC Holdings
Alex Bosgoed	Saskatchewan Power Corporation
Casey Malskeit	Omaha Public Power District
Cody Remboldt	Montana-Dakota Utilities
David Weir	Western Area Power Administration
Derrick Schlangen	Great River Energy
Greg Hill	Nebraska Public Power District
Greg Sessler	American Transmission Company
Jeff Beasley	Grand River Dam Authority
Josh Erdman	Xcel Energy
Lynn Schroeder	Sunflower Electric Power Corporation
Rochelle Trefry	MidAmerican Energy Company
Sarah Marshall	Alliant Energy
MRO Staff Present	
Name	**Title**
Jake Bernhagen	Senior Protection Systems Engineer
Rebecca Schneider	Reliability Analysis Administrator
Margaret Eastman	Security Administrator
John Grimm	Principal Systems Protection Engineer
Mark Tiemeier	Principal Technical Advisor

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

Other Attendees	
Name	**Company**
Jack Norris	NERC
Rich Bauer	NERC
Dylan Underwood	Southwestern Power Administration
Allan Bekkala	Minnesota Power
Gayan Wijeweera	Manitoba Hydro
Toby Johnson	Otter Tail Power Company
Terry Volkmann	Glencoe Light and Power
Elsammani Ahmed	ITC Midwest
Tyler Mitchell	Otter Tail Power Company
Craig Talbot	Minnesota Power
Tyler Baxter	Corn Belt Power Cooperative
Matt Wyatt	Liberty Utilities
Moeed Shamim	Saskatchewan Power Corporation
Kasey Borboa	Minnkota Power Cooperative
David Oswald	Liberty Utilities
Mark Gutzmann	Xcel Energy
Lauren Donati	Xcel Energy
Gabe Kainz	Otter Tail Power Company

AGENDA

NERC Activities

a. NERC SPCWG Update

Lynn Schroeder, Sunflower Electric Power Corporation and PRS Member

Action

Information

Report

Lynn Schroeder will provide an oral report during the meeting.

Classification: Public

AGENDA

NERC Activities

b. NERC MIDASUG Update

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Information

Report

Jake Bernhagen will provide an oral report during the meeting.

Classification: Public

AGENDA

NERC Activities

c. Transmission Availability Data System (TADS)

John Grimm, Principal Systems Protection Engineer, MRO

Action

Information

Report

John Grimm will provide an oral report during the meeting.

Classification: Public

AGENDA

PRS Business

a. Updates

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Information

Report

Jake Bernhagen will provide an oral report during the meeting.

Classification: Public

AGENDA

PRS Business

c. Action Item List Review

Ryan Einer, Protective Relay Subgroup Chair

Action

Discussion

Report

Chair Einer will lead this discussion during the meeting.

Classification: Public

AGENDA

2023 Meeting Dates

Ryan Einer, Protective Relay Subgroup Chair

Action

Information

Report

Chair Einer will provide an overview during the meeting.

	Q1 2023	Q2 2023	Q3 2023	Q4 2023
RAC	3/1	5/18	8/10	11/9
SAC	2/22	5/24	8/8	10/12
CMEPAC	2/21	5/31	8/9	10/19
PRS	3/14	6/27	9/6	12/5
OGOC	4/12	6/14	9/13	12/13
BOD	4/13	6/15	9/14	12/14

MRO CONFERENCE DATES 2023	
Q1	**RAM Conference: March 21-22, 2023 networking reception and conference (hybrid)**
Q2	**Reliability Conference: May 16-17, 2023 networking reception and conference (hybrid)**
Q3	**CMEP Conference: July 25-26, 2023 networking reception and conference (hybrid)**
Q4	**Security Conference: September 26-27, 2023 networking reception, training and conference (hybrid); Oklahoma City, OK**

Classification: Public

AGENDA

Commissioning Lessons Learned – Xcel Energy

Les Wolf, Manager, Substation Commissioning Engineering, Xcel Energy

Action

Information

Report

Les Wolf will provide an oral report during the meeting.

Classification: Public

MISOPERATIONS – COMMISSIONING LESSONS LEARNED

Les Wolf | Substation Commissioning Engineering

Shannon Bellinghausen | Substation Commissioning Engineering

June 27, 2023

AGENDA TOPICS

1. Lesson Learned
2. Relevant Best Practices

LESSONS LEARNED

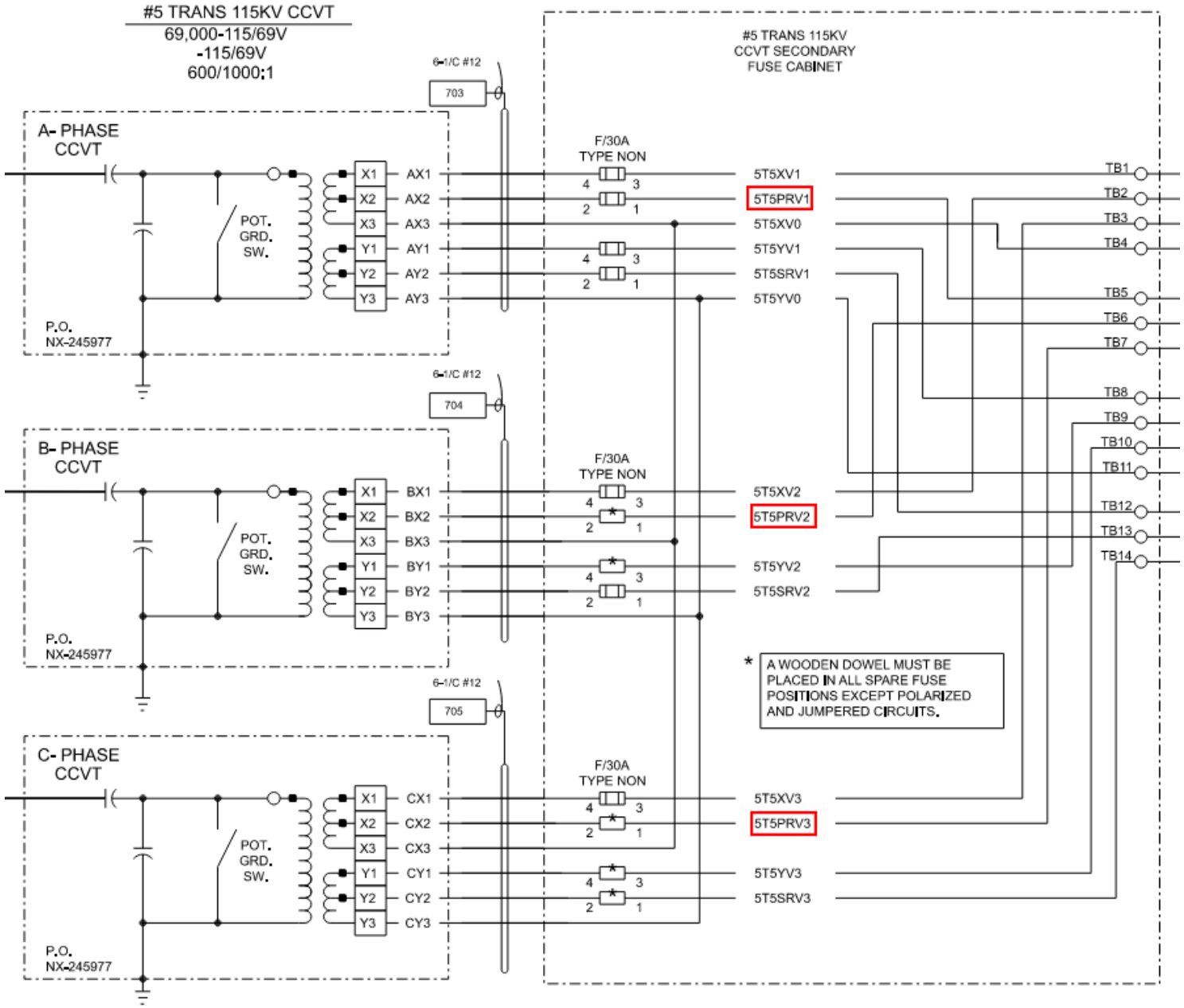
Misoperation – Prairie Substation

Event Description: January 2022, secondary transformer differential relay operated under a non-fault condition. GE-T60 operated on zone 1 when B and C phase voltages were ~20 kV and A phase was ~115 kV. When load on the transformer increased this condition looked like a phase-to-phase fault.

Cause of misoperation: Not having fuses installed in the CCVT secondary fuse cabinet for B and C phases which are the voltage inputs to the GE-T60.

Misoperation – Prairie Substation

- **Construction drawing shows wooden dowels in place. Dowels should have been removed and replaced with fuses.**
- **Previous protection scheme did not have distance elements and these voltages were not used.**
- **Was missed by design, construction, and commissioning of the new transformer differential relays.**



LESSONS LEARNED

Misoperation – Prairie Substation

How could this have been prevented? More focus on drawing review and thorough understanding of protection scheme changes during commissioning. Better process for load check verification.

What are we doing different? Shortly after this misoperation the load checking process was improved to make peer reviewing more robust. A dedicated email distribution list that the relay techs use solely for sending load check information was created. Load checks are sent to all protection engineers and all commissioning engineers. At minimum, one engineer from each department is required to review each load check.

LESSONS LEARNED

Misoperation – South Substation

Event Description: July 2021, 69 kV line tripped for a fault on a tapped substation feeder. Feeder protection should have operated first.

Cause of misoperation: Incorrect PT ratio setting in the 21P relay. PT ratio was set to 350:1 when the correct ratio was 600:1. This resulted in the line relay to overreach and operate for feeder faults at the tapped substation.

How could this have been prevented? More thorough review of relay settings by relay tech and commissioning engineer. Better process for load check verification.

What are we doing different? Additional emphasis on peer checking relay settings; created the following requirements: Relay technician send as-left relay settings to protection engineer. Protection engineer reviews and does setting compare before equipment can be placed into service.

This is one of the events that helped identify the need to improve the load check process.

Xcel Energy®

LESSONS LEARNED

Misoperation – HOPI / North Loving

Event Description: March 2018, 115 kV line current differential scheme operated under normal conditions. Line was in service several months before trip occurred.

Cause of misoperation: Incorrect CT circuit connection design. North Loving system phasing is ABC, Hopi system phasing is BCA. HOPI 411L relay was connected ABC causing a differential trip. Line was in service for several months before load increased enough to cause the 87L elements to operate.

How could this have been prevented? Low load initially, primary injection would have been a good option. More thorough load checking, like using the MET DIF command to compare what each relay is seeing. Peer review of load check information.

LESSONS LEARNED

Misoperation – Crossroads Substation

Event Description: February 2021, 345 kV capacitor bank #2 tripped offline due to a voltage differential condition detected by a SEL-487V.

Cause of misoperation: Loading resistors were missing from secondary circuit, which allowed the secondary voltage to enter a ferroresonance condition. This condition caused the 487V relay to operate.

How could this have been prevented? Visually inspect fuse cabinet to ensure loading resistors were installed in the PT circuit. Relay technician, wireman, and commissioning engineer could have identified missing resistors.

What are we doing different? Capacitor commissioning checklist was updated to ensure the proper resistors are installed.

BEST PRACTICES

Things that have worked well.

- **Load check process –** load checks are the last chance to identify a problem before it turns into a misoperation. Give this important commission process a lot of attention.
- **CT circuit comparison/verification –** check for consistency across M&R diagram, wiring externals, and relay settings. Visually check and confirm CT wiring on terminal blocks. This step in the commissioning process has proven itself to be very valuable.
- **Primary current injection –** CT circuits that cannot be proven with sufficient load can be verified with primary injection in many cases.
- **Protection settings review/compare –** as-left setting to be thoroughly reviewed and peer checked for correctness. During installation and testing protective device settings can get altered. Verification that settings are correct before in-servicing is critical.

Xcel Energy®

AGENDA

Relay Automation Demo
Kasey Borboa, Engineering Manager, Minnkota Power Cooperative

Action
Information

Report
Kasey Borboa will provide a live demonstration during the meeting.

Classification: Public

AGENDA

Misoperations

a. 2023 Update, Review and Discussion

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Information

Report

Jake Bernhagen will provide an oral report during the meeting.

Classification: Public

MIDWEST RELIABILITY ORGANIZATION

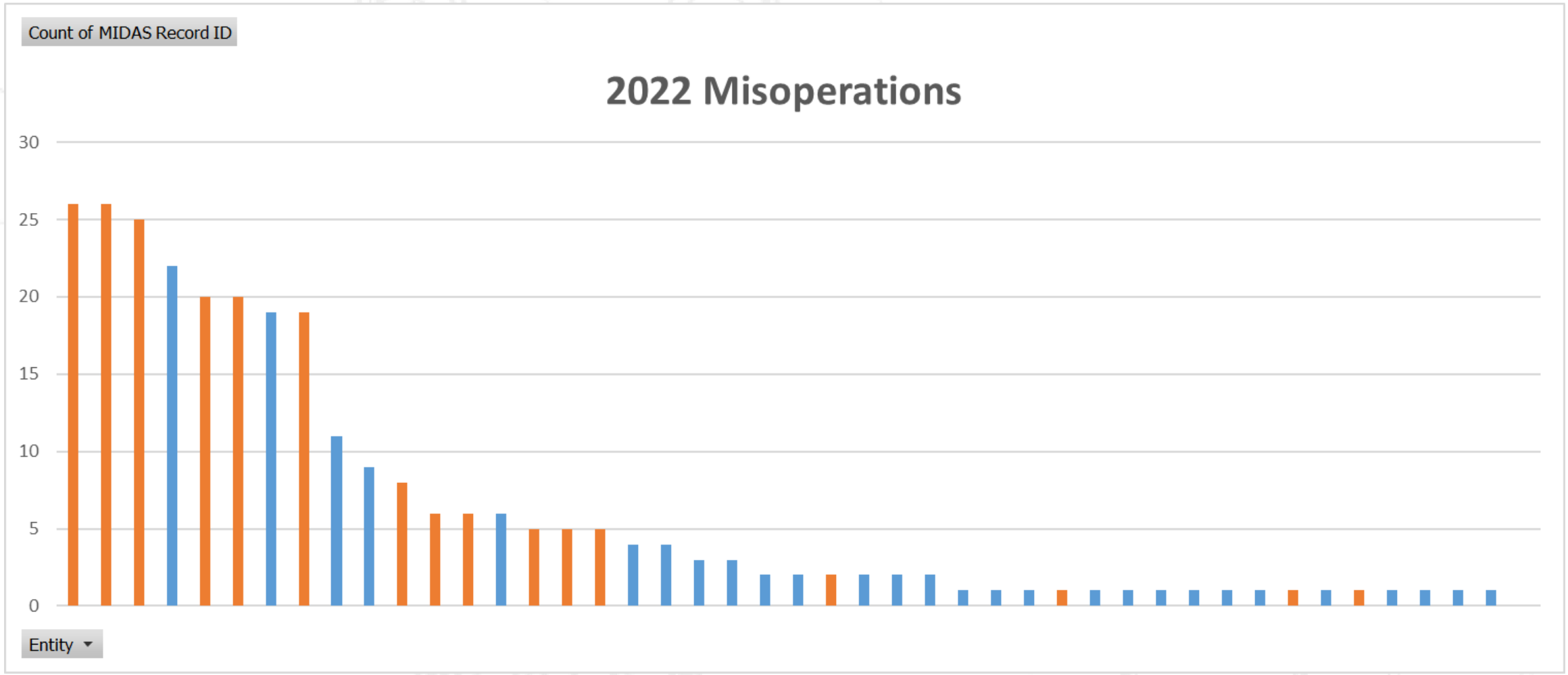
Q1 2023 PRS Misoperations Presentation

Jake Bernhagen, P.E.

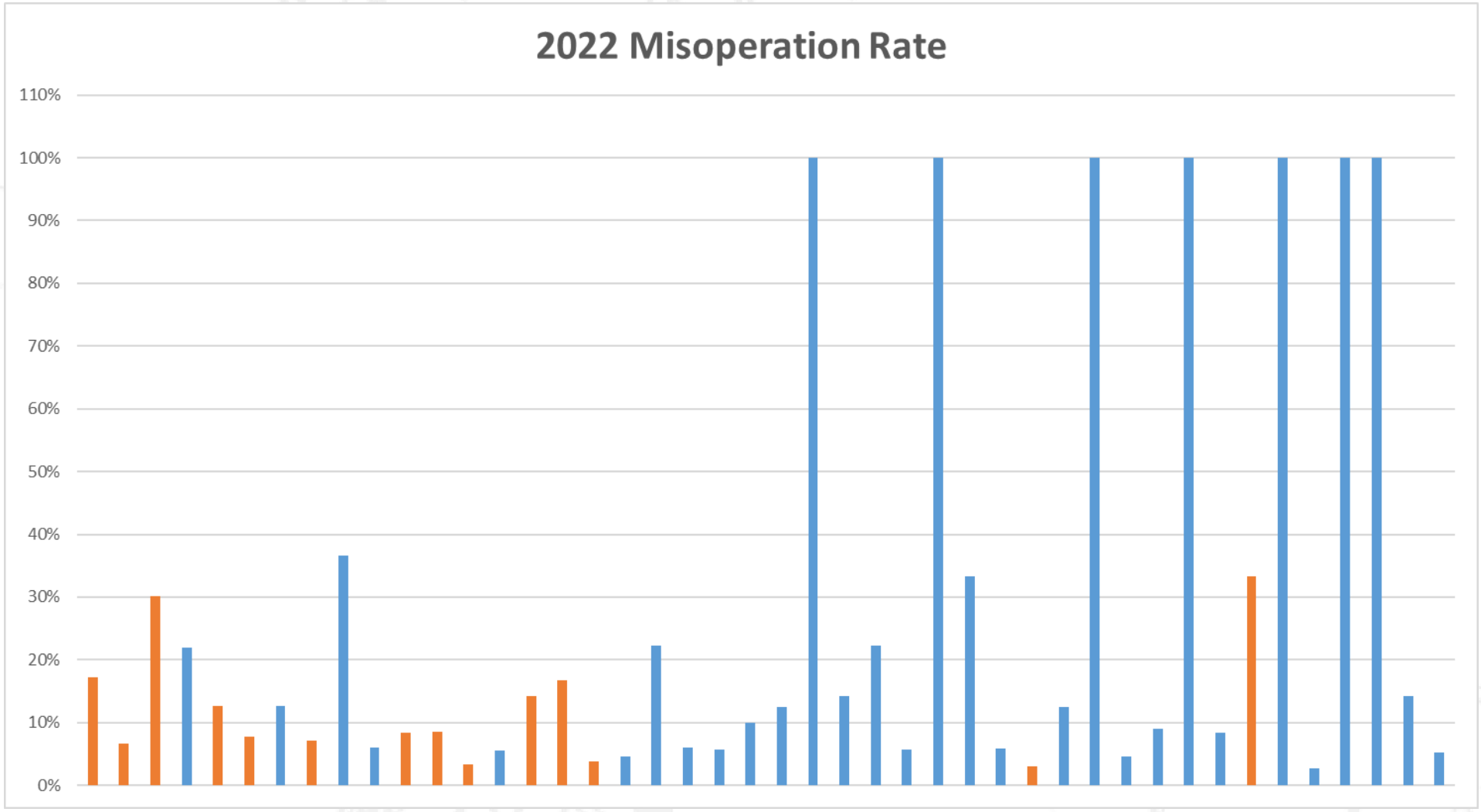
Manager, Reliability Performance

Midwest Reliability Organization

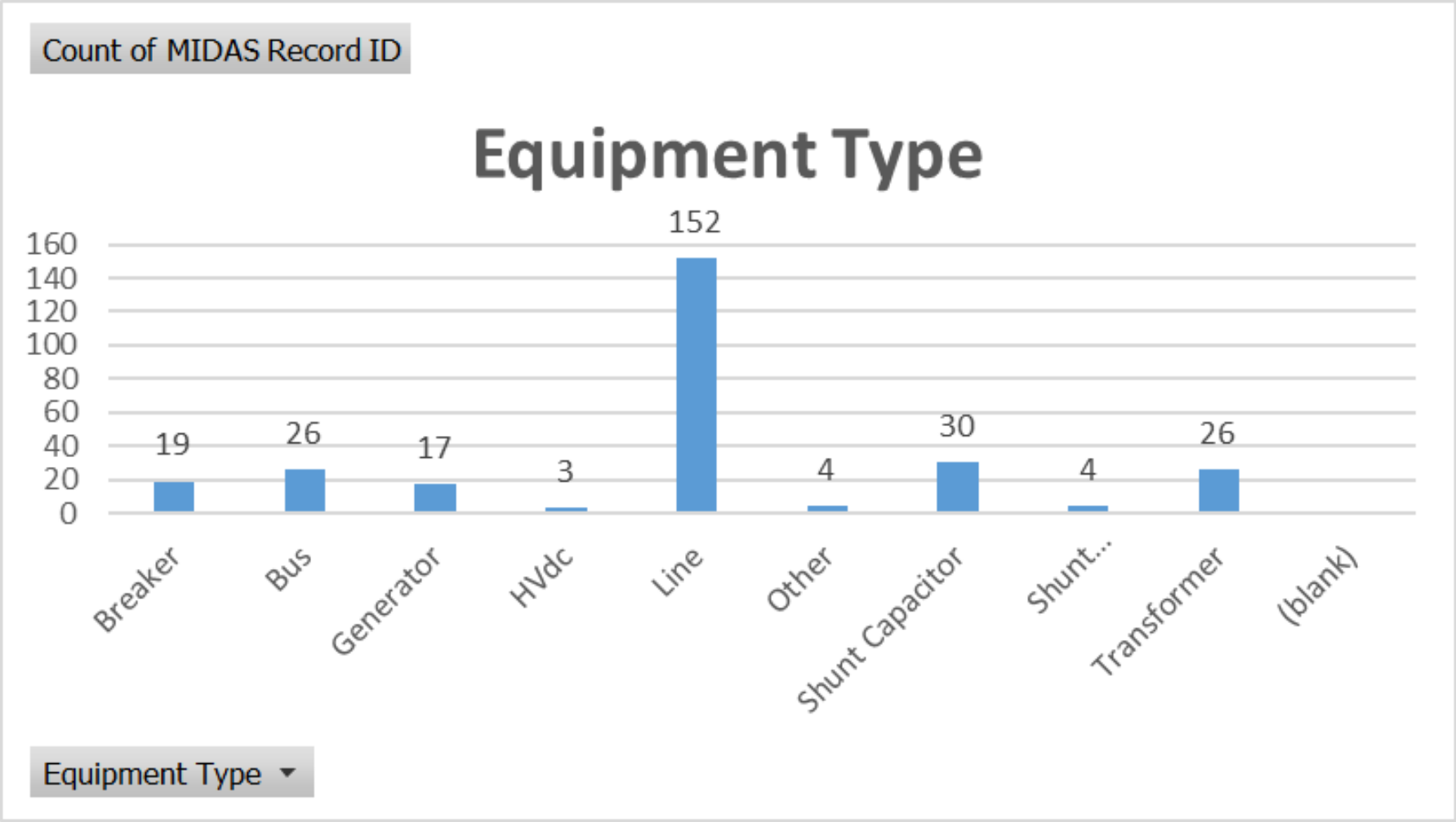
2022 Misoperations Summary



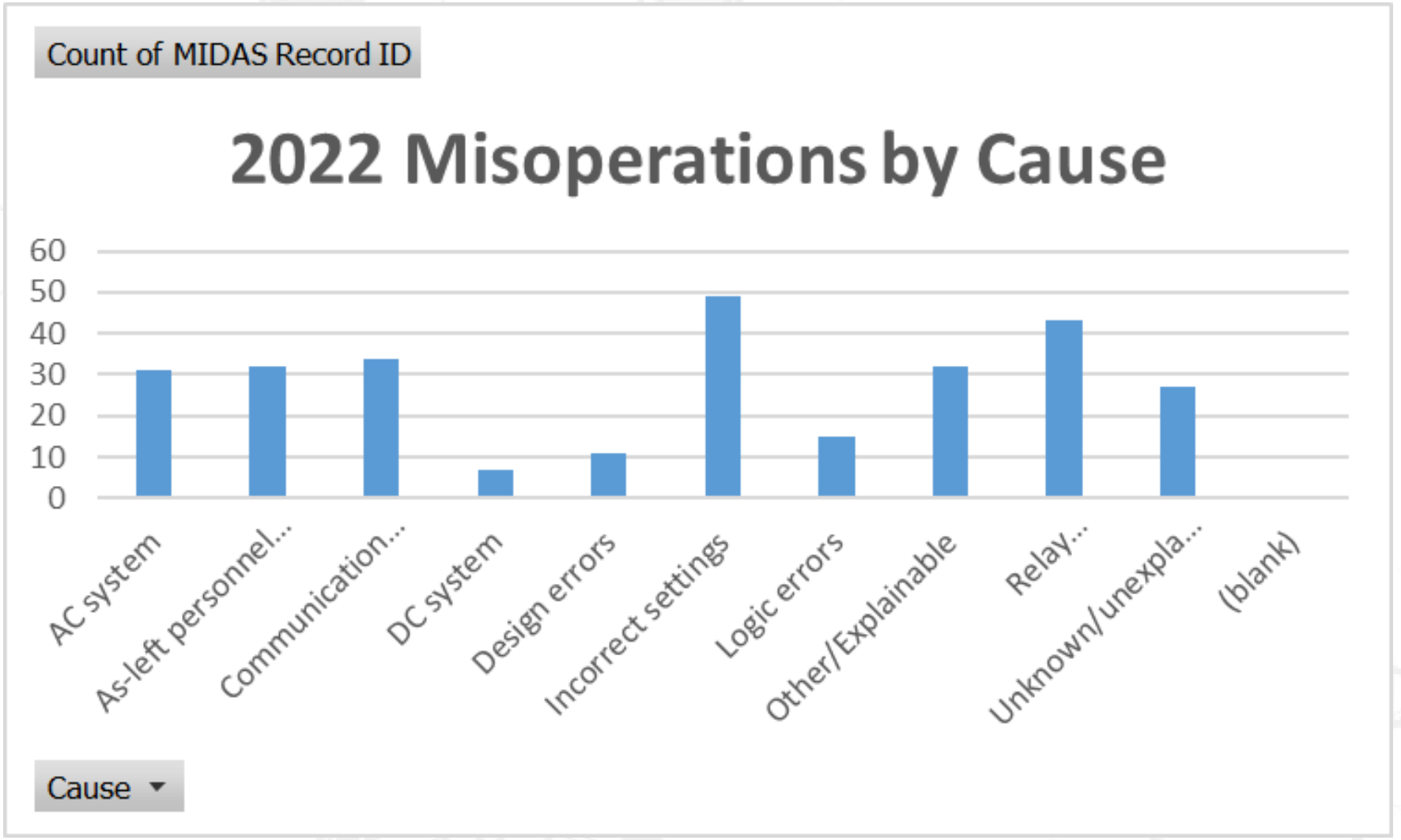
2022 Misoperations Summary



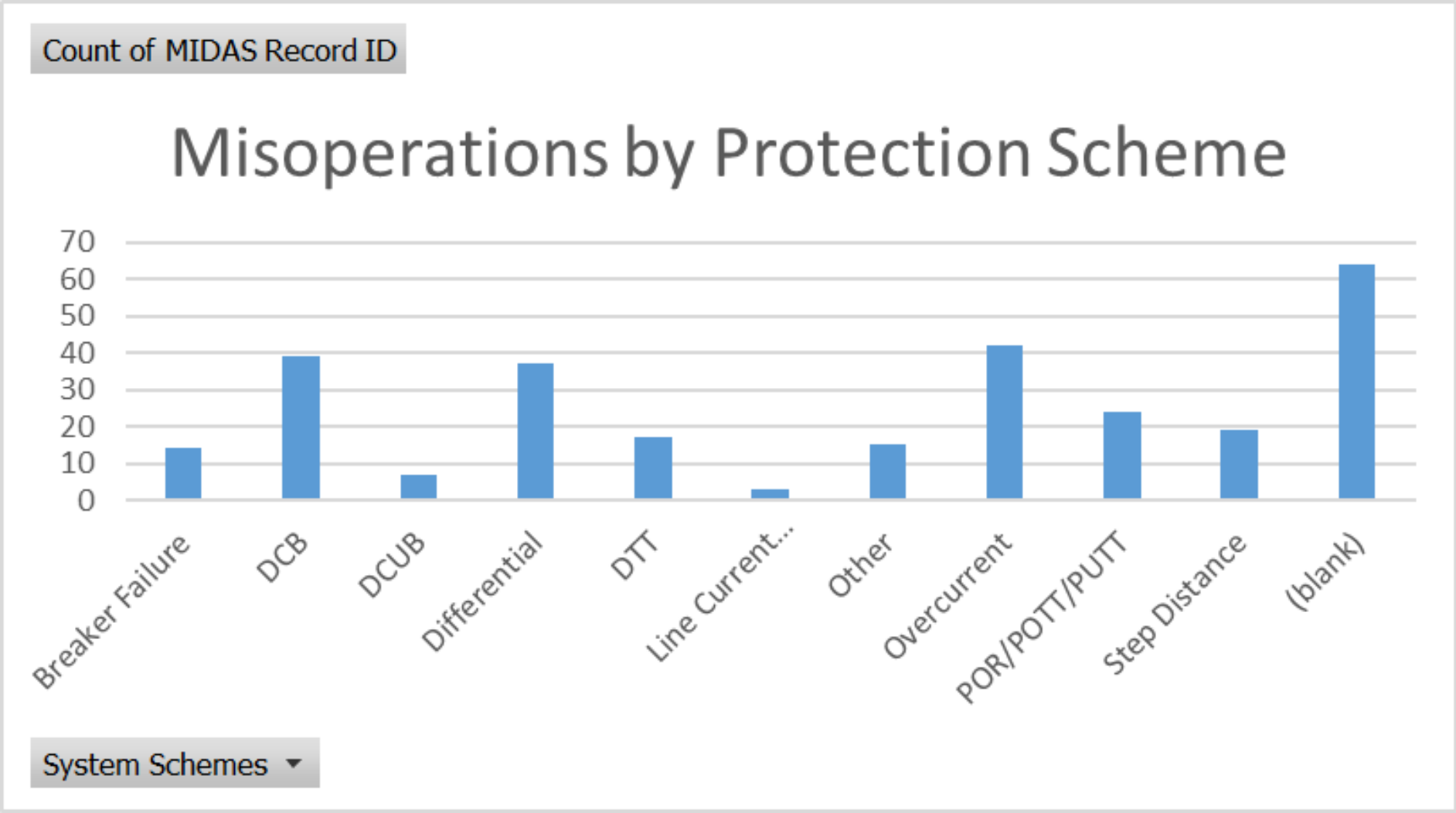
2022 Misoperations Summary



2022 Misoperations Summary



2022 Misoperations Summary



Questions?

AGENDA

Misoperations

b. Review NERC Lessons Learned

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Discussion

Report

Jake Bernhagen will lead the discussion during the meeting.

Classification: Public

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Lesson Learned

Combustion Turbine Anti-Icing Control Strategy

Primary Interest Groups
Generator Owner (GO)
Generator Operators (GOP)

Problem Statement
Unexpected icing due to intermittent interference from outside sources may present operating challenges.

Details
After an entity's investigation of an icing-over of a combustion turbine air inlet, it was determined that there were several situations where the original equipment manufacturer's (OEM) anti-icing logic did not detect all potential icing conditions as currently designed. This investigation was performed in consultation with the OEM's engineering department and included independent research from the entity's power plant users group. In a few instances, unexpected icing occurred where combustion turbine air inlets were subject to intermittent interference from outside sources of warm and moist air streams, such as when located near surface water bodies (rivers, lakes, oceans) or near artificial sources that emit warm, saturated air streams (such as cooling tower plumes, exhaust stack plumes, blowdown tank vents, flash tank vents, etc.). Although these outside sources are somewhat intermittent and unpredictable, they can occasionally impact the combustion turbine inlet air, depending on wind speed and direction, wind gust intensity, and plant equipment orientation. Due to the intermittent nature of these occurrences, the anti-icing instrumentation did not consistently detect these instances and icing in the inlet ductwork occurred.

Corrective Actions
As a result of these occurrences, the entity instituted a more aggressive combustion turbine anti-icing strategy to prevent a reoccurrence. In addition to using the existing OEM anti-icing software package, the entity's solution proactively opens the inlet bleed heat valve to a minimum value of 10% whenever ambient temperatures drop below 45°F, ensuring a baseline level of heating is added to the combustion turbine inlet air at all times during cold weather operation. This minimum value was recommended through consultation with the OEM's engineering department along with in-service testing on the combustion turbines. To date, this approach has proven effective and has prevented a reoccurrence of the issue.

Lesson Learned
Ensure that manual corrective actions are proactively taken when unexpected icing may occur due to intermittent interference from outside sources of warm, moist air streams from rivers, lakes, or oceans or near artificial sources that emit warm, saturated air streams, such as cooling tower plumes, exhaust stack

plumes, blowdown tank vents, or flash tank vents. Also see NERC Lesson Learned LL20120903 "Winter Storm Inlet Air Duct Icing."[1]

Click here for: Lesson Learned Comment Form

For more Information please contact:

NERC – Lessons Learned (via email)

Lesson Learned #:	LL20230401
Date Published:	April 19, 2023
Category:	Generation Facilities

This document is designed to convey lessons learned from NERC's various activities. It is not intended to establish new requirements under NERC's Reliability Standards or to modify the requirements in any existing Reliability Standards. Compliance will continue to be determined based on language in the NERC Reliability Standards as they may be amended from time to time. Implementation of this lesson learned is not a substitute for compliance with requirements in NERC's Reliability Standards.

[1] https://www.nerc.com/pa/rrm/ea/Lessons%20Learned%20Document%20Library/LL20120903_Winter_Storm_Inlet_Air_Duct_Icing.pdf

AGENDA

Misoperations

c. 2023 ERO Misoperation Workshop Update

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Discussion

Report

Jake Bernhagen will lead the discussion during the meeting.

Classification: Public

AGENDA

PRS Roundtable Discussion
Ryan Einer, Protective Relay Subgroup Chair

Action
Discussion

Report
Chair Einer will lead this discussion during the meeting.

Classification: Public

AGENDA

Q1 2023 Misoperations Review

a. Breakout Sessions

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Discussion

Report

Jake Bernhagen will lead the discussion during the meeting.

Classification: Public

AGENDA

Other Business and Adjourn

Ryan Einer, Protective Relay Subgroup Chair

Action

Discussion

Report

Chair Einer will lead this discussion during the meeting.

Classification: Public