Meeting Agenda

Protective Relay Subgroup (PRS)

Tuesday, June 11, 2024
9:00 a.m. to 3:00 p.m. Central

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

MIDWEST RELIABILITY ORGANIZATION

380 St. Peter St, Suite 800
Saint Paul, MN 55102
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www.MRO.net

Public

MRO PROTECTIVE RELAY SUBGROUP MEETING AGENDA

Agenda Item	
1	**Call to Order and Determination of Quorum** *Dennis Lu, PRS Chair*
2	**Standards of Conduct and Antitrust Guidelines** *Jake Bernhagen, Manager of Reliability Performance, MRO*
3	**Safety Briefing** *Shawn Keller, Outreach Coordinator, MRO*
4	**Chair's Remarks** *Dennis Lu, PRS Chair*
5	**Consent Agenda** *Dennis Lu, PRS Chair*
6	**NERC Activities** a. NERC SPCWG Update *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	**NERC Announcement: Request for Comments | SPCWG White Paper and Technical Reference Document** *Jake Bernhagen, Manager of Reliability Performance, MRO*
8	**PRS Business** *Jake Bernhagen, Manager of Reliability Performance, MRO*
9	**Action Item List Review** *Dennis Lu, PRS Chair*
10	**2024 Meeting Dates** *Dennis Lu, PRS Chair*
Break – 10:00 a.m.	
11	**Technical Presentation – Manitoba Hydro Misoperations** *Dennis Lu, Principal System Protection Engineer, Manitoba Hydro and PRS Chair*
12	**Technical Presentation – MidAmerican Energy Company** *Rochelle Trefry, Principal Engineer System Protection, MidAmerican Energy Company*
13	**Misoperations** *Jake Bernhagen, Manager of Reliability Performance, MRO* Q2 2024 Update, Review and Discussion
Lunch – 12:00 p.m.	
14	**Q2 2024 Misoperations Review – Breakout Sessions** *Jake Bernhagen, Manager of Reliability Performance, MRO*
15	**PRS Member Roundtable** *Dennis Lu, PRS Chair*

Agenda Item	
16	**Other Business and Adjourn** *Dennis Lu, PRS Chair*

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. Regularly attend meetings of the group(s) on which the member serves.
2. Competently prepare for, and be an active participant in, the meetings for the group(s) on which the member serves.
3. Collaborate with other organizational group members in support of the mission, vision, and strategic initiatives of MRO.
4. Support the Highly Effective Reliability Organization (HERO™) principles.

Call to Order and Determination of Quorum

Dennis Lu, Protective Relay Subgroup Chair

A current roster for the Protective Relay Subgroup is posted on MRO's public website here.

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 participant's 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.

Safety Briefing Video

Shawn Keller, Outreach Coordinator, MRO

Action

Information

Report

A short video highlighting in-person meeting safety logistics will be played at the meeting.

Chair's Remarks

Dennis Lu, Protective Relay Subgroup Chair

Action

Information

Report

Chair Lu will provide an oral report during the meeting.

Consent Agenda

Dennis Lu, Protective Relay Subgroup Chair

Action

Approve the consent agenda.

Report

The consent agenda includes draft minutes from the meeting held on March 12, 2024. The meeting minutes as written start on the next page.

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Draft Minutes of the Protective Relay Subgroup Meeting

Hybrid: St. Paul, MN and Webex

Tuesday, March 12, 2024, 9:02 a.m. to 3:03 p.m. Central

Notice for this meeting was electronically posted to the MRO website on February 13, 2024.
A final agenda, including advanced reading materials, was also posted on March 5, 2024.

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

   Protective Relay Subgroup (PRS) Chair Dennis Lu called the meeting to order at 9:02 a.m. Chair Lu 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 Principal Systems Protection Engineer, John Grimm, highlighted MRO's Standards of Conduct, Conflict of Interest, and Antitrust Guidelines.

3. **Safety Briefing**

   MRO Outreach Coordinator, Shawn Keller, presented a safety video illustrating the steps to take if various emergency situations are encountered onsite at MRO.

4. **Chair's Remarks**

   Chair Lu recognized PRS member and Vice Chair, Ryan Einer for his leadership role as Chair in 2023. He also thanked former member, Jeff Beasley for his service. Chair Lu welcomed the four new PRS members: Dylan Underwood, Nathan Gulczynski, Ryan Bissett and Tyler Porter. Chair Lu noted that John Grimm joined today's meeting as the PRS liaison in place of Jake Bernhagen.

5. **New Members' Welcome Presentation**

   Reliability Analysis Administrator, Rebecca Schneider, provided an overview of the new members' welcome presentation. The new members were invited to introduce themselves to the subgroup.

6. **Consent Agenda**

   The PRS reviewed the consent agenda, which included minutes from the December 6, 2023, 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 and PRS member, provided an update. Schroeder outlined the process for drafting and approval and noted that members of the small group drafting team do not need to be members of the SPCWG. The SPCWG reports to the Reliability and Security Technical Committee (RSTC) who gives final approval before posting for industry.

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Current projects include a whitepaper on footnote 13 of TPL001, a PRC024 IBR Whitepaper, a Technical Reference related to maintenance for ethernet based P&C, and a Technical Reference for "Transmission System Phase Backup Protection". The "Determination of Practical Transmission Relaying Loadability Settings" Implementation Guide is pending RSTC final approval.

Schroeder stated concerns with entities having coordination issues related to FERC Order 881 and relay settings. Discussion ensued.

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

MRO Manager of Reliability Performance, Jake Bernhagen was absent, and no NERC MIDASUG update was provided at this meeting.

Transmission Availability Data System (TADS).

Grimm shared a NERC Load Loss presentation and a questionnaire which he instructed the PRS members to distribute to the individuals in their organizations responsible for reporting TADS data.

8. PRS Business

Updates.

Grimm highlighted a position paper on FERC Order 881 and a recent NERC Lesson Learned published on March 4, 2024, entitled "Protective Relay Solid-State Output Contact Voltage Leakage."

Action Item List Review.

Chair Lu reviewed the action item list and updates were made accordingly.

9. 2024 Meeting Dates

Chair Lu reviewed the proposed 2024 meeting dates for the PRS and the other councils and subgroups.

MRO Director of Reliability Analysis, Bryan Clark, discussed PRS activities that tie into the Reliability Advisory Council (RAC) Work Plan and MRO Regional Risk Assessment (RRA). Clark encouraged the PRS to consider expanding the quarterly technical presentations into an outreach effort, such as a webinar. Clark invited the subgroup members to attend the MRO Annual Reliability Conference scheduled for May 15, 2024.

10. Technical Presentation

OG&E Misoperations

Ryan Einer, OG&E and PRS Vice Chair, gave a presentation on a high-speed directional element misoperation OG&E experienced in August 2020. The misoperation occurred on a reverse fault on a backup relay. OG&E and the manufacturer worked together to analyze the data and determine the issue causing the relay to trip. OG&E discovered that some of their relay models required a firmware upgrade to correct the issue. They are in the process of deploying firmware updates across their entire system. Einer stressed the importance of partnering with manufacturers to leverage their support when trying to identify a root cause and develop a corrective action plan. Discussion ensued.

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To accommodate scheduling conflicts, Chair Lu moved the Misoperations (Agenda Item 12) ahead on the agenda. These minutes reflect the order in which the reports were provided.

11. Misoperations

2023 Update, Review and Discussion

Grimm provided a summary of MRO's 2023 misoperations data. MRO's misoperations rate (8.43%) decreased slightly in 2023 compared to the previous year. In fourth quarter 2023 the number of misoperations during a fault (14) was at the lowest level in the last five years. Grimm noted that human error related misoperations continue to be an issue. There was discussion around the NERC Misoperation Impact Score developed by the ERO and MIDAS User Group to estimate the impact of a misoperation on the Bulk Electric System (BES).

12. Setting Development and Commissioning Best Practices – ATC

Greg Sessler, System Protection Team Leader, American Transmission Company (ATC), and Kevin Demeny, Senior Commissioning Engineer, ATC, gave a presentation on commissioning best practices and ATC's relay setting process and controls. Sessler described the electronic relay setting process tool called Cherwell. Peer review is completed for all changes in the setting process. Additionally, the protection specialist performs setting verification before the relay goes into service. ATC utilizes a relay setting database that can integrate with other databases in the organization.

Demeny gave an overview of ATC's commissioning best practices. The best practices highlighted included human performance tools used in the field, yellow lined schematics for contactors, weekly safety calls with construction, vegetation management and commissioning. Demeny noted that good catches and near misses are tracked by commissioning contractors and submitted quarterly. Discussion ensued.

Grimm highlighted a recent lesson learned pertinent to the PRS and demonstrated how to navigate to the lesson learned section on NERC's website.

To accommodate scheduling conflicts, Chair Lu moved the PRS Roundtable Discussion (Agenda Item 14) ahead on the agenda. These minutes reflect the order in which the reports were provided.

13. PRS Roundtable Discussion

Chair Lu invited member participants to share other relevant industry observations. No roundtable topics were shared.

14. Q4 2023 Misoperations Review

Breakout Sessions

The PRS members reviewed the fourth quarter 2023 misoperations in breakout sessions both in-person and via Webex. Discussion ensued.

15. Other Business and Adjourn

The PRS members reviewed the current PRS Charter, and no changes were recommended. Having no further business to discuss, the meeting was adjourned at 3:03 p.m.

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Prepared by: Rebecca Schneider, Reliability Analysis Administrator
Reviewed and submitted by: John Grimm, Principal Systems Protection Engineer

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Exhibit A – Meeting Attendees

PRS Members Present	
Name	**Company**
Dennis Lu, Chair	Manitoba Hydro
Ryan Einer, Vice Chair	Oklahoma Gas & Electric
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
Dylan Underwood	Southwestern Power Administration
Glenn Bryson	American Electric Power
Greg Hill	Nebraska Public Power District
Josh Erdman	Xcel Energy
Lynn Schroeder	Sunflower Electric Power Corporation
Nathan Gulczynski	American Transmission Company
Rochelle Trefry	MidAmerican Energy Company
Ryan Bissett	Central Iowa Power Cooperative
Sarah Marshall	Alliant Energy
Scott Paramore	Kansas City Board of Public Utilities
Tyler Porter	Great River Energy
MRO Staff Present	
Name	**Title**
John Grimm	Principal Systems Protection Engineer
Rebecca Schneider	Reliability Analysis Administrator
Shawn Keller	Outreach Coordinator

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Bryan Clark	Director of Reliability Analysis
Eric Graftaas	Principal Power Systems Engineer
Sarah Wernette	Senior Systems Protection Engineer
Mark Tiemeier	Principal Technical Advisor
Max Desruisseaux	Principal Power Systems Engineer
Kristine Albrecht	Human Resources Generalist
Anna Martinson	RAM and External Affairs Administrator
Other Attendees	
Name	**Company**
Kevin Demeny	American Transmission Company
Greg Sessler	American Transmission Company
Allen Halling	Evergy
Catherine Jacobs	MidAmerican Energy Company
Elsammani Ahmed	ITC Midwest
Juan Placid	J J Power & Energy Inc.
Michael Grexa	Oglethorpe Power Corporation
Ricardo Rodriguez	City of Ames
Sonja Myers	CERTREC
Stephen Farnsworth	Basin Electric Power Cooperative
Tommy Shea	McPherson Board of Public Utilities

NERC Activities

Lynn Schroeder, Sunflower Electric Power Corporation
Jake Bernhagen, Midwest Reliability Organization
John Grimm, Midwest Reliability Organization

Action

Information

Report

- NERC System Protection and Control Working Group (SPCWG) – *Lynn Schroeder*
- NERC Misoperation Information Data Analysis System User Group (MIDASUG) – *Jake Bernhagen*
- Transmission Availability Data System (TADS) – *John Grimm*

NERC Announcement: Request for Comments | SPCWG White Paper and Technical Reference Document

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Information

Report

Jake Bernhagen will lead this discussion during the meeting.

PRS Business Updates

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Information

Report

- Joint PRS meeting with WECC's Relay Working Group (RWG) on Oct. 3, 2024
- Special nominations meeting via Webex (September 2024)
- Eastern Interconnection Reliability Assessment Group (ERAG) Short Circuit Spreadsheet – sent on behalf of Bryan Clark on April 18, 2024

Action Item List Review

Dennis Lu, Protective Relay Subgroup Chair

Action

Discussion

Report

Chair Lu will lead this discussion during the meeting.

2024 Meeting Dates

Dennis Lu, Protective Relay Subgroup Chair

Action

Information

Report

Future meeting dates are listed below.

2024 PRS Meeting Dates

- October 3, 2024 – Joint Meeting with WECC RWG (Salt Lake City, UT)
- December 10, 2024 – Q4 PRS Meeting (Hybrid)

2024 MRO Conference Dates

- July 23-24, 2024 – CMEP Conference (Kansas City, MO)
- October 1-2, 2024 – Security Conference (St. Paul, MN)

Technical Presentation – Manitoba Hydro Misoperations

Dennis Lu, Manitoba Hydro and PRS Chair

Action

Information

Report

Chair Lu will provide an oral report during the meeting.

Technical Presentation – MidAmerican Energy Company

Rochelle Trefry, MidAmerican Energy Company and PRS Member

Action

Information

Report

Rochelle Trefry will provide an oral report during the meeting.

SEL-411L C37.118 Channel Alarm Logic

Rochelle Trefry, Principal Engineer System Protection

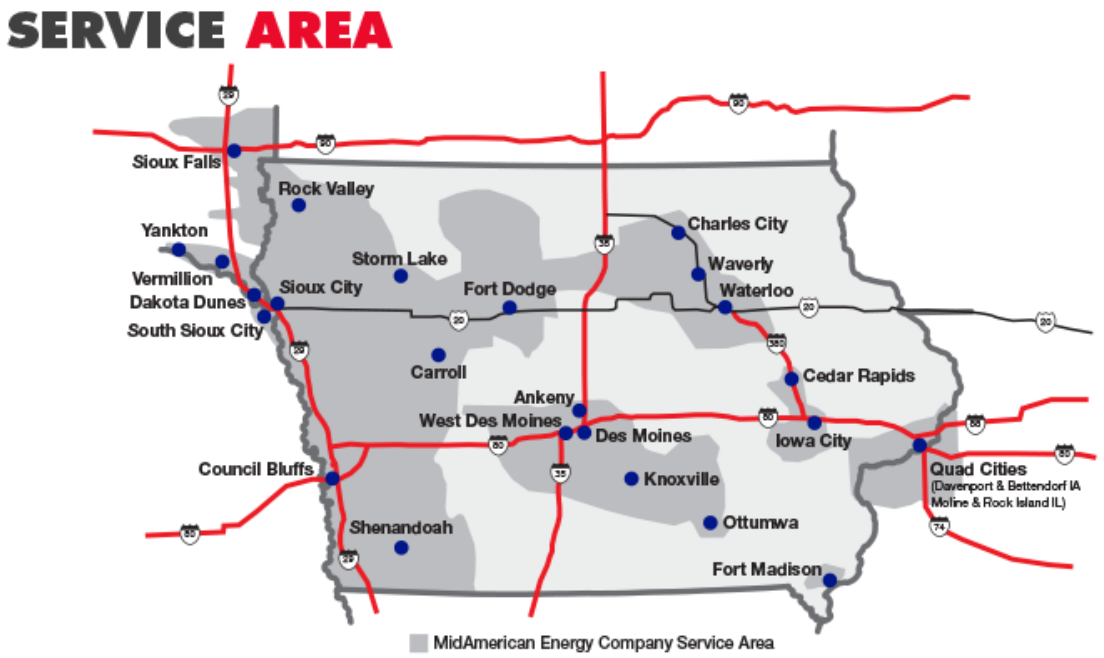
June 11, 2024

MIDAMERICAN ENERGY COMPANY®

MidAmerican Energy Company Overview

- MidAmerican Energy provides electric and natural gas service in Iowa, Illinois and South Dakota, and natural gas service in Nebraska

- MidAmerican owns and operates over 6,000 miles of electric transmission lines and over 500 substations across Iowa and neighboring states



Standard line panel – SEL-411L Relays

- Dual SEL-411L Relays - standard for all line terminals
- Line current differential used whenever possible
- Required for short lines (physically short or electrically short)

SEL-411L 87L over C37.94 and MPLS

- Potential for asymmetry over Multiprotocol Label Switching (MPLS)
- Connect an external IRIG-B time source from a BNC connection
- C37.118-2005 IRIG-BXX0 includes additional control bits
  - Time quality, year, leap seconds, DST, UTC time offset, parity

NOTE: When setting 87CHpSN = T, you must provide an IRIG-B time source capable of accurately reporting IRIG-B time quality. It is a best practice to provide an IRIG-B signal to the BNC IRIG-B input of the relay directly from the clock or IRIG-B source, and to only connect the IRIG-B input of the relay to the clock or IRIG-B source. Do not use an intermediary device such as an RTU, PLC, communications processor, or port server to distribute time for this application.

NOTE: To use external time-based mode using IRIG for the data synchronization, the GPS clock must be C37.118 compliant, and the SEL-411L global setting IRIGC must be set to C37.118. If PTP is used as the external time-based source, the Port 5 setting PTPPRO must be set to C37.238.

Time Sources and Settings

MEC Standards

7.3.2 IRIG-B

The SEL-2407 can provide modulated and/or unmodulated IRIG-B outputs. This standard specifies the unmodulated output for all time sources to the RTU and protective relays if required. The unmodulated IRIG-B timecode is IRIG-B00X. The last digit, either 2 or 0, indicates what output codes will be sent to the end devices. This standard specifies the 0 code which supplies all IEEE C37.118-2005 extensions. This BCD time code consists of HH,MM,SS,DDD plus straight binary seconds of the day, control function codes such as year, leap second, daylight-savings time, UTC time offset, time quality and parity.

7.3.6 Time Source for Line Protection Relays

For SEL-411L relaying utilizing C37.94 line differential, a direct BNC coaxial cable utilizing IEEE C37.118 (B000) from the SEL-2407 to the SEL-411L is recommended by SEL. SEL-411L relaying will set the "HIRIG" bit when an optimal time source has been obtained from the GPS clock. See SEL-411L manual details below in figure 2:

Default Channel Alarm Logic

SEL-411L Relay Manual

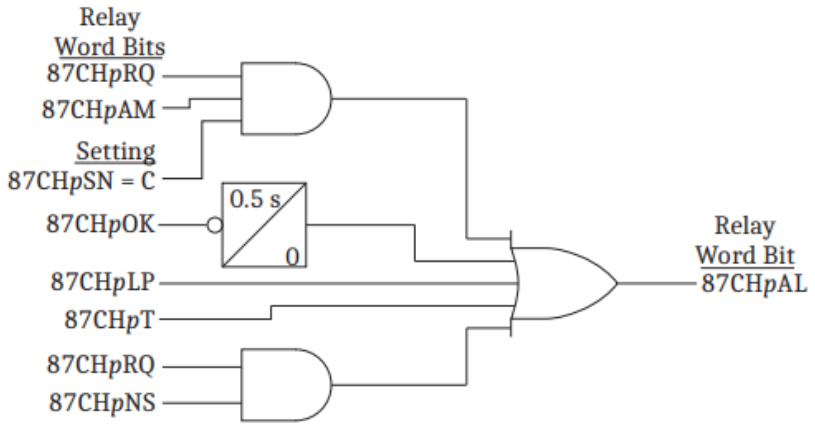


Figure 7.12 Default Channel Alarm Logic

The relay declares an alarm state for a channel if any one of the following is true (see *Figure 7.12*).

- The channel is not OK for half a second (channel drop out).
- The lost packet alarm is asserted.
- The channel round-trip alarm is asserted.
- Channel asymmetry is exceeded while the channel is required.
- The channel is required for the 87L function, but it cannot be synchronized in terms of aligning the current data.

- Asymmetry Logic is only active for Channel Based Data Sync (87CHpSN = C)

SEL-411L 87 Channel Monitoring Settings

C37.94 over MPLS

Channel n Timing Source	87T1MCn = E
Time Based Data Sync	87CHnSN = T
Max Round Trip Delay for Ch n (ms)	87CHnMT = 15.0
Max Step Change in Ch n (ms)	87CHnMD = 3.0
Max Allowable Asym. for Ch n (ms)	87CHnMA = 4.0
Ch n Lost Packet Alarm Threshold	87CHnPCH = 262

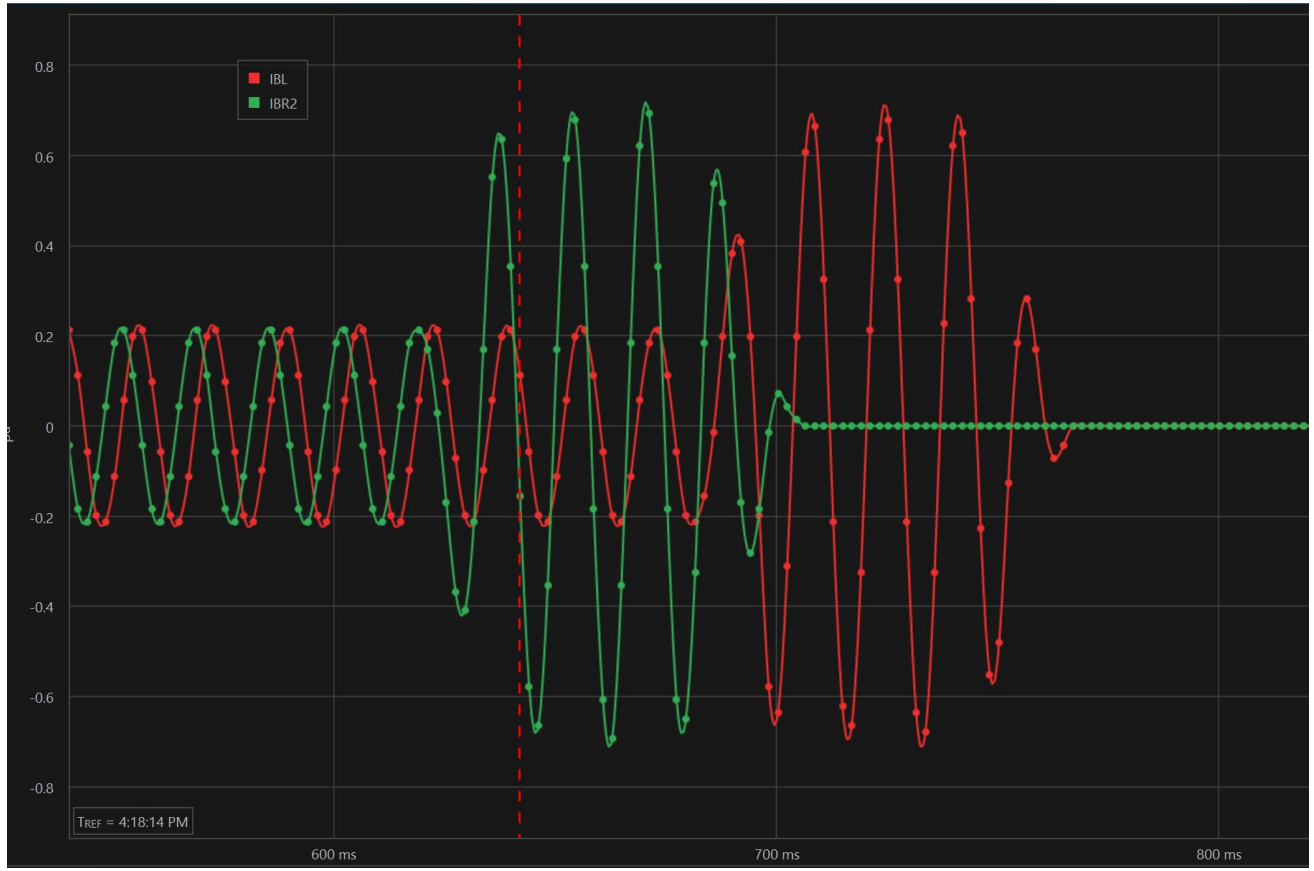
What happens if you don't have a C37.118 time signal?

Table E.4 Four-Bit IRIG-B Time Quality (TQ) Code–IRIG-B Bits 71-74

Binary	Hex	Value
1111	F	Time not traceable to UTC
1011	B	Time within 10 seconds of UTC
1010	A	Time within 1 second of UTC
1001	9	Time within 100 ms of UTC
1000	8	Time within 10 ms of UTC
0111	7	Time within 1 ms of UTC
0110	6	Time within 100 µs of UTC
0101	5	Time within 10 µs of UTC
0100	4	Time within 1 µs of UTC
0011	3	Time within 100 ns of UTC
0010	2	Time within 10 ns of UTC
0001	1	Time within 1 ns of UTC
0000	0	Clock is locked

- If the SEL-411L relay is expecting a C37.118 time source but the clock is not set to output the control functions, the relay views the missing bits as 0000 and will consider the clock to be high accuracy.
- Bad antenna connection and incorrect clock settings may not be detected.

External Fault 87L Trip



- Local: Antenna had a bad connection to SEL-2407 and improper clock settings
- Remote: Good Antenna connection, incorrect SEL-2407 clock settings, correct time based on DFR records

- Relay did not properly sync time and tripped on differential for an external fault

SEL-411L Event Report

05_20_200016_18_14_642_80C -11STRIP.HDR - Notepad

File Edit Format View Help

```
                                        Date: 05/20/2000  Time: 16:18:14.642
                  1 SEL-411L            Serial Number: 1201620800

Event: TRIP             FLM: SE                              Time Source: HIRIG
TW Location: $$$$.$$(mi) Z-Based Location: $$$$.$$(SE)       From: LOCAL
Event Number: 10263     Shot 1P: 0   Shot 3P: 0        Freq: 59.99     Group: 1
Targets: INST B_PHASE C_PHASE 87L 50PICUP
Breaker 1: OPEN         Trip Time: 16:18:14.642
Breaker 2: OPEN         Trip Time: 16:18:14.642

PreFault:     IA     IB     IC     IG    3I2       VA       VB       VC    V1mem
MAG(A/kV)    298    310    303     20     41   93.425   93.691   93.654   93.590
ANG(DEG)  -173.5   64.6  -60.1 -126.3  -39.7      0.0   -120.1    119.8     -0.1

Fault:
MAG(A/kV)    439   1010    651     42   1305   91.157   69.664   73.145   77.273
ANG(DEG)  -176.8   21.6 -145.1 -142.0  -89.9     -2.6   -130.9    128.6     -1.5

                87 Differential Currents
PreFault:     IA     IB     IC     IQ     IG
MAG(pu)     0.22   0.23   0.22   0.03   0.02
ANG(DEG)  -129.5  108.2  -16.9    1.3  -83.6

Fault:
MAG(pu)     0.28   0.63   0.48   0.66   0.03
ANG(DEG)  -121.9   98.2  -59.3   -4.6  -75.4
```

- Date and Time are not correct (actual: 5/21/2023 16:18:14.681)
- Event report shows the Time Source: HIRIG (high-accuracy IRIG)
- Comm alarms (87CHnAL) asserted on a few occasions, ranging from < 1 minute to ~30 minutes

SEL-411L Com 87L Reports

Date: 05/25/2023 Time: 10:13:55.926

87L APPLICATION STATUS

2SS - Two terminals with single serial channel

MASTER

MEDIUM/PROTOCOL	Configuration	Status
Serial Channel 2	850nm C37.94 Fiber	OK
Synchronization	External-time-based	High precision
Time Fallback	Mode 4	OK

TIME SOURCE	Local Status	Remote Status
	Locked	Locked

STATISTICS	Channel 2
Channel Status	OK
Channel Role	In use
Receive Status	OK
Synch Config	Ext-time-based
Synch Status	Ext-time-based
Synch Accuracy	High precision
Time Status	Locked
High Lost Packet Count	OK
High Latency	OK
High Asymmetry	--
Round-Trip Delay (ms)	10.1
Transmit Delay (ms)	0.0
Receive Delay (ms)	46.4
Asymmetry (ms)	46.35
Lost Packet Count 40s	0
Lost Packet Count 24hr	0

HISTOGRAMS

Channel Round-Trip Delay (last 24 hours)

Delay (ms)	Channel 2 (%)
0 - 2	0.0
2 - 4	0.0
4 - 6	0.0
6 - 8	0.0
8 - 10	0.0
10 - 12	100.0
12 - 15	0.0
15 - 20	0.0
20 - 30	0.0
30+	0.0

Channel Asymmetry (last 24 hours)

Asymm (ms)	Channel 2 (%)
0.00 - 0.25	0.00
0.25 - 0.50	0.00
0.50 - 0.75	0.00
0.75 - 1.00	0.00
1.00 - 1.50	0.00
1.50 - 2.00	0.00
2.00 - 3.00	0.00
3.00 - 4.00	0.00
4.00 - 5.00	0.00
5.00+	100.00

SEL-411L Com 87L Reports

```
                                Date: 05/24/2000  Time: 09:50:15.061
87L APPLICATION STATUS
                    2SS - Two terminals with single serial channel
                    ALARM ON CHANNEL 2

MEDIUM/PROTOCOL         Configuration             Status
Serial Channel 2        850nm C37.94 Fiber        --
Synchronization         External-time-based       NOT SYNCHRONIZED
Time Fallback           Mode 4                    OK

TIME SOURCE             Local Status              Remote Status
                        Locked                    --

STATISTICS              Channel 2
Channel Status          ALARM
Channel Role            FAILED
Receive Status          ALARM
Synch Config            Ext-time-based
Synch Status            --
Synch Accuracy          --
Time Status             --
High Lost Packet Count  ALARM
High Latency            --
High Asymmetry          --
Round-Trip Delay (ms)   --
Transmit Delay (ms)     --
Receive Delay (ms)      --
Asymmetry (ms)          --
Lost Packet Count 40s   9984
Lost Packet Count 24hr  409238
```

```
HISTOGRAMS
Channel Round-Trip Delay (last 24 hours)
Delay (ms)              Channel 2 (%)
0 - 2                     0.0
2 - 4                     0.0
4 - 6                     0.0
6 - 8                     0.0
8 - 10                    0.0
10 - 12                 100.0
12 - 15                   0.0
15 - 20                   0.0
20 - 30                   0.0
30+                       0.0

Channel Asymmetry (last 24 hours)
Asymm (ms)              Channel 2 (%)
0.00 - 0.25               0.00
0.25 - 0.50               0.00
0.50 - 0.75               0.00
0.75 - 1.00               0.00
1.00 - 1.50               0.00
1.50 - 2.00               0.00
2.00 - 3.00               0.00
3.00 - 4.00               0.00
4.00 - 5.00               0.00
5.00+                   100.00
```

SEL-411L Manual Time Quality Indications

The TIRIG and TSOK Relay Word bits should be asserted (logical 1), indicating that the relay is in the high-accuracy IRIG timekeeping mode (HIRIG).

If TSOK is not asserted, but TIRIG is asserted, the relay is in regular IRIG time-keeping mode. Following is a list of possible reasons for not entering HIRIG mode:

- The IRIG-B clock does not use the IEEE C37.118 control bit assignments, or the IRIG-B signal is not of sufficient accuracy.
- The termination resistor, required by some IRIG clocks, is not installed.
- The time-source clock is reporting that its time error is greater than 1 µs.

If neither TSOK nor TIRIG is asserted, the relay is not in an IRIG time-source mode. Following is a list of possible reasons for not entering IRIG mode:

- The IRIG-B clock signal is improperly configured.
- The termination resistor, required by some IRIG clocks, is not installed.

Lab Testing

IRIG Time Source Type (IRIG, IEEE*) **TSTYPE** :=
(Hidden and forced to IEEE if EPMIP > 0)

*(When TSTYPE := IEEE, the device requires IEEE C37.118 control bits to be sent from the IRIG clock. If TSTYPE is set to IEEE, but control bits are not included in the IRIG signal, then the Device Word bit TIRIG will continually toggle.)

- SEL-411L relay provided with a standard IRIG-B signal (without the control bits) will assert TIRIG and TSOK (Time Source OK)

The Time-Synchronization Relay Word bits in *Table 18.7* indicate the present status of the high-accuracy timekeeping function of the relay.

Table 18.7 Time-Synchronization Relay Word Bits

Name	Description
TIRIG	Asserts while relay time is based on IRIG-B time source.
PTP	Synchronized to a PTP source.
TPTP	The active relay time source is PTP.
TSOK	Time synchronization OK. Asserts while time is based on high-accuracy IRIG-B or PTP time source (HIRIG or HPTP mode) of sufficient accuracy for synchrophasor measurement.
PTPSYNC	Asserts while the relay is synchronized to a high-quality PTP time source.
PMDOK	Phasor measurement data OK. Asserts when the relay is enabled and synchrophasors are enabled (Global setting EPMU := Y).

- SEL-735 relay provided with a standard IRIG-B signal (without the control bits) will toggle TIRIG and does not assert TSOK (Time Source OK)

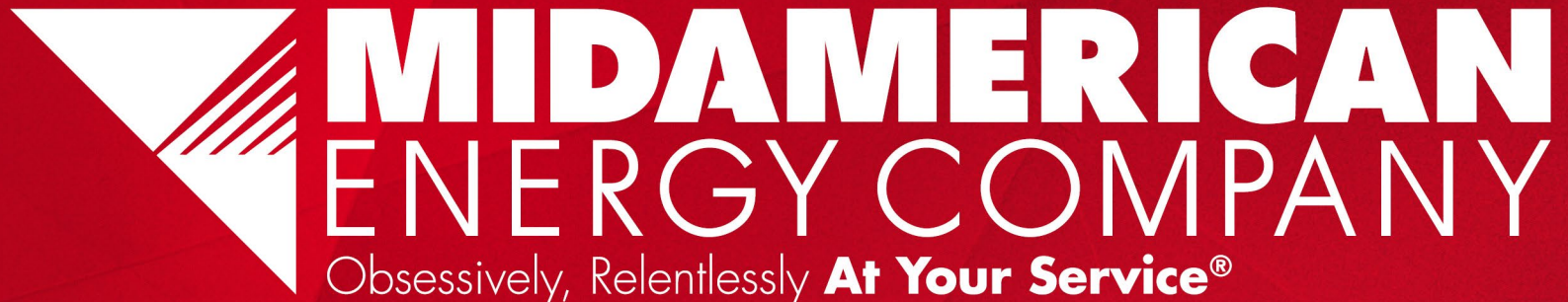
The Time Synchronization Device Word bits in *Table I.5* indicate the present status of the timekeeping function of the SEL-735.

Table I.5 Time Synchronization Device Word Bits

Name	Description
IRIGOK	Asserts while meter time is based on IRIG-B time source.
TSOK	Time Synchronization OK. Asserts while time is based on an IRIG-B time source of sufficient accuracy for synchrophasor measurement.
PMDOK	Phasor measurement data OK. Asserts when the SEL-735 is enabled and able to produce Synchrophasor data. A few seconds may be necessary for PMDOK to assert when the meter is first turned on, after any of the settings are changed, or when an IRIG-B time signal is first connected.

Solutions

- Requested SEL to modify the SEL-411L logic to detect if a C37.118 signal is not being sent as expected – like the SEL-735 logic.
- Add additional automation logic to SEL-411L settings to detect missing control bits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Misoperations

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Q2 2024 Update, Review and Discussion

Report

Jake Bernhagen will lead this discussion during the meeting.

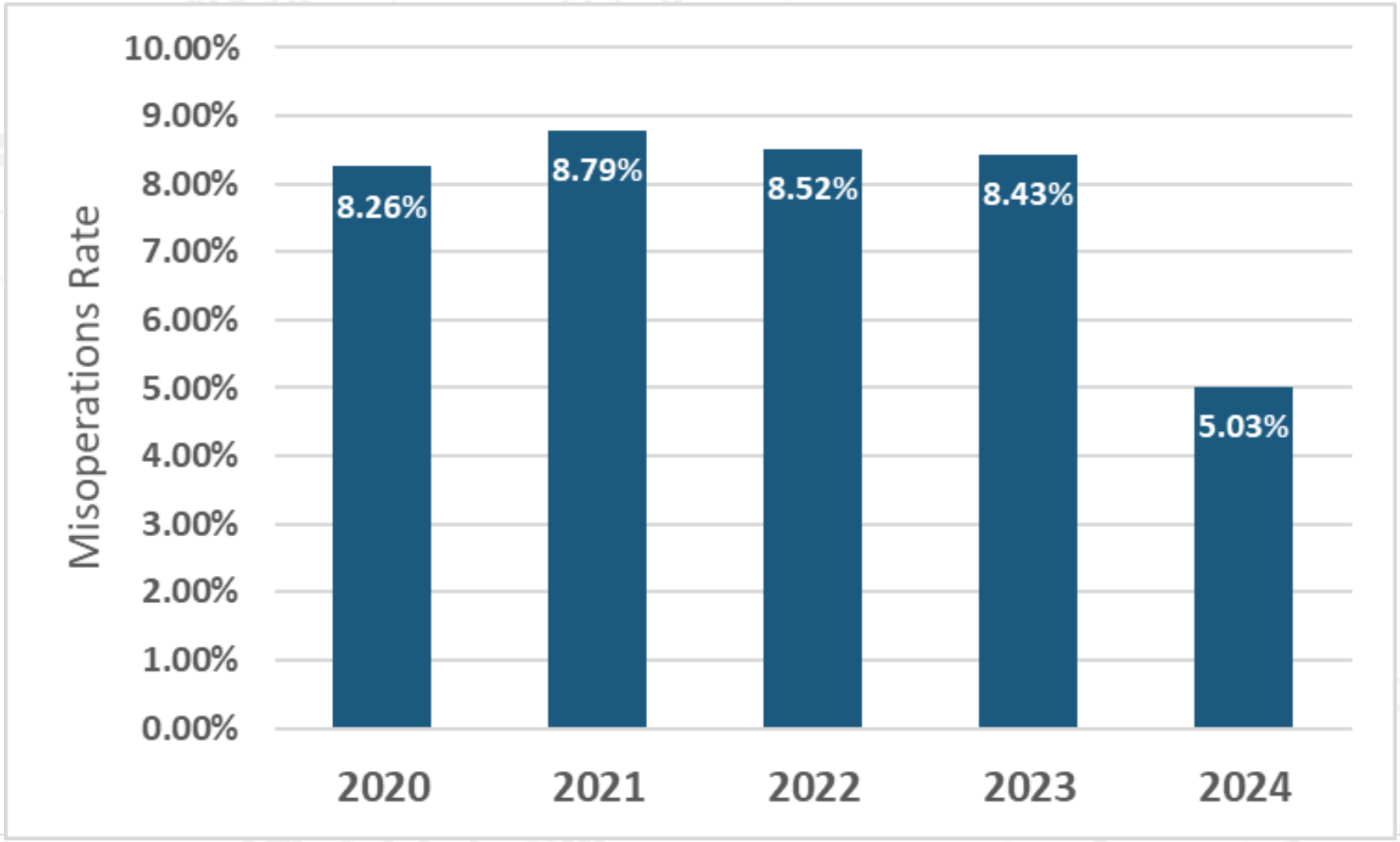
MIDWEST RELIABILITY ORGANIZATION

Q2 2024 PRS Misoperations Presentation

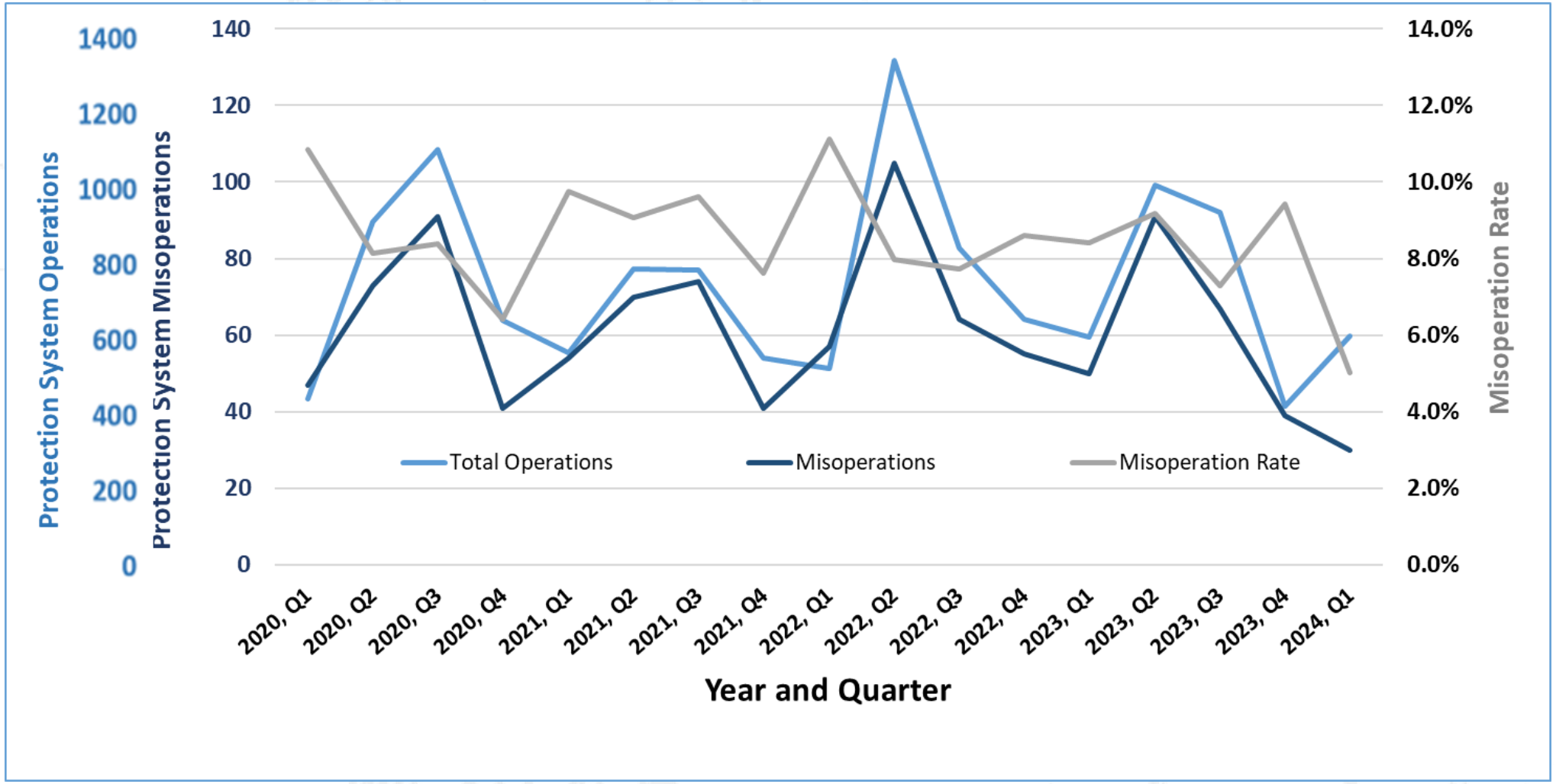
Jake Bernhagen, P.E.
Manager, Reliability Performance
Midwest Reliability Organization

CLARITY | ASSURANCE | RESULTS

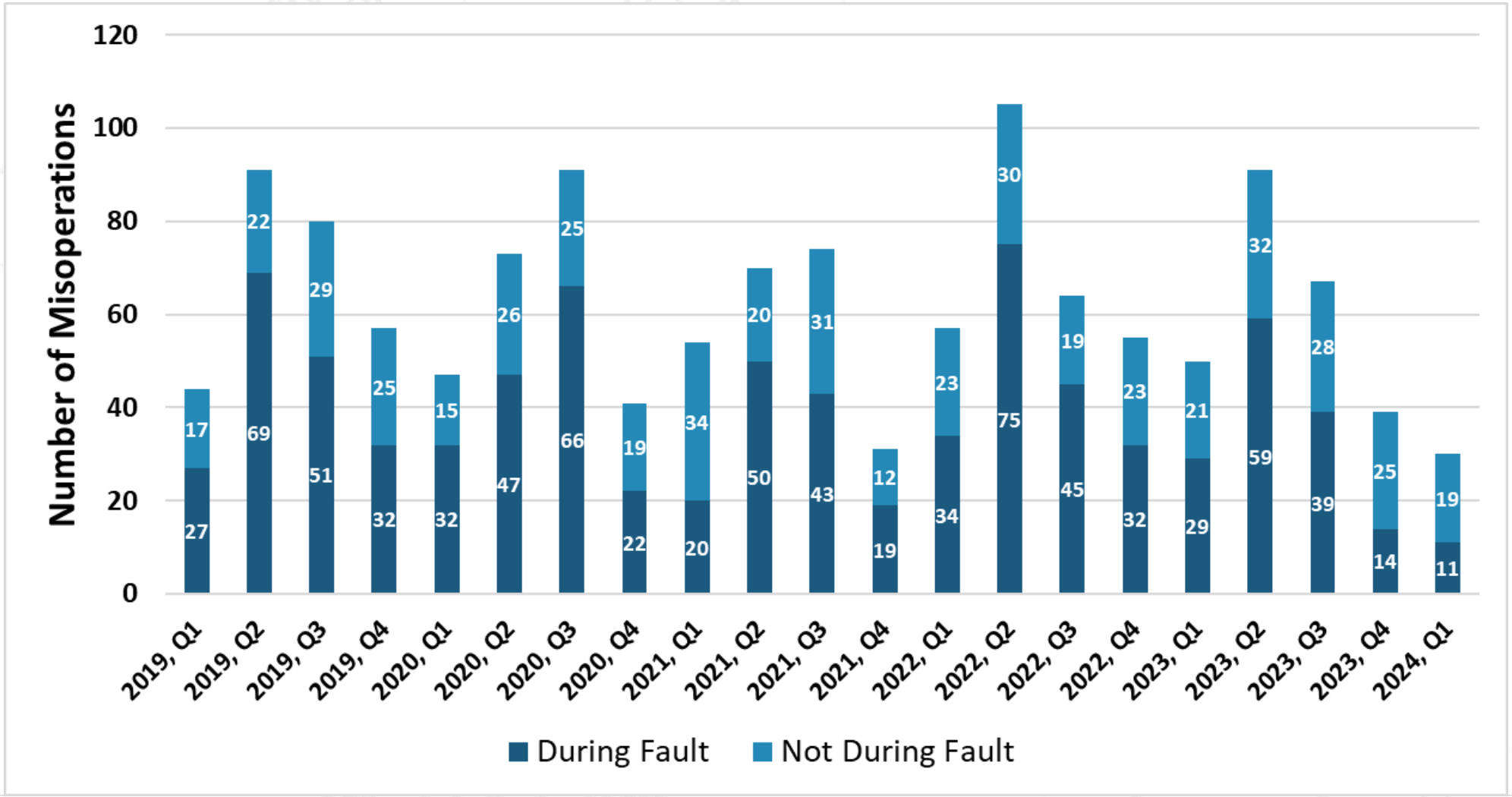
MRO Misoperation Rate



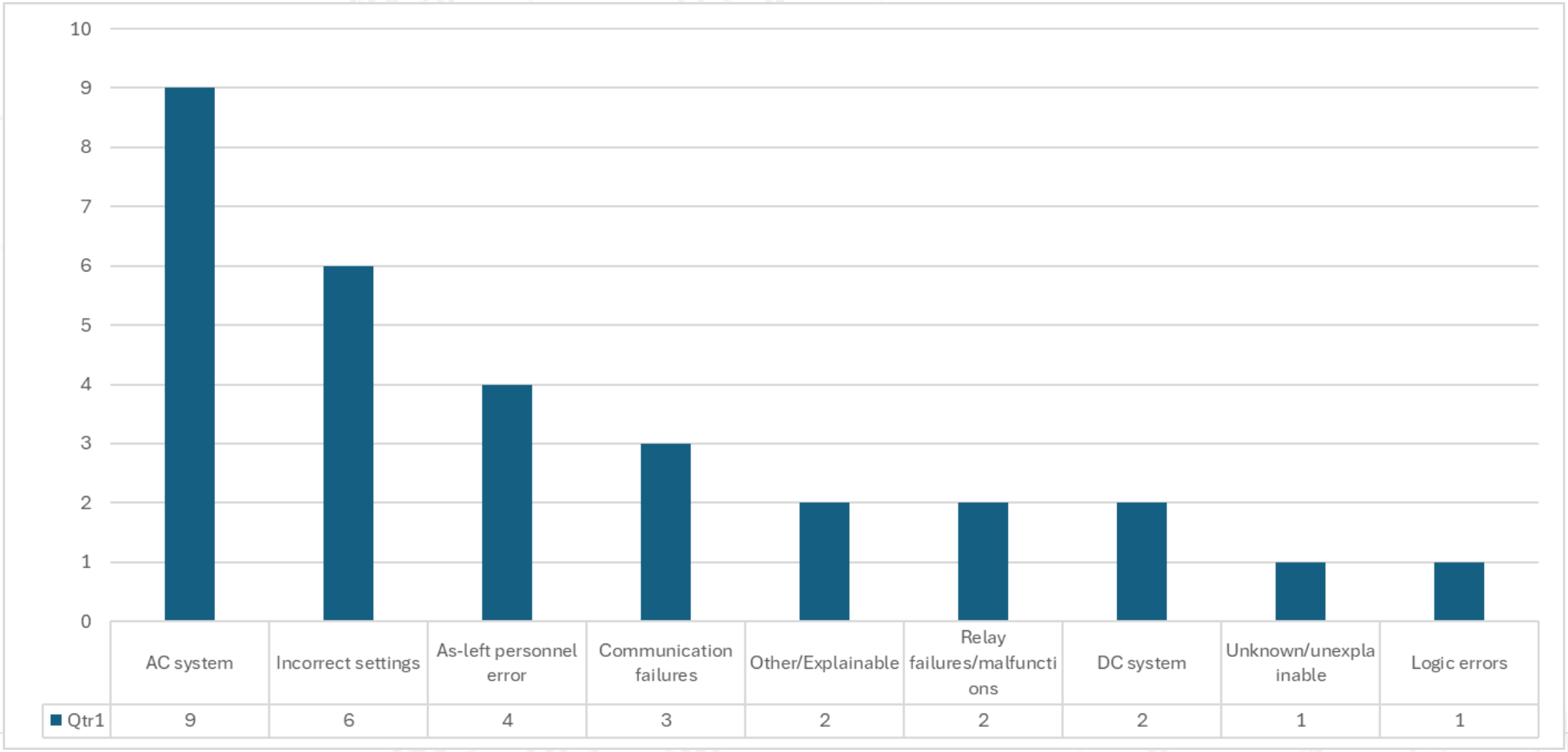
MRO Misoperation Rate



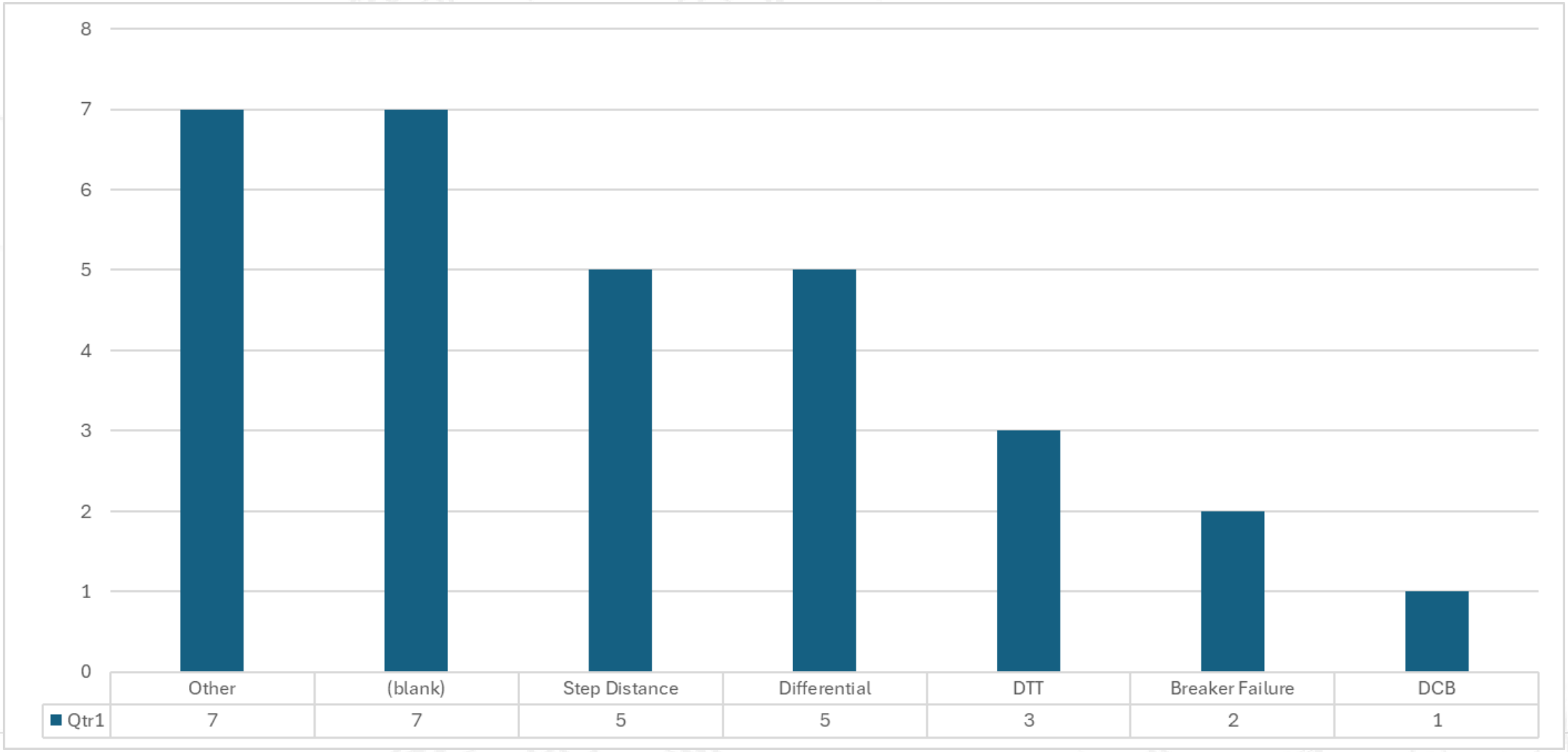
MRO Misoperation Rate



2024 Misoperations by Cause



2024 Misoperations by Scheme



Questions?

Q2 2024 Misoperations Review

Jake Bernhagen, Manager of Reliability Performance, MRO

Action

Discussion

Report

Jake Bernhagen will lead this discussion during the meeting.

PRS Member Roundtable

Dennis Lu, Protective Relay Subgroup Chair

Action

Discussion

Report

Chair Lu will lead this discussion during the meeting.

Other Business and Adjourn

Dennis Lu, Protective Relay Subgroup Chair

Action

Discussion

Report

Chair Lu will lead this discussion during the meeting.