RF WINTER RECAP OF CONVENTIONAL UNIT PERFORMANCE DURING THE WINTER OF 2022-2023

Tim Fryfogle, Principal Engineer

Tech Talk with RF | July 15, 2024

RELIABILITY FIRST

AGENDA

GADS HISTORY

GADS METRICS

- Weighted-Equivalent Generation Forced Outage Rate (WEFOR)
- Starting Reliability (SR)
- Availability Factor (AF)

REVIEW OF WINTER WEATHER EVENTS

CONVENTIONAL GADS HISTORY

- Electric utility industry initiated in 1963
- Became mandatory for certain units in 2012
  - Conventional generating units 20 MW and larger
- Fundamentals of the three GADS data types:
  - Design - equipment descriptions
  - Performance - summaries of generation produced, fuels units, start-ups, etc.
  - Event - description of equipment failures
- Widely used across industry to assess and improve generator performance

SELECTION CRITERIA

Identify Winter Outages

- Narrow Months to (Nov-Feb)
- Review Verbal Descriptions

Performance – lost MW hours

- Forced and Derates
- Prioritize based on largest to smallest MW hours

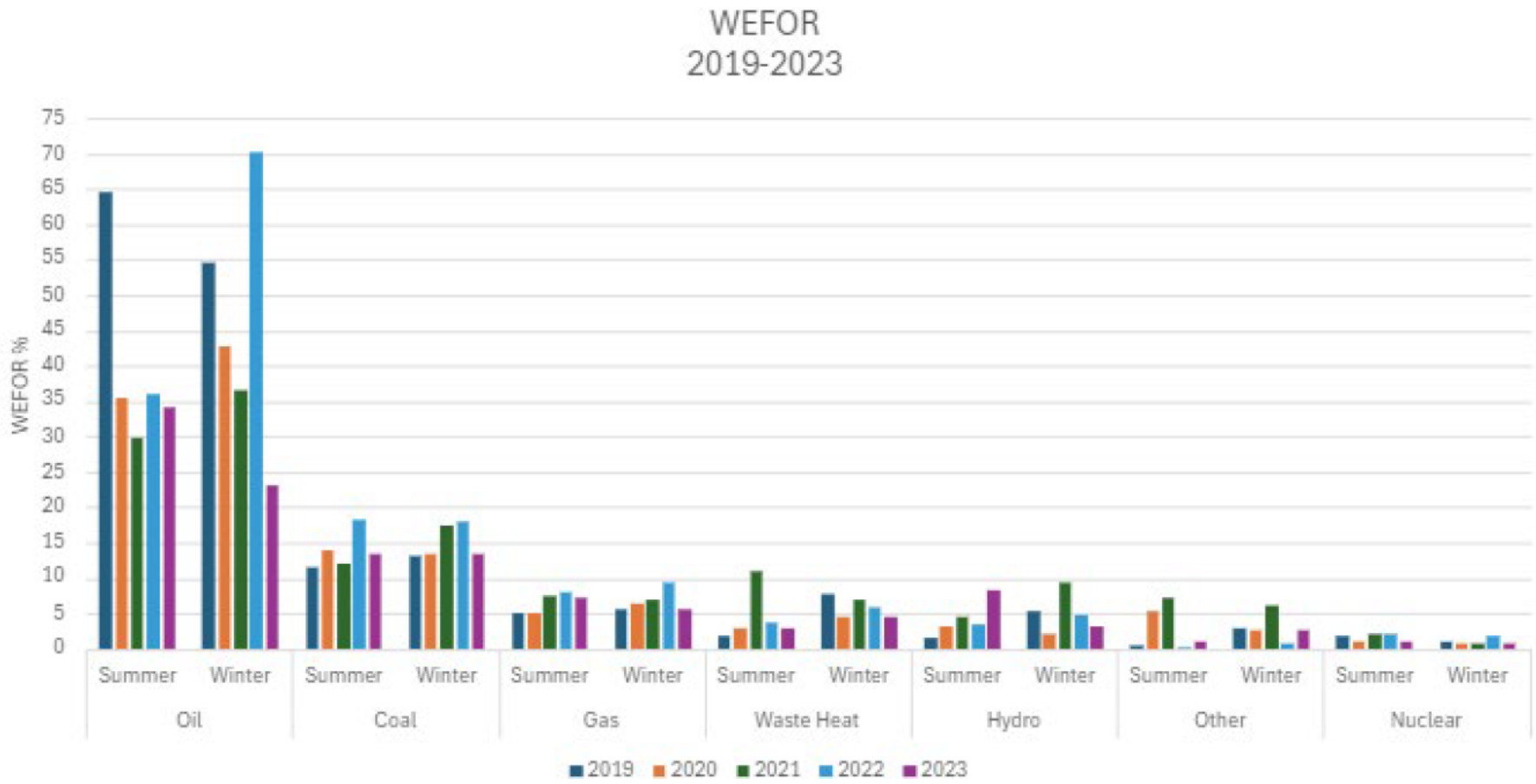
WINTER PERFORMANCE

Weighted-Equivalent Generation Forced Outage Rate (WEFOR) - measures the probability that a unit will not be available to deliver its full capacity at any given time due to forced outages and derates.

- Individually, these statistics provide important information to plant owners in an effort to benchmark and improve the performance of their own generators.
- Lower is better.
- This indicator answers the following questions:
  - On average, how often are generators out of service?
  - What is the trend of generation outages?
  - How do generator outages differ between different fuel types?

WINTER PERFORMANCE – WEFOR BY FUEL TYPE

Weighted-Equivalent Generation Forced Outage Rate (WEFOR)



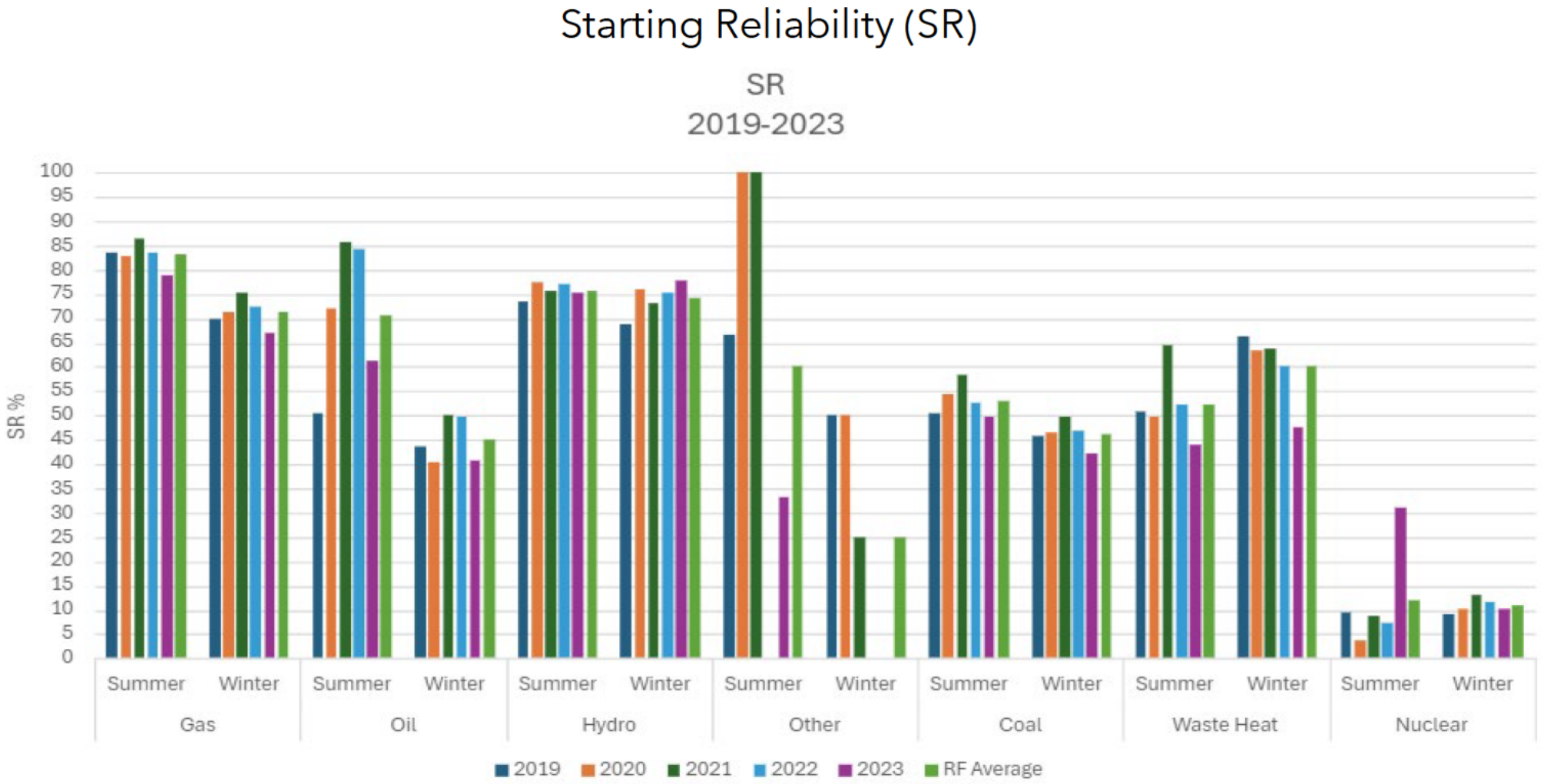
WEFOR during the last cold weather events by fuel type during the winter months of November – February.

STARTING RELIABILITY

Starting Reliability (SR) – Measures the total amount of Actual Unit Starts divided by the amount of Attempted Starts multiplied by 100%.

- Base load units are identified as lower due to no actual starts vs Attempted Starts for the month.
- Highly dependent on what happens immediately before and/or immediately after a start-up.

WINTER PERFORMANCE – STARTING RELIABILITY BY FUEL TYPE



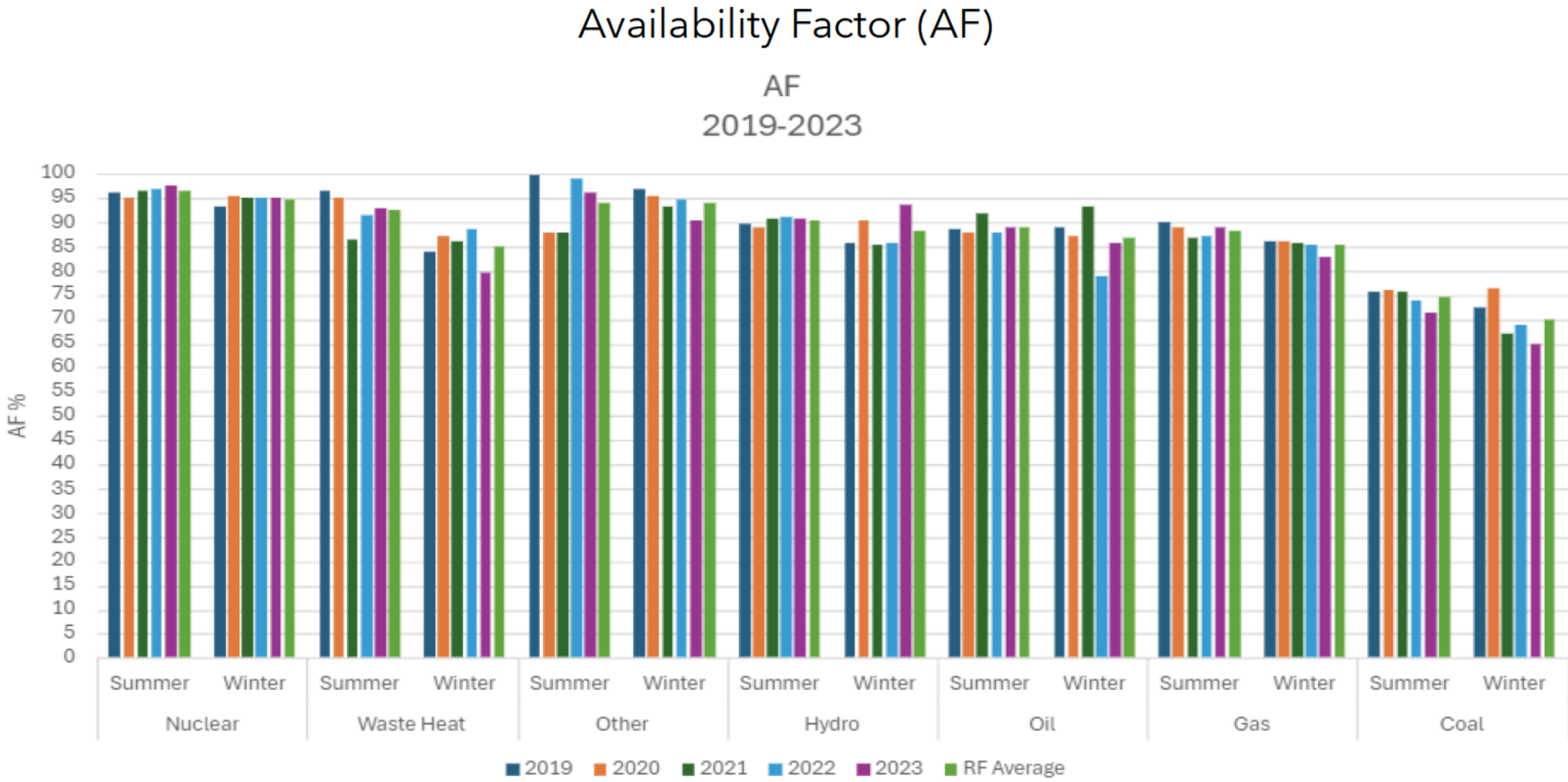
SR during the last cold weather events by Fuel Type during the winter months of November – February.

AVAILABILITY FACTOR

Availability Factor (AF) – Measures the amount hours of the unit availability (minus outage hours), divided by the amount of hours in the timeframe being analyzed, multiplied by 100%.

- Units with lower outages have a higher availability factor.
- Highly dependent on what happens with outages during the month.

WINTER PERFORMANCE – AVAILABILITY FACTOR BY FUEL TYPE



AF during the last cold weather events by Fuel Type during the winter months of November – February.

WINTER EVENTS

Used GADS events and analyzed the verbal descriptions

- Put into groups based on verbal event descriptions and totaled amount of MW hours lost

2022-2023 Winter (Nov-Feb)		
Unspecified*	394,077 MWh	39%
Frozen Transmitters	288,027 MWh	29%
Frozen Lines	136,563 MWh	14%
Frozen Equipment	106,208 MWh	11%
Frozen Valves	71,715 MWh	7%
Frozen Level Indicators	6,140 MWh	Less than 1%
Icing Inlet Filters	1,001 MWh	Less than 1%

* 98% of MWh lost was due to a single unit, was unable to dive into more detail based on verbal description

UNSPECIFIED

- Unspecified highest amount of MWh lost
  - 394,077 MWh lost

TRANSMITTER ENCLOSURES

Frozen Transmitters

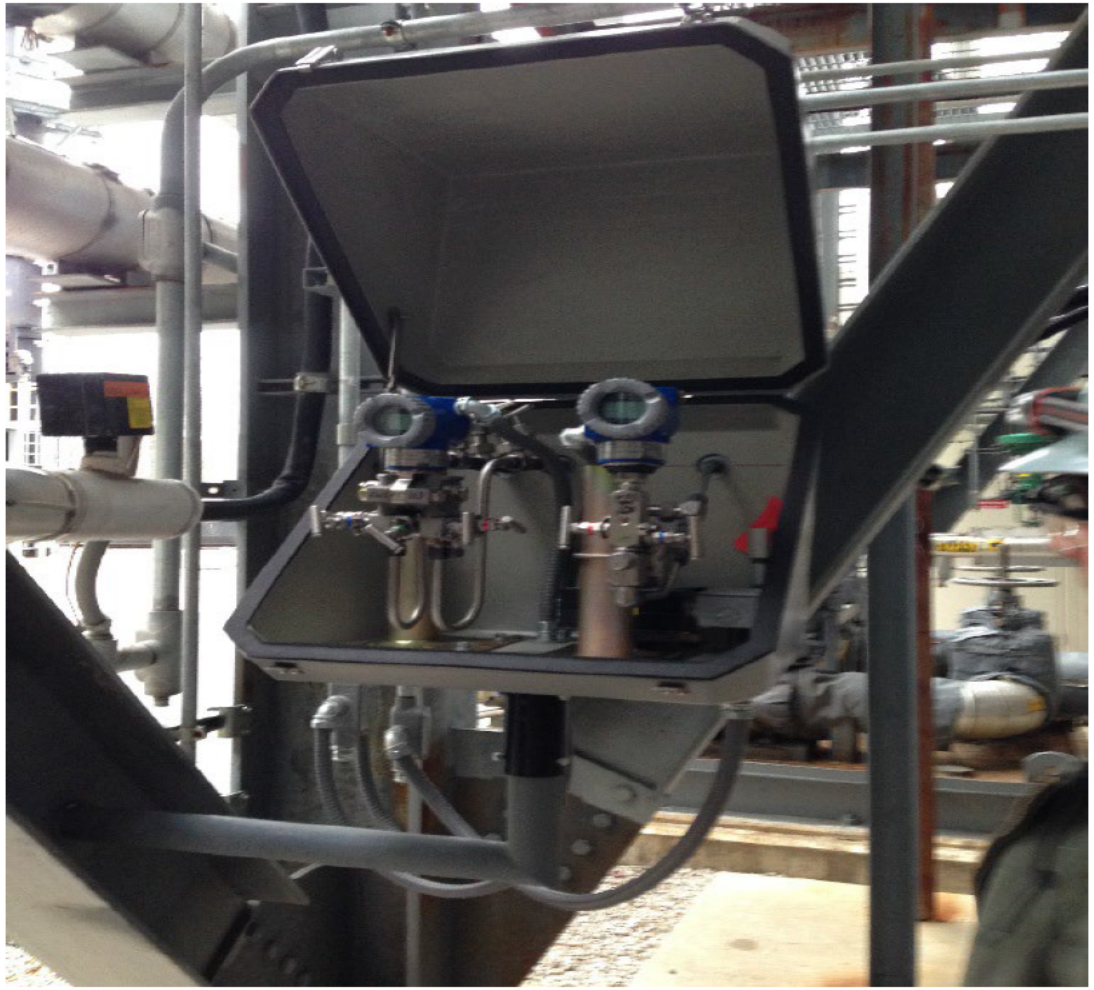
- 288,027 MWh lost

Insulation blankets were added to historically extreme cold weather vulnerable O'Brien Critical Transmitter Boxes.

"Suitcase" style metal boxes fabricated around critical valves/actuators to prevent/minimize operational issues.

TRANSMITTER ENCLOSURES

Replacement of various transmitter enclosures with improved design to maintain internal temperatures above freezing conditions.



FROZEN SENSING LINES

Frozen Sensing Lines

- 136,563 MWh

New O'Brien Heat Trace system with exterior clamps

- Old design utilized metal clamps that were internally secured to the transmitter sensing lines and directly connected to the structural steel.
- This acted as a heat sink and resulted in freezing of the sensing lines.

FROZEN EQUIPMENT

Frozen Equipment

- 106,208 MWh

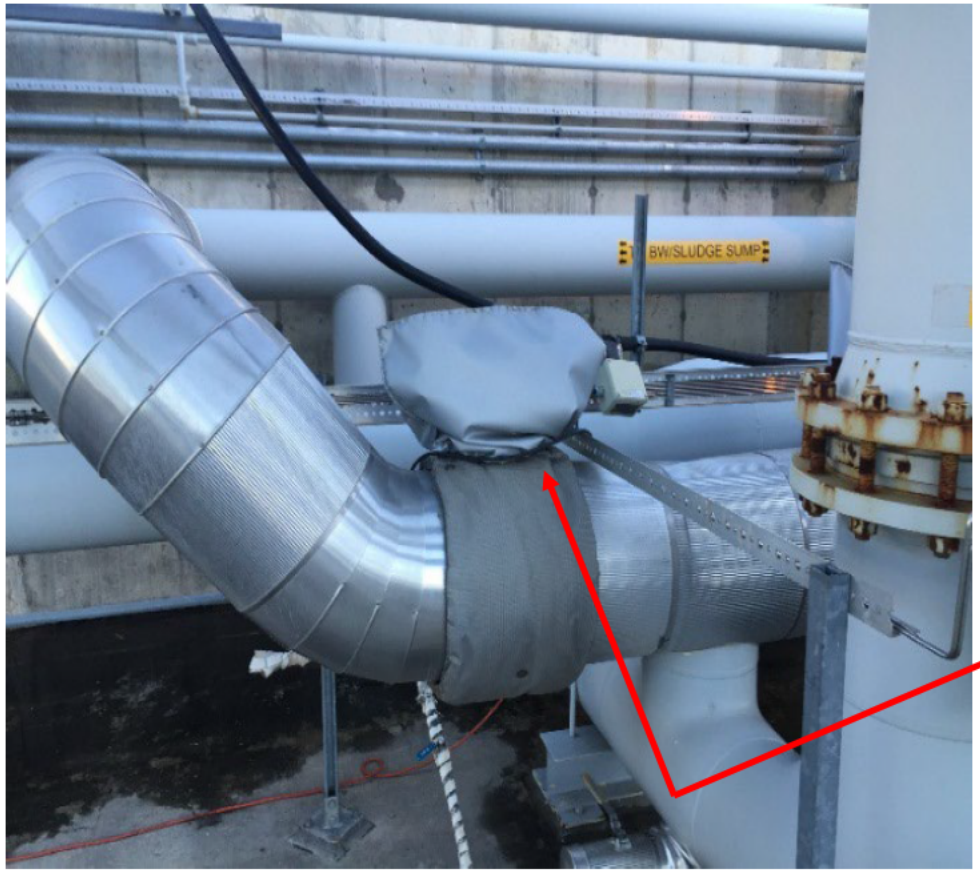
Permanent weather shelters were constructed over duct burner skids to protect them from freezing rain and ice and then wrapped on three sides to provide a windbreak.

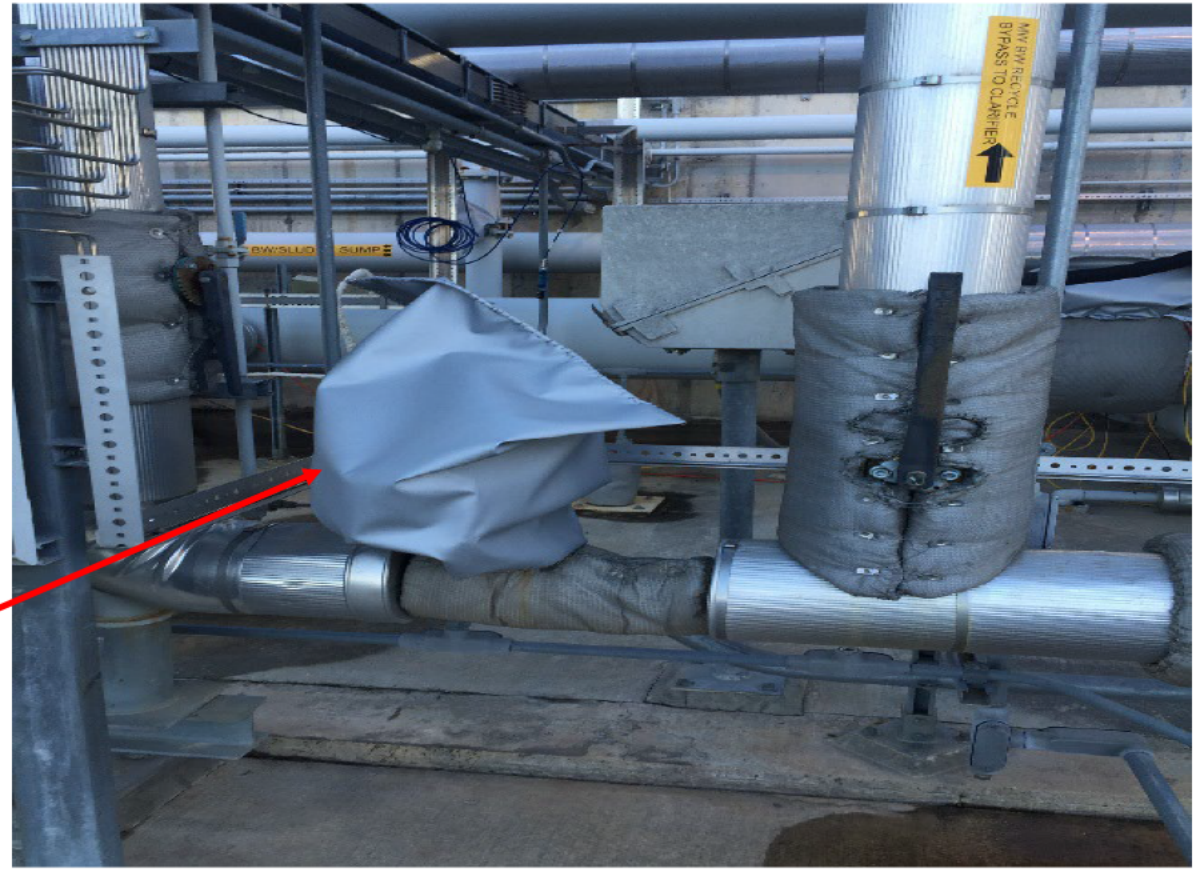
Additionally, temporary wind breaks were installed around certain heat trace panels to provide some protection of plant personnel from the elements when monitoring the panels.

VALVE INSULATIONS

Frozen Valves

- 71,715 MWh lost





Temporary insulation covers on critical valves.

FROZEN LEVEL INDICATORS

Frozen level indicators

- 6,140 MWh

Placed thermometers inside all outside boxes as well as all buildings housing critical components.

Boxes that did not have glass installed were drilled to provide an inside temperature reading.

ICING INLET FILTERS

Icing inlet filters

- 1,001 MWh

Anti-icing system that prevents ice from forming on the air intake filters. It has a series of heating coils with a 50/50 glycol water blend flowing through them that is heated using auxiliary steam to increase the temperature of the air pulled through the intake.

Temporary heaters and ducting utilized to prevent the formation of ice and snow on the surface of the air inlet filters.

EXTREME COLD WEATHER PREPAREDNESS

Mike Hughes, Manager, Entity Engagement

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AGENDA

THE "WHY"

EOP-012-2

SMALL GROUP ADVISORY SESSIONS (SGAS)

COLD WEATHER WINTERIZATION SITE VISITS

THE WHY

Winter Storm Elliott Report

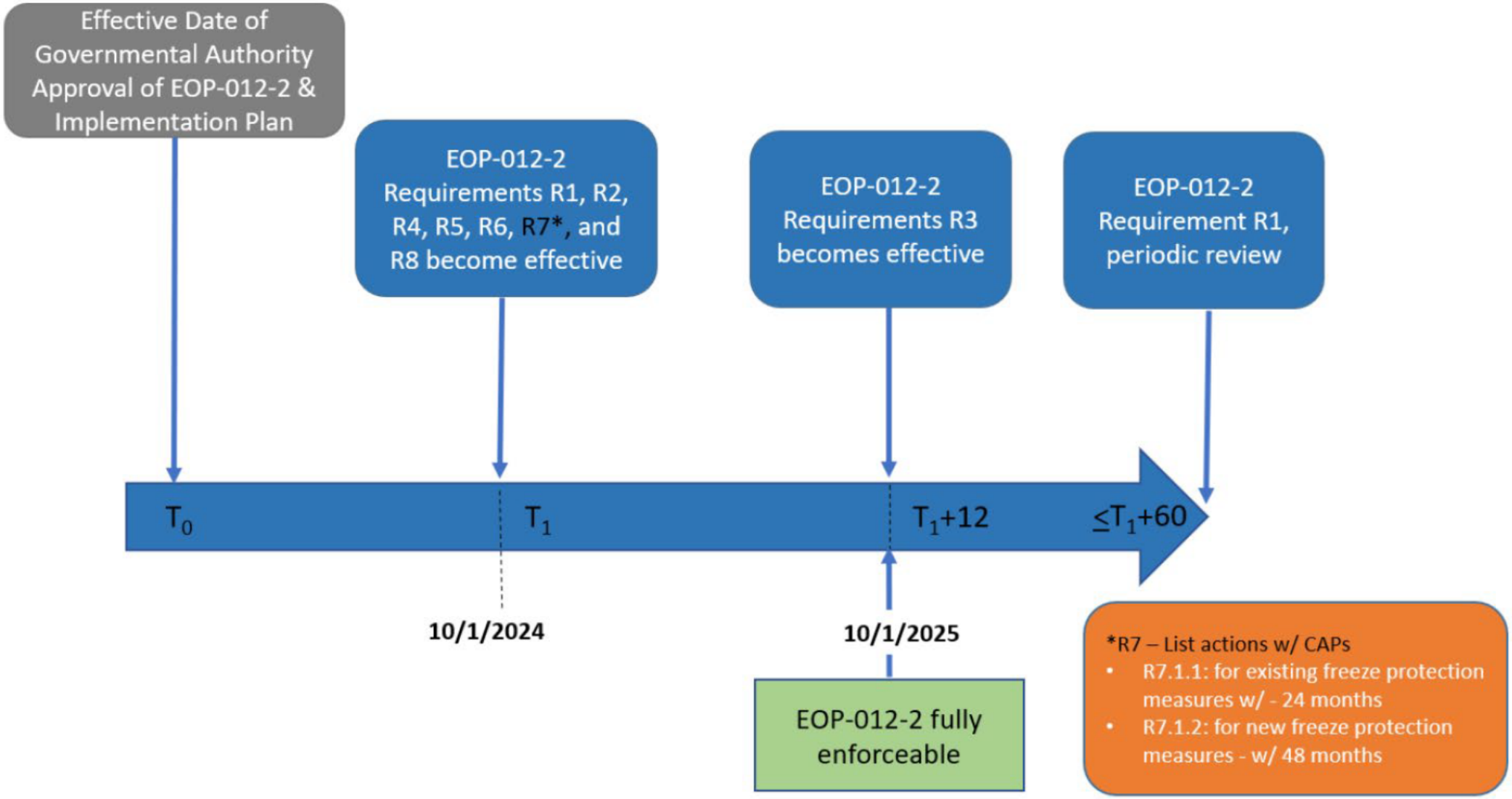
- 2022
- 1,702 units
- 90,500 MW unplanned
- 127,000 MW total (18%)

EOP-012-2

FERC Order RD24-5-000

- Approved EOP-012-2 and Implementation Date for EOP-012-4
- Directs NERC to:
  - Develop modifications to redefine/modify "Constraints"
  - Evaluate and confirm validity of each constraint
  - Shorten and clarify corrective action plan (CAP) timelines in R7
  - Implement more frequent reviews for constraints in R8 part 8.1

IMPLEMENTATION PLAN



KEY POINTS FOR R1 (GO)

Think Internal Controls for all Requirements!!

Document Extreme Cold Weather Temperature (ECWT) (value/date/source) at least once every 5 calendar years

Document cold weather performance data

- Operating limitations (capability, availability, fuel supply/inventory/switching, environmental)
- Minimum temperature-design, historical operating, OR performance by analysis

KEY POINTS FOR R2 (GO)

What internal controls are in place?

Specific to units with Commercial Operation Date (COD) on/after 10/1/2027

- ECWT ≤ 32°F, self-commits or is required to operate ≤ 32°F (Exemption allowed per footnote 1 in EOP-012-2!)

Implement Freeze Protection Measures (FPM) for Generator Cold Weather Critical Component (GCWCC)

- Capability to operate at ECWT with 20 mph wind for not less than 12 hrs. Or max duration if < 12 hrs. (e.g. solar) OR
- Develop CAP to add new or modify freeze protection measures (FPM)

KEY POINTS FOR R3 (GO)

What internal controls are in place?

Specific to units with COD prior to 10/1/2027

- ECWT ≤ 32°F, self-commits or is required to operate ≤ 32°F (Exemption allowed per footnote 1!)

Implement FPM for GCWCC

- Capability to operate at ECWT OR
- Develop CAP to add new or modify FPM

KEY POINTS FOR R4 (GO)

What internal controls are in place?

Implement/maintain cold weather preparedness plan(s) including:

- Lowest ECWT for each unit (note - lowest ever)
- Generating unit cold weather data
- Documentation identifying GCWCC
- FPM or GCWCC including measures to reduce wind chill and effects of freezing precipitation (where necessary)
- Annual inspection and maintenance of FPM (all)

KEY POINTS FOR R5 (GO)

Generator Owner and Generator Operator identify entity responsible for providing unit-specific training

- Coordination
- Designation
- Unit-specific training

Entity responsible shall provide training to its maintenance or operating personnel implementing plan

- Provision of training
  - Identification of personnel (may include contractors)
  - Training materials relevant to site cold weather control
  - Timing aspects (prior to implementation of plan!)

Think Internal Controls!!

KEY POINTS FOR R6 (GO)

What internal controls are in place?

Specific to units experiencing a Generator Cold Weather Reliability Event (GCWRE)

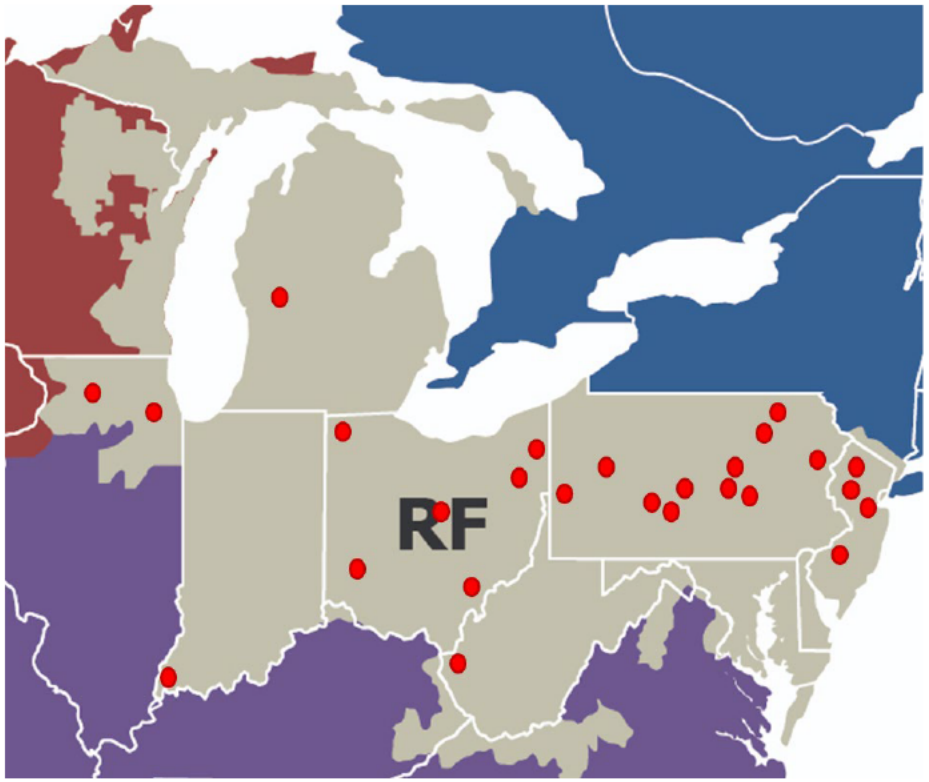
- ECWT ≤ 32°F, self-commits or is required to operate ≤ 32°F (Exemption allowed per footnote 4!)

Develop a Corrective Action Plan (CAP) within 150 days or by July 1 and contain (as a minimum):

- Summary of cause(s) for GCWRE and relevant data
- Review of applicability to other units owned
- Identification of operating limitations or impacts to cold weather preparedness until CAP completed

WINTERIZATION SITE VISITS

Plant Visit General Locations



2014-2015 – 9 surveys, 3 visits

2015-2016 – 28 surveys, 7 visits

2016-2017 – 8 surveys, 6 visits

2017-2018 – 7 surveys, 4 visits

2018-2019 – 26 surveys, 7 visits

2019-2020 – 21 surveys, 2 visits

2020-2021 – Hold - COVID

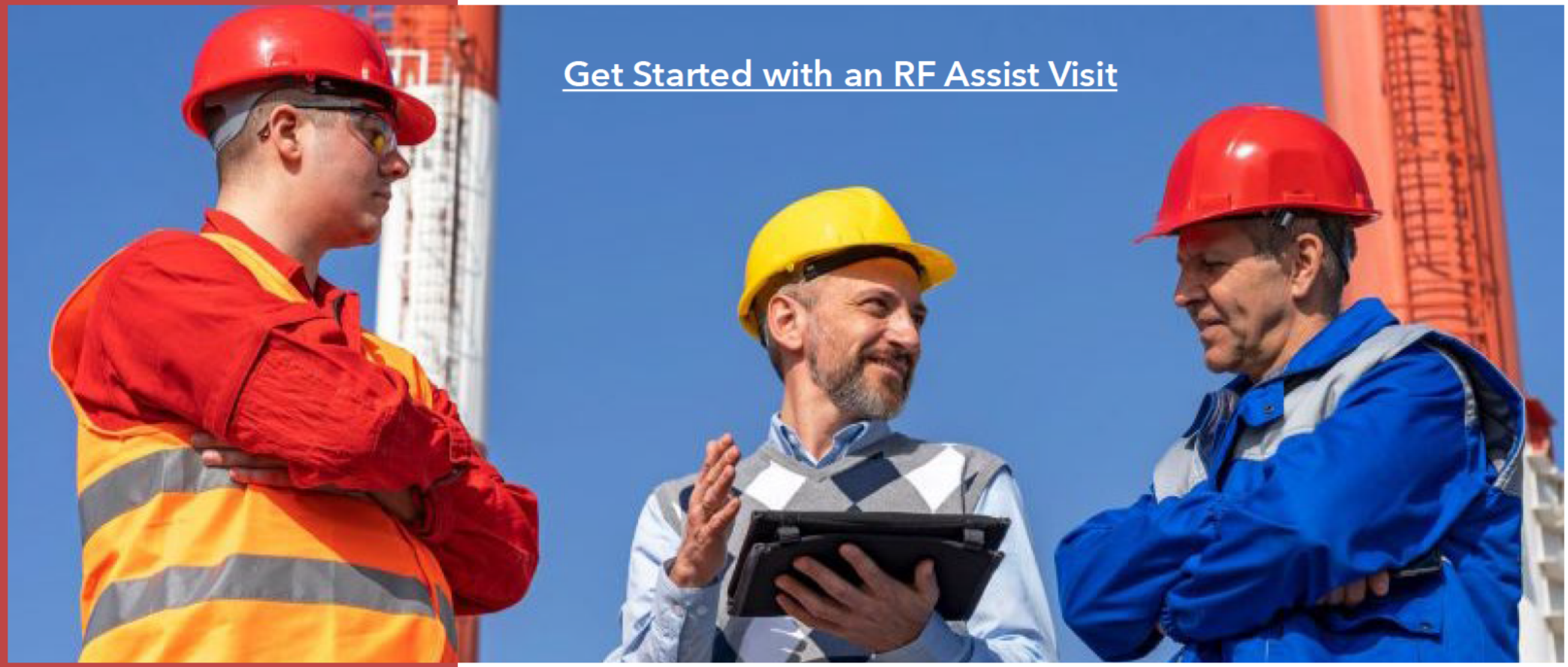
2021-2022 – 14 surveys, 4 visits

2022-2023 – 23 surveys, 11 visits

2023-2024 – 23 surveys, 16 visits

FORWARD TOGETHER RELIABILITYFIRST

COLD WEATHER WINTERIZATION SITE VISIT



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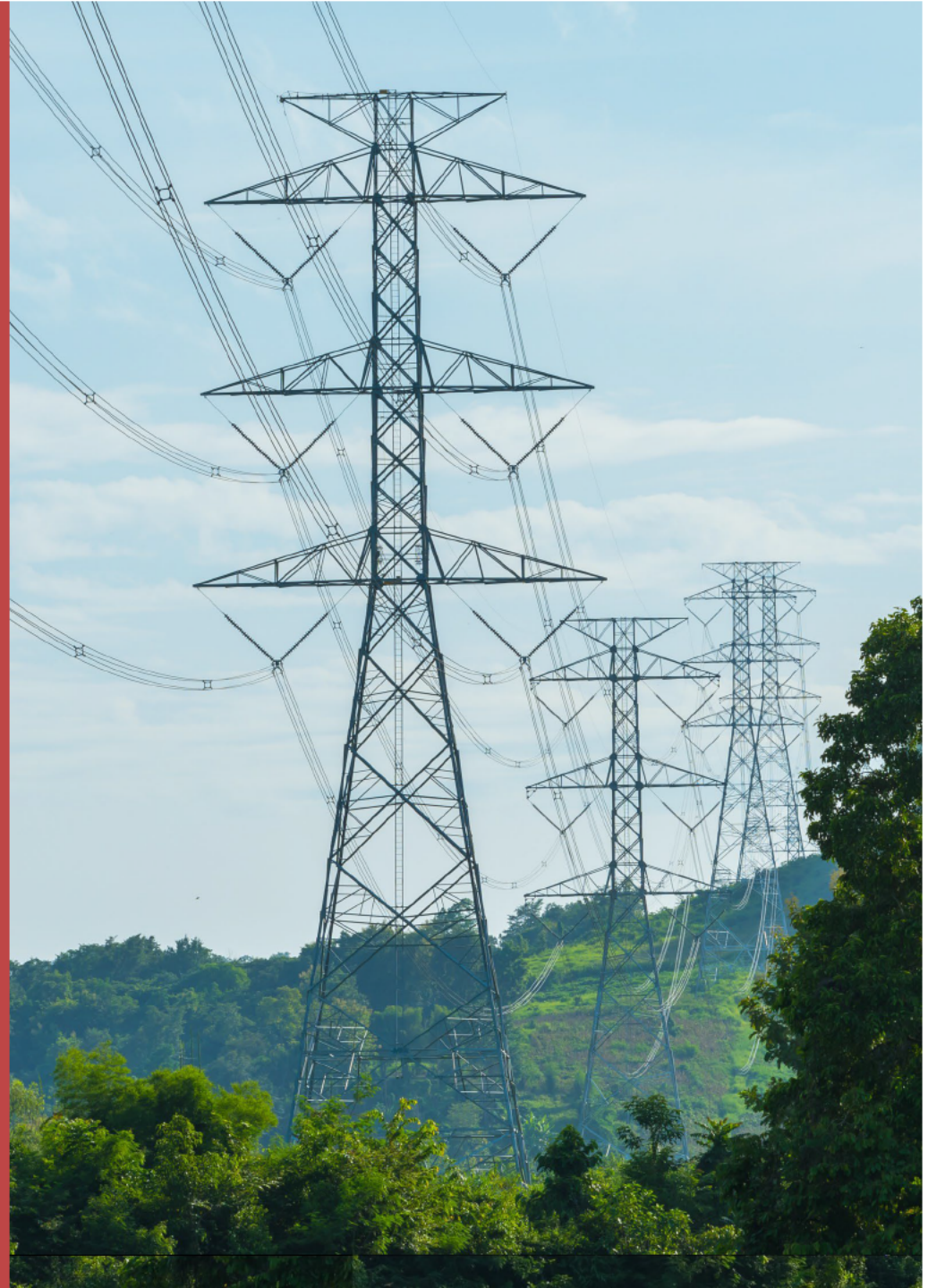

QUESTIONS & ANSWERS

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