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Remedial Action Scheme Review Subcommittee

July 10, 2024

Gene Henneberg, Chair

and

Davis Erwin, Vice Chair

Remedial Action Scheme Review Subcommittee (RASRS)

- Committee Purpose
  - The RASRS assists and helps facilitate the RCs in their review of the reliability aspects of existing, modified, planned, and retiring Remedial Action Schemes (RAS). The RASRS provides a uniform review process to enhance grid performance within the Western Interconnection.
- Items for Discussion:
  - Open discussion of how FERC Order 881 on Ambient Adjusted Ratings will affect Remedial Action Schemes.

What Will FERC Require?

Facility Ratings for equipment that may be affected by ambient air temperature

- Ambient Adjusted Ratings (AAR)
  - Calculated at least once per hour (used in real time operations)
  - Up to date ambient air temperature forecast for the 240-hour AAR window and Facility
- Uniquely determined emergency ratings for contingency analysis in the operations horizon
- At least 4 seasonal ratings used beyond the 240-hour AAR window
- For near term point-to-point transmission, network and secondary service
  - Expected temperature plus forecast margin
  - Historical max/min ±10°F, increment no more than 5°F, updates for new records
  - Determine need for near term interruption or redispatch of network services
  - Day/night ratings with sunrise/sunset updates
  - Post to OASIS
  - Dynamic Line Ratings, DLR (impact of wind, solar, etc) are allowed, but not required except for day/night
- **Full implementation by July 2025**

What Else Will FERC Require?

- RTOs/ISOs implement AAR in the real time and day ahead markets, any intra-day unit commitments, and any near-term transmission service offered
- Determine need for curtailments
- AAR required on all lines
- Transmission Owner has ultimate rating determination responsibility
- Five-year refresh requirement
- **AAR generally applies to Remedial Action Schemes**

Any AAR Exceptions?

Facilities whose rating is not affected by ambient air temperatures

- Stability based ratings
- Voltage based ratings
- Ratings based on several non-load PRC-023 R1 Criteria
  - 3 -- Maximum line theoretical power transfer with zero (3.1) or actual (3.2) source reactances
  - 4 -- Series compensated lines, 2nd bullet (essentially criteria 3), maybe 1st bullet (capacitors)
  - 5 -- End-of-line 3-phase fault current
  - 7 – Load center terminals to remote generation
  - 8 – Bulk system terminals to remote loads
  - 9 – Load center terminals to remote loads from the bulk system
  - 12 – Adequately protect the transmission line (mostly impedances)
  - 13 – Other limitations. This is your own rating method if not based on ambient temps
- **NO general AAR exception for RAS, but approved RAS are exempt from PRC-023 criteria**

AAR and Emergency Ratings?

- Emergency ratings for contingency analysis in the operations horizon depend on the TO's rating method.
- Normal and emergency ratings may be the same.
- Emergency ratings are real time ratings, so are also an AAR rating.
- RAS react to system contingencies. The post-contingency power system is in an emergency configuration.

What Do Other Folks Do Now for AAR?

Based on the descriptions in FERC Order 881

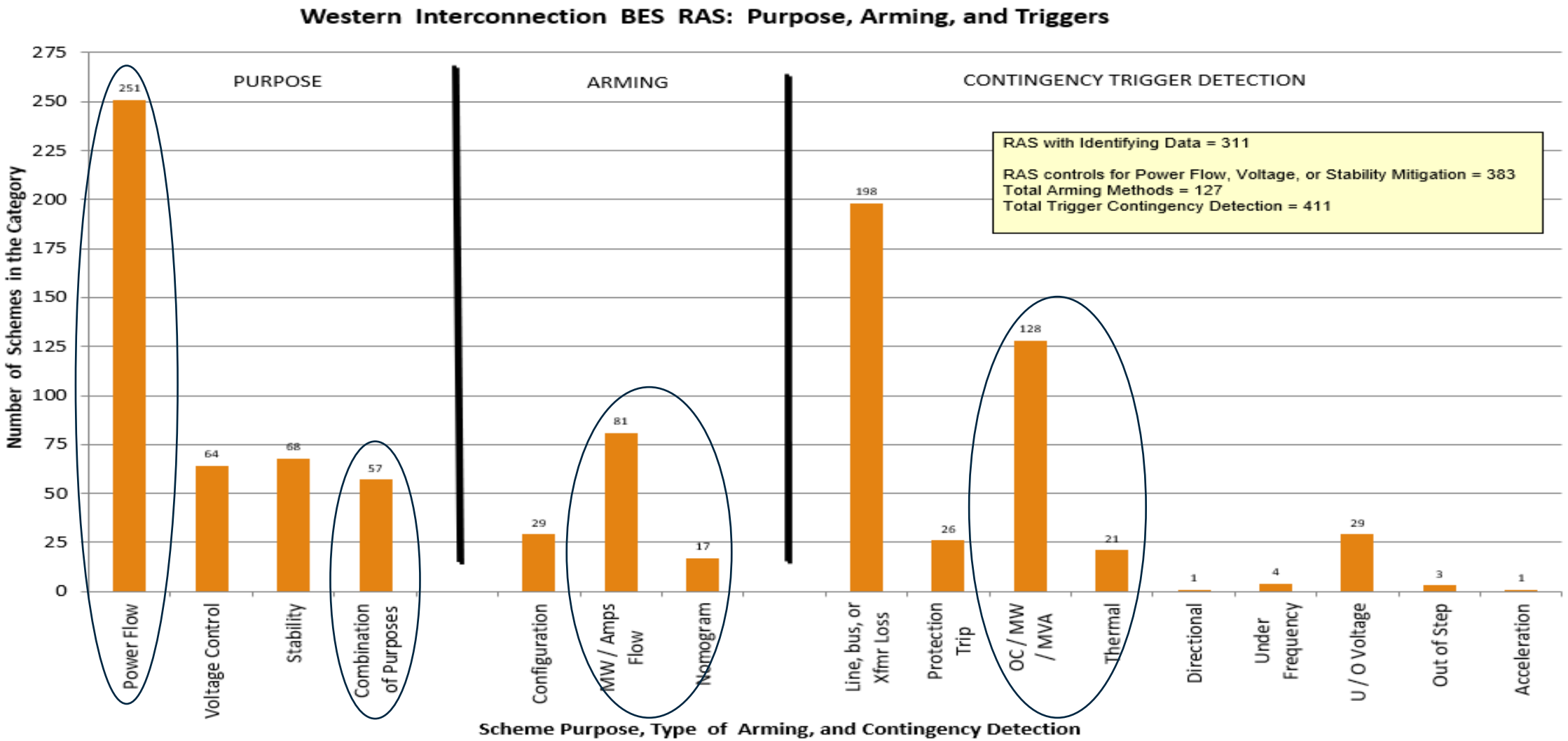
- **AEP** uses AAR within its PJM, SPP, and ERCOT footprints.
- **EXELON** uses AAR in all 6 of its utilities.
- **Dominion** uses PJM's AAR method in Virginia and parts of South Carolina.
- **Duke Energy** uses AAR, but questions FERC's estimate of implementation costs.

What Does PJM Do for AAR?

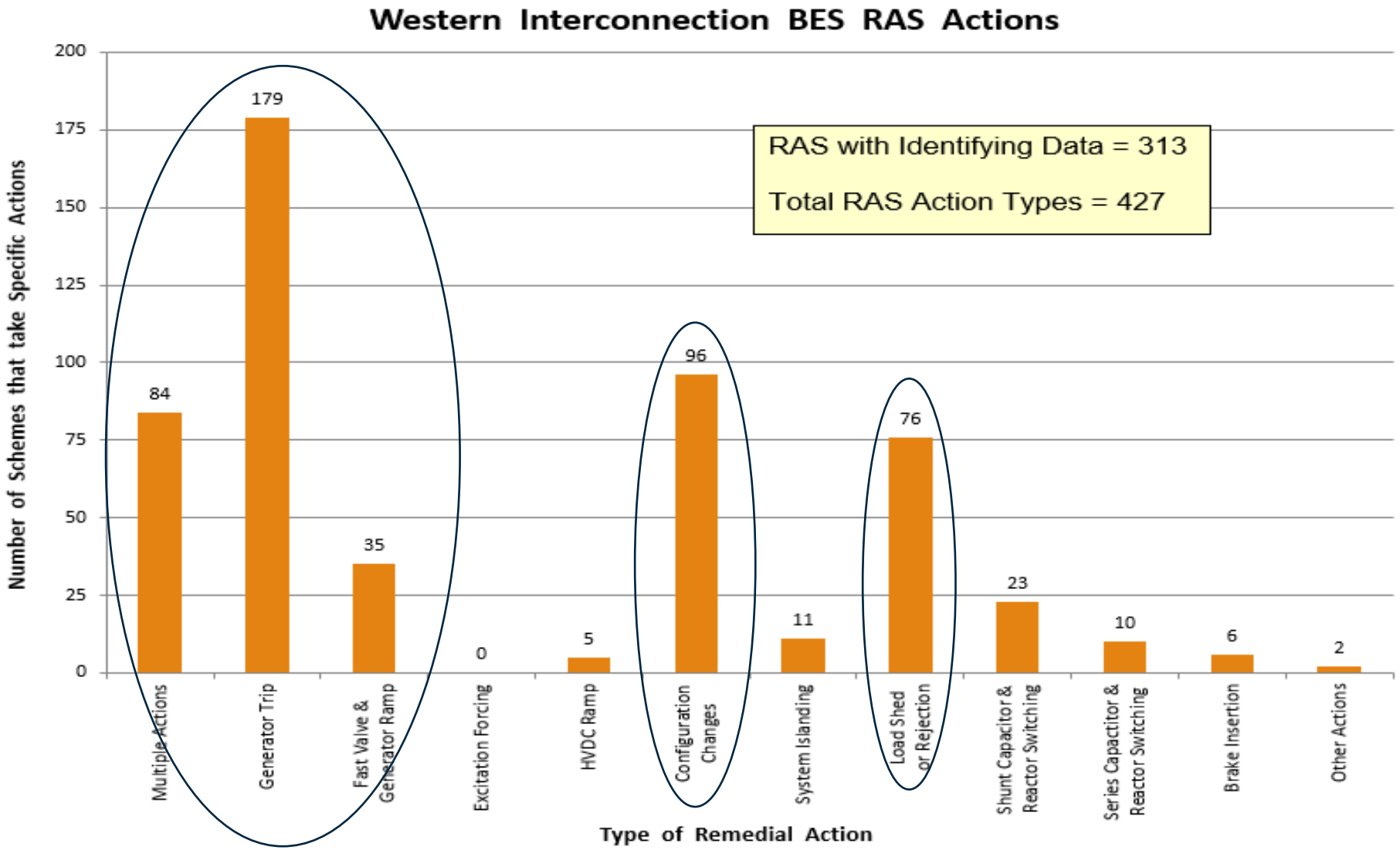
Based on the descriptions in FERC Order 881

- Presently use eight 9°F (5°C) AAR increments from 32°F to 95°F plus day/night distinctions (16 rating sets, at least two used each day).
- Ambient temperature rating sets are based on the weather forecast.
- Thermal limit calculations based on either AAR or (optional) dynamic limits.
- Facilities may have both short term and long term (STE and LTE) emergency ratings, but these may be the same.
- Facilities (including RAS) use the limiting equipment emergency rating for contingency analysis.
- PJM has 13 in service RAS (from the M03 Transmission Operations manual). **Four** RAS mitigate thermal loads, two of which also mitigate stability limits.

What is the Western Interconnection RAS Impact?



What RAS Actions may be Affected?



RAS Challenges for AAR

RAS are currently designed based on a defined set of assumptions and conditions (i.e. generation dispatch, load, and static equipment ratings). They are needed and effective to address the reliability concerns identified for those conditions. AAR may change those conditions.

One approach is to differentiate RAS as either Event based or Response based.

Event vs Response Based RAS

Event based RAS operate on specific contingencies and take action identified in offline studies. As Facility ratings change, the limiting equipment may change and the designed remedial actions may not be effective for the new conditions.

Response based RAS mitigate overloads, thermal overloads, or contingency + overload. These schemes monitor specific line(s) and take the designed action when an overload condition is detected.

Both RAS types are modelled by RTCA to identify real-time system impact and any contingency violations.

RAS Functions that Need Evaluation for AAR?

PURPOSE

- **Power Flow –** the upper limit on what might need AAR evaluation
- **Combination –** if power flow for a specific RAS is part of the combination, AAR may be needed

ARMING

- **MW/Amps Flow –** need evaluation and may need AAR updates
- **Nomogram –** usually stability or voltage limits, but need evaluation and may need AAR updates

RAS Functions that Need Evaluation for AAR?

CONTINGENCY TRIGGERS

- **OC** -- probably need AAR updates
- **MW/MVAR --** need evaluation and may need AAR updates
- **Thermal** -- probably already complies with AAR (approaches DLR)

RAS ACTION and RESULTS

- **AAR limits** may be significantly different than the original action trigger.
- **System studies** may be needed to confirm system performance within the new (wider) action trigger range

One Approach to RAS Changes

Even when new/modified RAS actions are not required, arming and/or action trigger levels may be affected.

- Option 1: Real time AAR calculated by System Operations, e.g. lookup table
  - Applied to EMS
  - Control level (arming, action trigger) sent to RAS via SCADA upon AAR update and sent back to EMS to confirm level
  - What happens for loss of comm or RTU? RAS and EMS default to Seasonal rating after 30 minutes
  - AAR sent from EMS to RC via ICCP
- Option 2: Real time AAR/DLR calculated by RAS via thermal model
  - RAS sends AAR rating to EMS via SCADA
  - What happens for loss of comm or RTU? EMS defaults to Seasonal rating after 30 minutes
  - AAR sent from EMS to RC via ICCP
- 10-day AAR Forecast is not needed by the RAS for real time operations, but RAS must be included when developing the 10-day AAR forecast

Any PRC-012-2 Functional Modifications?

Are RAS changes to implement AAR a functional change under the PRC-012-2 criteria?

RAS Change	Functional Change?
System conditions or contingencies monitored by the RAS (event based RAS?)	Occasionally
Actions the RAS is designed to take (event based RAS?)	Occasionally
RAS hardware beyond in-kind replacement to match original functionality	Occasionally
RAS logic beyond correcting existing errors	Unlikely
Redundancy levels, i.e. addition or removal	Unlikely
Arming level	No
Action trigger level	No

Key Takeaways

- RAS that mitigate stability or voltage conditions are unlikely to require modifications due to AAR.
- Event based RAS affected by AAR may require additional system studies. Any identified functional modifications need prior review and approval by the RC under PRC-012-2.
- RAS that mitigate overload conditions likely will require arming or action trigger modifications due to AAR. These are not RAS functional changes under PRC-012-2, so will not need prior RC review and approval.

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Electric Reliability and Security for the West

Contact:

Gene Henneberg

Principal Protection Engineer

Gene.Henneberg@nvenergy.com