NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Project 2010-13.3

Phase 3 of Relay Loadability: Stable Power Swings

Protection System Response to Power Swings Standard Drafting Team
Industry Webinar
July 28, 2014

RELIABILITY | ACCOUNTABILITY




Drafting Team

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Presenters

- Team Members
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- Observers
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- NERC
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Agenda

- Administrative Items
  - Antitrust and Disclaimers
  - Objectives
- Project History
  - Project Background
  - Technical Report
- Standard – PRC-026-1
  - Applicability
  - Requirements
  - Attachment A
- Closing Remarks
  - Including Questions & Answers Session

Administrative Items

Antitrust Guidelines

- NERC Antitrust Guidelines
  - It is NERC's policy and practice to obey the antitrust laws and to avoid all conduct that unreasonably restrains competition. This policy requires the avoidance of any conduct that violates, or that might appear to violate, the antitrust laws. Among other things, the antitrust laws forbid any agreement between or among competitors regarding prices, availability of service, product design, terms of sale, division of markets, allocation of customers or any other activity that unreasonably restrains competition. It is the responsibility of every NERC participant and employee who may in any way affect NERC's compliance with the antitrust laws to carry out this commitment.

Disclaimers

- Disclaimer
  - Participants are reminded that this meeting is public. Notice of the meeting was widely distributed. Participants should keep in mind that the audience may include members of the press and representatives of various governmental authorities, in addition to the expected participation by industry stakeholders.
- Presentation Material
  - Wording in this presentation is used for presentation purposes and may not reflect the official posted draft of the standard or other documents
  - The drafting team's working copy of PRC-026-1, draft 2
    - Was distributed with the webinar announcement
    - Is posted on the Project 2010-13.3 NERC project page under "related files"
    - Is subject to change

Objectives

- Webinar is intended to provide general information
- Informal Question and Answer (Q&A) at the end
  - Q&A session is intended to improve overall understanding
  - Submit questions and comments via the chat feature
  - Some questions may require future team consideration
  - Please reference slide number, standard section, etc.
  - Presenters will attempt to address each question
  - Webinar and chat comments are not a part of the official project record

Project History

Project Background

- FERC Order No. 733 (dated March 18, 2010)
  - Approved PRC-023-1 – Transmission Relay Loadability
  - Directed NERC to address three other items
- Project SAR addressed directives in three phases
  - Modification to transmission relay loadability (PRC-023-2)
  - Address generator relay loadability (PRC-025-1)
  - Address relay loadability due to stable power swings (PRC-026-1)
- Subsequent FERC Order Nos. 733-A and 733-B
  - Responded to industry and NERC concerns
  - Reaffirmed the need for a loadability standard to address power swings
- Technical report developed for drafting team guidance
  - NERC System Protection & Control Subcommittee (SPCS)
  - NERC System Analysis & Modeling Subcommittee (SAMS)

Technical Report

- *Protection System Response to Power Swings*, August 2013
  - Generally referred as PSRPS Report or SPCS Report
  - Promote general understanding of the overall concepts related to the nature of power swings
  - The effects of power swings on protection system operation
  - Techniques (and limitations) for detecting power swings
  - Methods for assessing the impacts on protection system operation
- Starting point for a Reliability Standard
  - Identification of circuits (i.e., BES Elements)
  - Applicability to functional entities
  - Provide methods for demonstrating protection systems will properly respond to power swings

Why the Standard is Moving Forward

- Responsibility
  - Address a reliability concern (i.e., tripping during stable power swings)
  - ERO to be responsive to directives
- Two options exist to meet responsibilities:
  1. Develop requirements applicable to protection systems on all circuits, or
  2. Identify the specific circuits on which a power swing may affect protection system operation and develop requirements applicable to protection systems on those specific circuits
- The PRC-026-1 approach is consistent with the PSRPS Report
  - Provides definitive criteria for identifying Elements
  - Provides protection system assessment criteria
  - Does not sacrifice protection system dependability and security
- Equally effective and more efficient approach to meet directives

Draft 1 Stakeholder Concerns

- PSRPS report recommended a standard was not necessary
- Standard's purpose was perceived as unachievable
  - "relays do not trip" was revised to "relays are not expected to trip"
- January 1, 2003 historical date (removed)
- Planners only allowed one month to provide identified Elements
  - Revised to "each calendar year"
- Requirements
  - Responsibilities not clearly defined between entities
  - Time periods were restrictive and unclear
  - Relay evaluation Requirement overly complicated
- Application Guidelines
  - Need to include more examples and additional detail

Standard – PRC-026-1

Applicability

- Functional Entities:
  - Generator Owners and Transmission Owners that apply load-responsive protective relays on Elements (based on Attachment A)
  - Planning Coordinator (has widest-area view)
- Facilities
  - Bulk Electric System (BES) Elements
    - Generators, transformers, and transmission lines
- Changes in draft 2
  - Reliability Coordinator and Transmission Planners were removed
    - Stakeholders concerned about potential notification overlap and which criteria should each entity be responsible for performing
    - Stakeholders affirmed a single source is more practical

Requirement R1

- Consistent with PSRPS Report Criteria
  1. Generator(s) where an **angular** stability constraint exists which is addressed by an operating limit or a Remedial Action Scheme (RAS) and those Elements terminating at the transmission switching station associated with the generator(s).
  2. An Element that is **monitored** as part of a System Operating Limit (SOL) that has been established based on **angular** stability constraints identified in system planning or operating studies.
  3. An Element that **forms** the boundary of an island due to **angular** instability within **the most recent underfrequency load shedding (UFLS) assessment**.
  4. An Element identified in the most recent Planning Assessment where relay tripping occurs due to a **stable or unstable** power swing during a **simulated disturbance**.
  5. An Element **reported** by the Generator Owner or Transmission Owner pursuant to Requirement R2 or Requirement R3, unless the Planning Coordinator determines the Element is no longer susceptible to power swings.

Requirement R2 and R3

R2. Each Transmission Owner shall, within 120 calendar days of identifying an Element that meets either of the following criteria, provide notification of the Element to its Planning Coordinator:

Criteria:

1. An Element that **trips** due to a **stable or unstable** power swing during an actual system Disturbance.
2. An Element that **forms** the boundary of an island during an actual system Disturbance.

R3. Each Generator Owner shall, within 120 calendar days of identifying an Element that meets the following criterion, provide notification of the Element to its Planning Coordinator:

Criterion:

1. An Element that **trips** due to a **stable or unstable** power swing during an actual system Disturbance.

Requirement R4

R4. Each Generator Owner and Transmission Owner shall, within the appropriate timeframe in Part 4.1, perform one of the actions in Part 4.2 for each Element identified pursuant to Requirement R1, R2, or R3.

- Three aspects of relay evaluation
  - 4.1 Timeframes (based on notification of Elements or events)
  - 4.2 Actions (evaluation of relay)
  - 4.3 Criteria for evaluations
    - (A) Distance relay criteria
    - (B) Overcurrent relay criteria

R4, Part 4.1 Timeframes

- Within 12 calendar months of receiving notification of an Element pursuant to Requirement R1 that has not been assessed in the last three calendar years in accordance with 4.2 Actions
- Within 12 calendar months of identifying an Element pursuant to Requirement R2 or R3

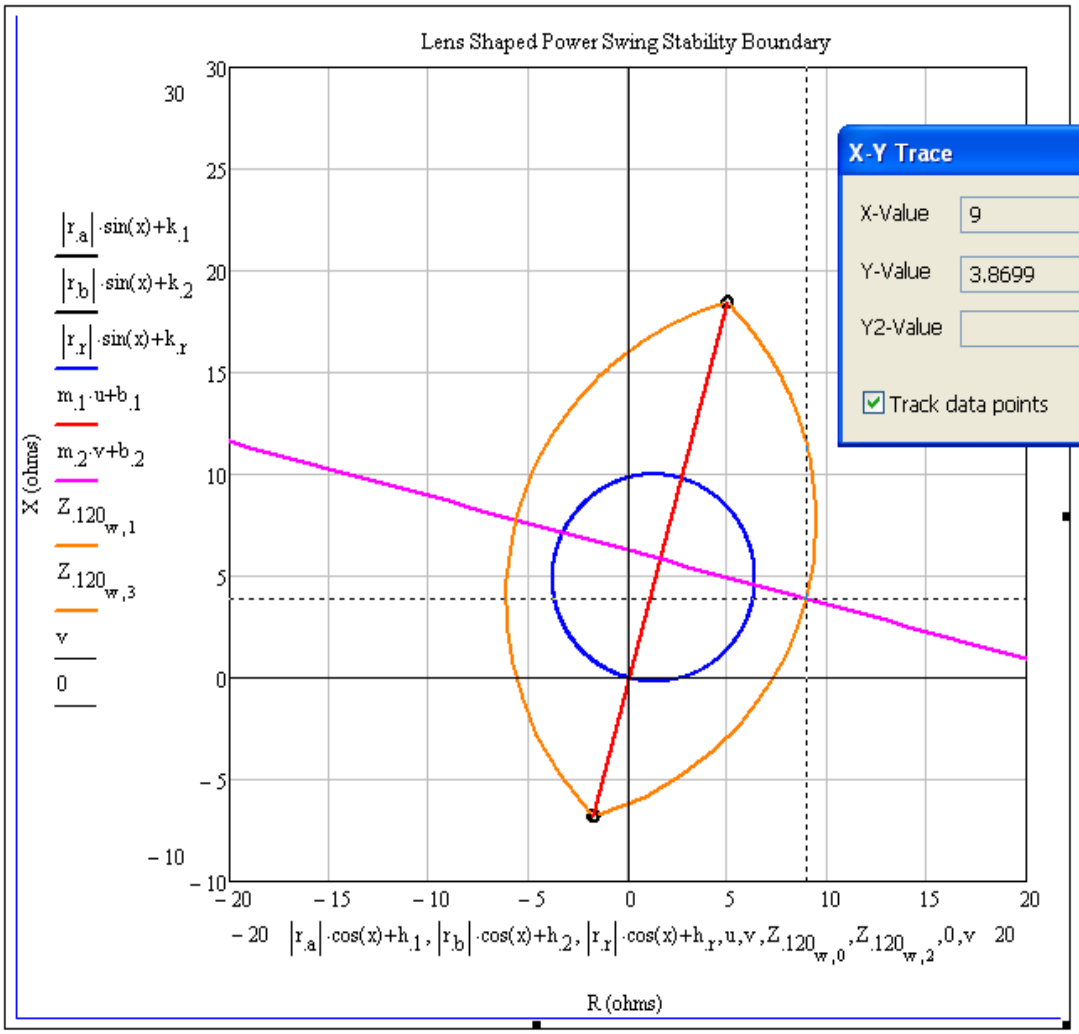
***Note**: The presentation will cover Part 4.3 next in order to demonstrate role of Part 4.2 later in the presentation.*

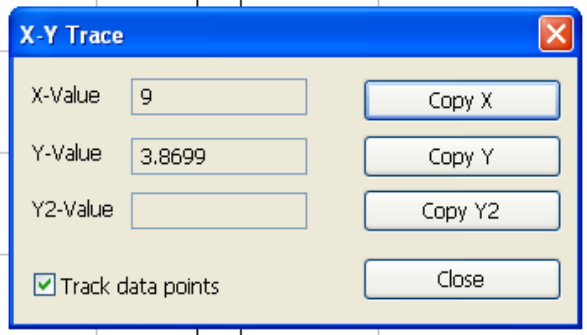
R4, Part 4.3 Criteria (A)

A distance relay impedance characteristic, used for tripping, that is completely contained within **the portion of** the lens characteristic formed in the impedance (R-X) plane that connects the endpoints of the total system impedance (**with the parallel transfer impedance removed**) **bounded** by varying the sending end and receiving end voltages from **0.5** to 1.0 per unit, while maintaining a constant system separation angle across the total system impedance where:

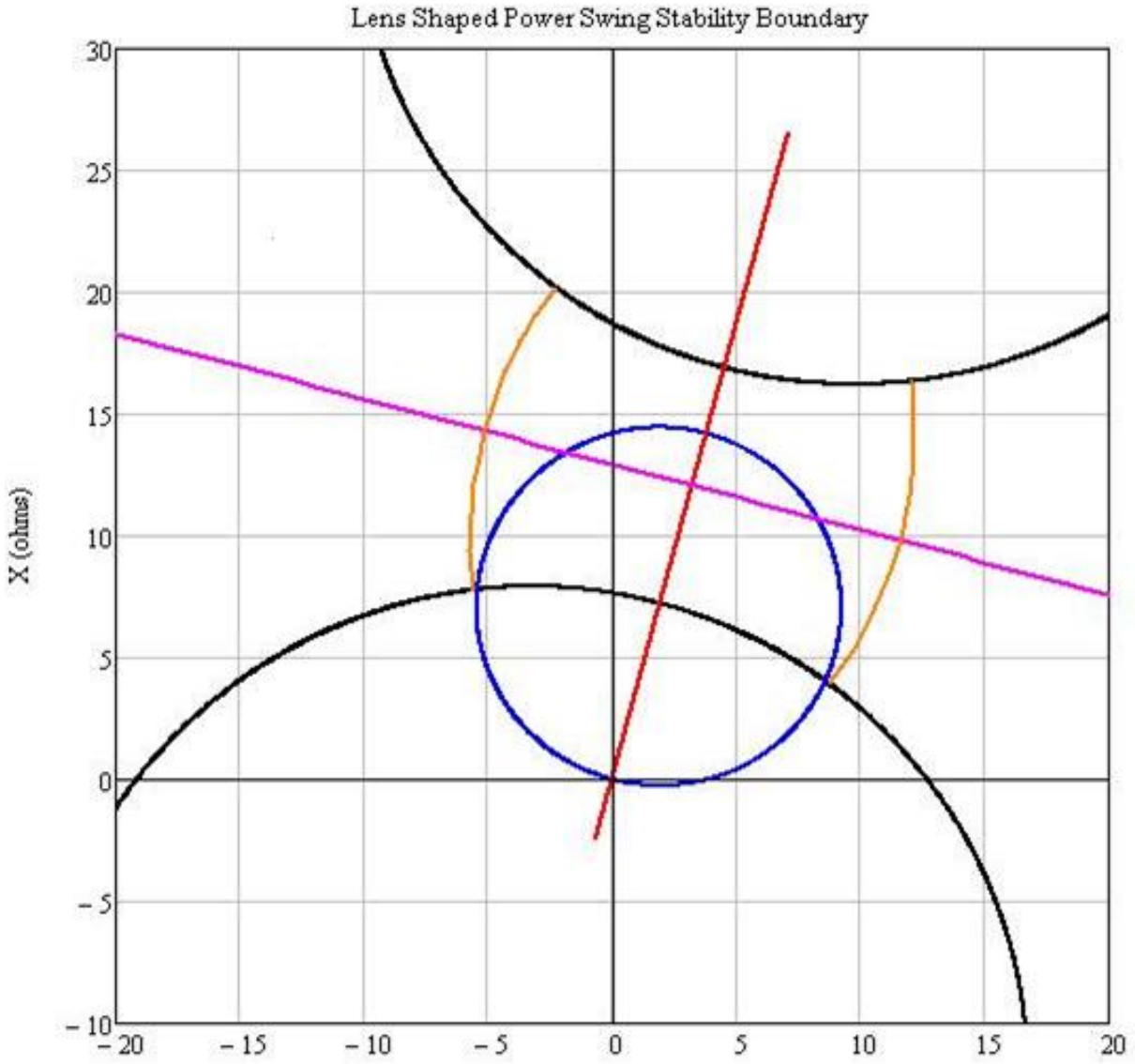
1. The system separation angle is:
   - At least 120 degrees where power swing blocking is not applied, or
   - An angle less than 120 degrees as agreed upon by the **respective** Planning Coordinator, Reliability Coordinator, and Transmission Planner where power swing blocking is not applied.
2. All generation is in service and all transmission Elements are in their normal operating state **when calculating the system impedance**.
3. **Saturated** (**transient** or sub-transient) reactance is used for all machines.

Impedance Plot – Draft 1

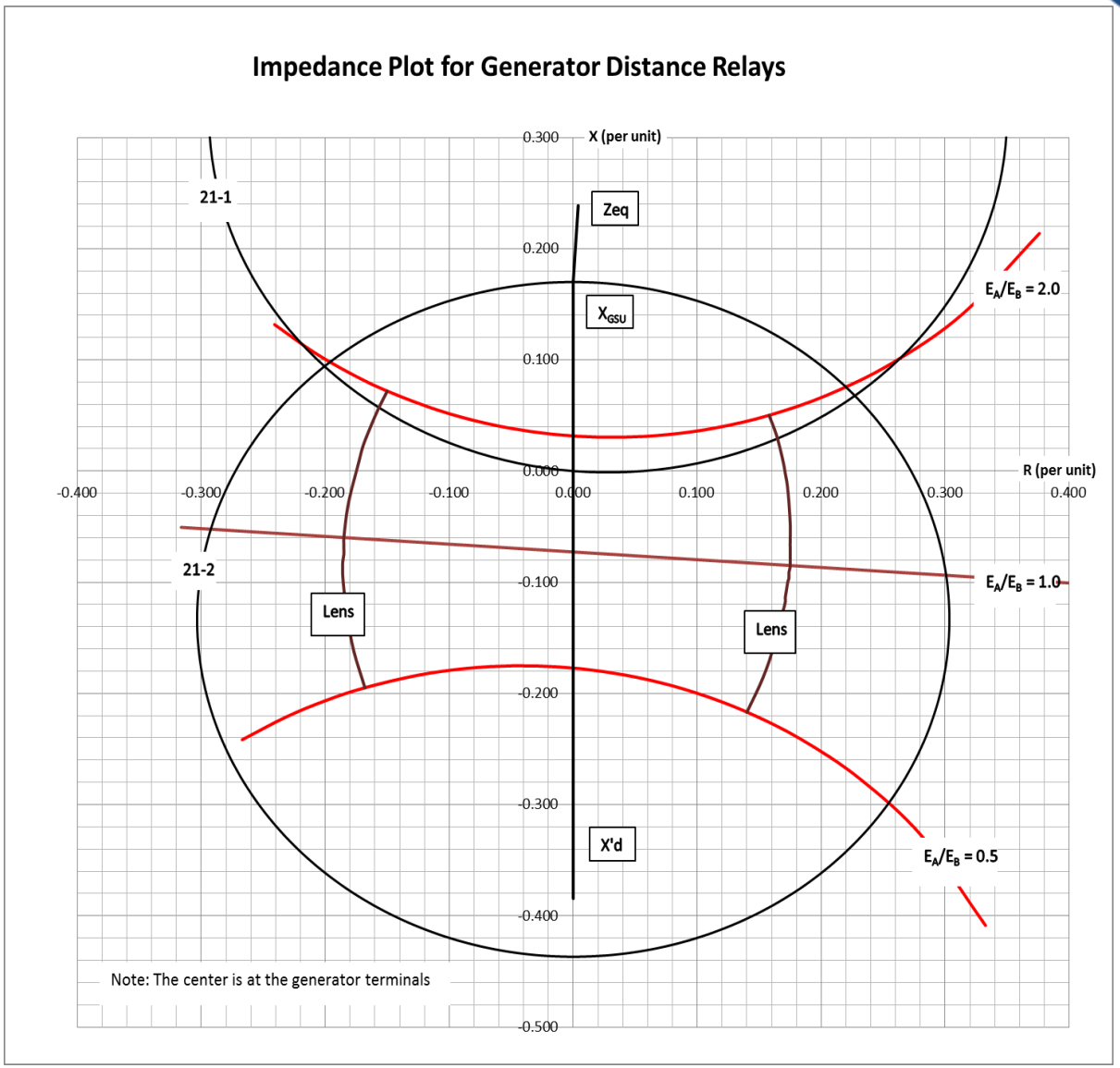




R4, 4.3 (A) Impedance Plot Typical for Transmission



R4, 4.3 (A) Impedance Plot Typical for Generation



R4, Part 4.3 Criteria (B)

(B) The pickup of an overcurrent element used for tripping, that is above the calculated current value (with the parallel transfer impedance removed) for the conditions below:

1. The system separation angle is:
   - At least 120 degrees where power swing blocking is not applied, or
   - An angle less than 120 degrees as agreed upon by the respective Planning Coordinator, Reliability Coordinator, and Transmission Planner where power swing blocking is not applied.
2. Both the sending and receiving voltages at 1.05 per unit.
3. All generation is in service and all transmission Elements are in their normal operating state when calculating the system impedance.
4. Saturated (transient or sub-transient) reactance is used for all machines.

R4, Part 4.2 Actions

- Demonstrate that the existing load-responsive protective relays are not expected to trip in response to a stable power swing based on the 4.3 Criteria below
- Demonstrate that the existing load-responsive protective relays are not expected to trip in response to a stable power swing because power swing blocking is applied
- Develop a Corrective Action Plan (CAP) to modify the Protection System so that the load-responsive protective relays are not expected to trip in response to a stable power swing based on the 4.3 Criteria below or by applying power swing blocking

R4, Part 4.2 Actions (Continued)

- If none of the options above results in dependable fault detection or dependable out-of-step tripping (if out-of-step tripping is applied at the terminal of the Element):
  a. provide the technical justification for retaining the existing Protection System design and settings to the respective Planning Coordinator, Reliability Coordinator, and Transmission Planner, or
  b. provide the technical justification for modifying the Protection System design, settings, or both to the respective Planning Coordinator, Reliability Coordinator, and Transmission Planner, and develop a CAP for this modification of the Protection System.

Requirement R5 & Attachment A

R5. Each Generator Owner and Transmission Owner shall implement each CAP developed pursuant to Requirement R4, and update each CAP if actions or timetables change, until all actions are complete

- Attachment A
  - New addition to draft 2 (similar to PRC-023 approach)
  - Will most likely change based on feedback the drafting team has received
  - Stakeholders prefer to have a list of what is “applicable”
    - Prefer to discuss why or why not relays are applicable in the Application Guidelines

Closing Remarks

Going Forward

- The SDT in-person meeting – August 4-7, 2014
  - Minneapolis, MN at Xcel (downtown) contemporaneously with the SPCS
  - Open to industry
  - SDT will set aside time for technical discussion with industry (remotely and in-person) from 2:00-5:00 p.m. Central on Monday, August 4, 2014
  - At www.nerc.com – See Program Areas, Standards calendar for registration details
- Next Steps
  - Additional 45-day comment period and ballot mid-August 2014
  - SDT meeting mid-October 2014
  - Final ballot October-November 2014
  - Present to NERC Board of Trustees in November 2014
  - File to meet December 31, 2014 regulatory deadline in Order 733

Commenting

- Effective feedback:
  - Specific to question, brevity is best
  - Provide suggestions or equally effective alternative
  - Indicating agreement with others is preferred over copying the comments (e.g., “ABC agrees with XYZ’s comments...” or “ABC agrees with XYZ’s comments except for…”)
  - Provide proposed change and rationale
- Less effective feedback:
  - Repeating same comment multiple times
  - No reference to where suggested change should occur
  - Non-specific concerns (e.g., “This change is not needed.”)
- Balloting will be in legacy system

Question and Answer Session

- Please submit your questions via the chat window
  - This session is intended to help general understanding
  - Please reference slide number, standard section, etc.
  - Presenters will respond to as many questions as possible
  - Some questions may have to be deferred to the team
- For the official record
  - Webinar and chat comments are not a part of the official project record
  - Comments must be submitted via the project page during posting
  - The drafting team will consider any informal feedback
    - Send to a team member
    - Send to the Standards Developer (scott.barfield@nerc.net) for distribution to the team

Conclusion

- Encourage working through forums or trades
  - To become aware of industry direction on topics
  - Develop consolidated comments informally or during postings
- NERC Standard Developer, Scott Barfield-McGinnis
  - Email at scott.barfield@nerc.net
  - Telephone: 404-446-9689
  - To receive **Project 2010-13.3** announcements and updates
    - Request to be added to **PSRPS_Plus**
- Webinar slides and recording will be posted to www.nerc.com
  - In about 24 hours following webinar under “Standards” / “Webinars”
  - Link will be provided in the next “Standards Bulletin”
- Thank you for participating