

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

May 12, 2014

RELIABILITY | ACCOUNTABILITY



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- Bill Edwards, Counsel
- Phil Tatro, Principal Performance and Analysis Engineer

- Administrative Items
 - Antitrust & Disclaimers
 - Objectives & Project Background
 - Technical Report
- Standard – PRC-026-1
 - Applicability
 - Initial Development to Current Approach
 - Requirements
- Application Guidelines
- Other Posted Documentation
- Closing Remarks
 - Including Questions & Answers Session



Administrative Items

- **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.

- **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

- 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

- NERC System Protection & Control Subcommittee (SPCS)
 - Developed technical report to be used as guidance
- Appointed a new Phase 3 standard drafting team
 - Protection System Response to Power Swings (PSRPS SDT)
 - Experienced in:
 - Planning, protective relaying, or both
 - All Regions & Interconnections
 - From both U.S. and Canada

- *Protection System Response to Power Swings, August 2013*
 - 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., Elements)
 - Provide methods for demonstrating protection systems are appropriately set
 - Applicability to functional entities



Standard – PRC-026-1

- Consistent with SPCS technical report
 - Functional Entities:
 - Generator Owners (GO) and Transmission Owners (TO) that apply load-responsive protective relays on Elements
 - Planning Coordinator (PC), Reliability Coordinator (RC), and Transmission Planners (TP) (wide-area view)
 - Facilities:
 - Bulk Electric System (BES) Elements
 - Generators, transformers, and transmission lines

- R1 – All entities identify Elements based on criteria, including Disturbance(s)
- R2 – GO/TO performs an evaluation (relays pass or not)
- R3 – GO/TO notifies the TP of non-passing Elements
- R4 – TP performs prescribed simulations
- R5 – TP provides simulation results to GO/TO
- R6 – GO/TO uses simulation results
 - Demonstrate relay is not expected to trip
 - Develop a Corrective Action Plan (CAP)
 - To revise the protection system settings
 - To modify or replace the protection system
- R7 – Implement the CAP

- Included Requirements for notifications
 - Although important to reliability, general perception is administrative
- Simulations to be performed by the TP were overly prescriptive
 - May limit simulation of the worst case stable power swing
 - Increases entity burden
 - Provided no flexibility

- R1 – PC/RC/TP identify Elements using specific criteria
- R2 – GO/TO identify Elements using past Disturbances
- R3 – GO/TO shall meet options for Protection Systems for identified Elements (R1 or R2)
 - Demonstrate or make modifications (using a CAP) so that the relay is not expected to trip in response to a stable power swing
 - If dependable fault detection or dependable out-of-step tripping, obtain agreement from the PC, RC, and TP (e.g., use existing settings, or other modification - CAP)
- R4 – Implement CAP (if developed)

- Fewer Requirements
- Allows TP flexibility in simulations
 - Use existing models
 - Simulate based upon experience
 - Modify model parameters to achieve worst case stable swing
- Removes notification requirements
 - Improves communication among operators, owners, and planners
 - Eliminates burden of retaining notification evidence
- Allows performance options to be under a single Requirement
 - Relay screening process
 - Modification of the Protection System
 - If needed, collaborate with planners and operators

- The PC, RC and TP shall identify Elements based upon criteria...
 1. An Element that is located or terminates at a generating plant, where a generating plant stability constraint exists and is addressed by an operating limit or a Special Protection System (SPS) (including line-out conditions).
 2. An Element that is associated with a System Operating Limit (SOL) that has been established based on stability constraints identified in system planning or operating studies (including line-out conditions).
 3. An Element that has formed the boundary of an island within an angular stability planning simulation where the system Disturbance(s) that caused the islanding condition continues to be a credible event.
 4. An Element identified in the most recent Planning Assessment where relay tripping occurred for a power swing during a Disturbance.

- The GO and TO shall identify Elements based upon criteria...
 1. An Element that has tripped since January 1, 2003, due to a power swing during an actual system Disturbance where the Disturbance(s) that caused the trip due to a power swing continues to be credible.
 2. An Element that has formed the boundary of an island since January 1, 2003, during an actual system Disturbance where the Disturbance(s) that caused the islanding condition continues to be credible.
- Use of the NERC defined glossary term, “Disturbance”
- Continues to be “credible”
 - Permits an Element to be removed as an identified Element
 - Changes to BES topologies (e.g., station bus reconfiguration)
 - Changes to operating conditions (e.g., retirement of generation)

- Use of historical date (January 1, 2003)
 - Identifying Elements is a “current day” reliability activity
 - Ensures that “known events” prior to the effective date are utilized in identifying at-risk Elements
 - Important to reliability to address known risks
 - Evidence prior to the effective date is not required
- Reliability Standard Audit Worksheet (RSAW) will provide an audit approach to improve understanding
 - Requirement is not mandating evidence prior to standard
 - Required – Evidence of Disturbances from Effective Date forward where tripping was due to a power swing
 - Use available/known historical Disturbance due to power swings
 - Historical Disturbances continue to be credible

- The GO and TO shall...
 - Demonstrate that the existing Protection System is not expected to trip in response to a stable power swing based on the criterion* below.
 - Demonstrate that the existing Protection System is not expected to trip in response to a stable power swing because power swing blocking is applied.
 - Develop a CAP to modify the Protection System so that the Protection System is not expected to trip in response to a stable power swing based on the criterion* below **or** by applying power swing blocking.

*See next slide for criterion.

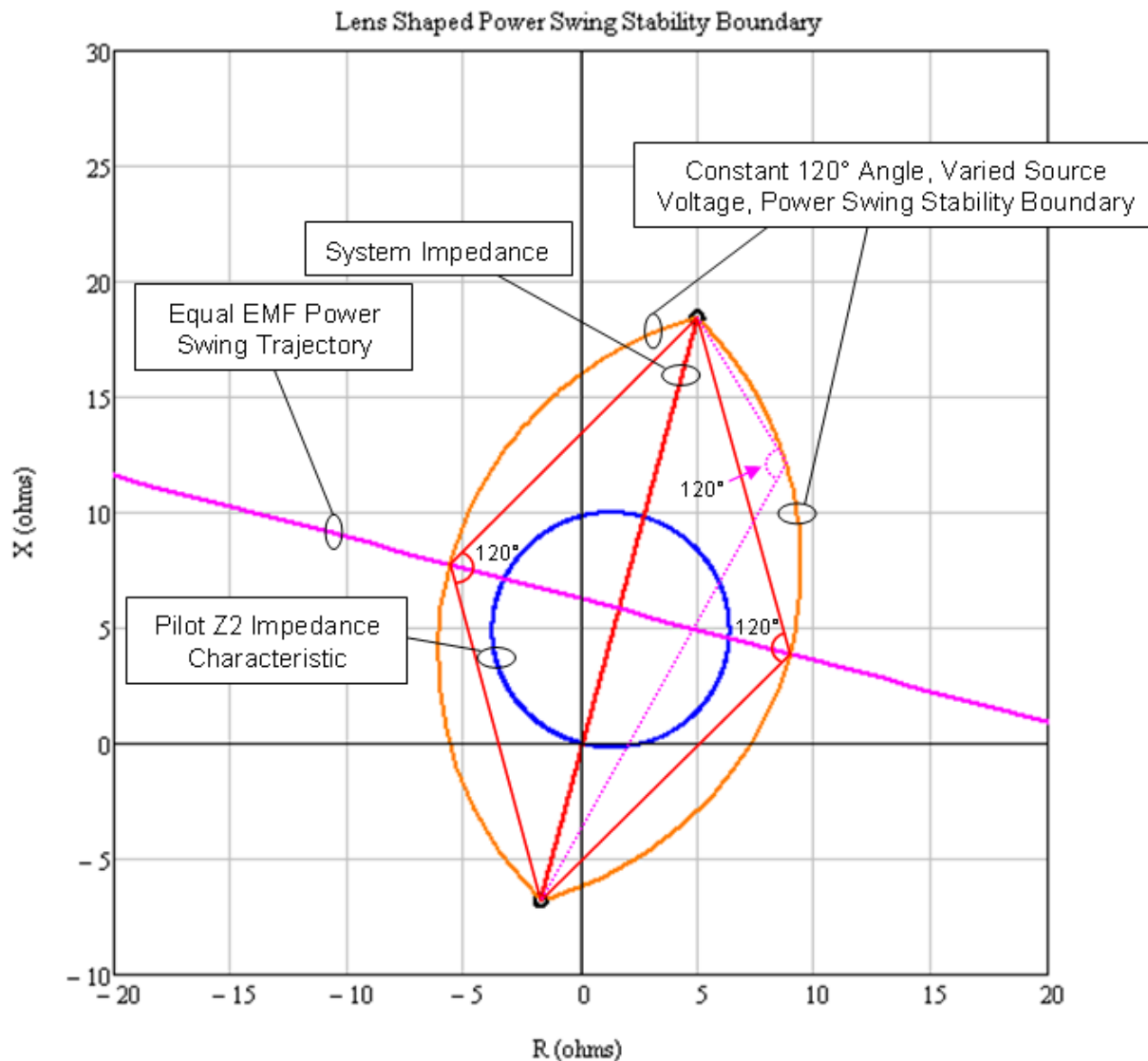
- A distance relay impedance characteristic, used for tripping, that is completely contained within the lens characteristic formed in the impedance (R-X) plane that connects the endpoints of the total system impedance by varying the sending end and receiving end voltages from 0 to 1.0 per unit, while maintaining a constant system separation angle across the total system impedance where:
 1. Where power swing blocking is not applied, the system separation angle is:
 - At least 120 degrees, or
 - Less than 120 degrees as agreed upon by the PC, RC, and TP
 2. All generation is in service and all transmission Elements are in their normal operating state.
 3. Sub-transient reactance is used for all machines.

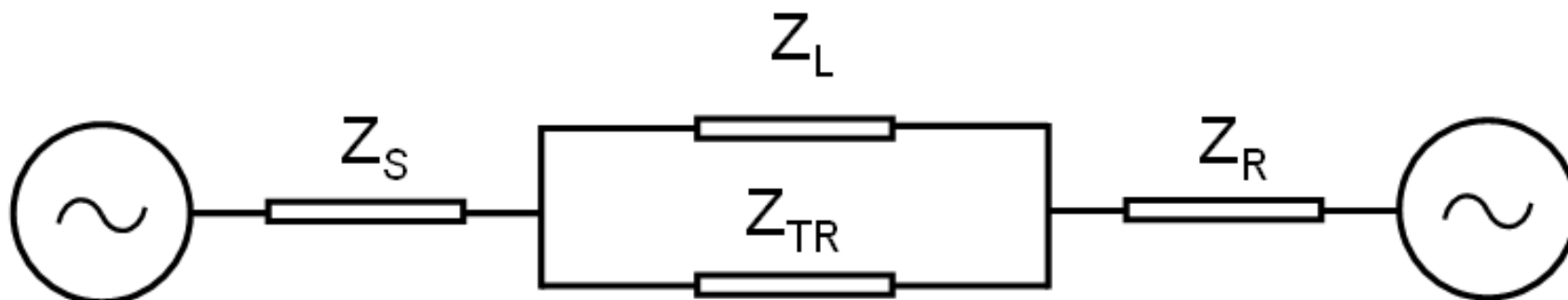
- The GO and TO shall...
 - If none of the options above results in dependable fault detection or dependable out-of-step tripping:
 - a. obtain agreement from the respective Planning Coordinator, Reliability Coordinator, and Transmission Planner of the Element that the existing Protection System design and settings are acceptable, or
 - b. obtain agreement from the respective Planning Coordinator, Reliability Coordinator, and Transmission Planner of the Element that a modification of the Protection System design, settings, or both are acceptable, and develop a CAP for this modification of the Protection System.
- Benefits
 - Allows the appropriate entity to perform simulations based upon experience
 - Supports communication among entities with wide-area visibility
 - Achieves a proper balance of protection system security and dependability

- Implementation of a CAP
 - Allows entity discretion in determining how to meet the performance
 - Revise protection system settings
 - Modify the protection system (e.g., install power swing blocking)
 - Replace the protection system
- Communicating CAP actions and/or timeline
 - Communicating CAP details is not a Requirement
 - The standard by its requirements inherently creates communication among entities
 - The GO and TO can provide information as a matter of practice without compliance obligations
 - The PC, RC, or TP may request a periodic update (e.g., when preparing Annual Assessments)
 - A requirement to update an entity has little or no impact on reliability

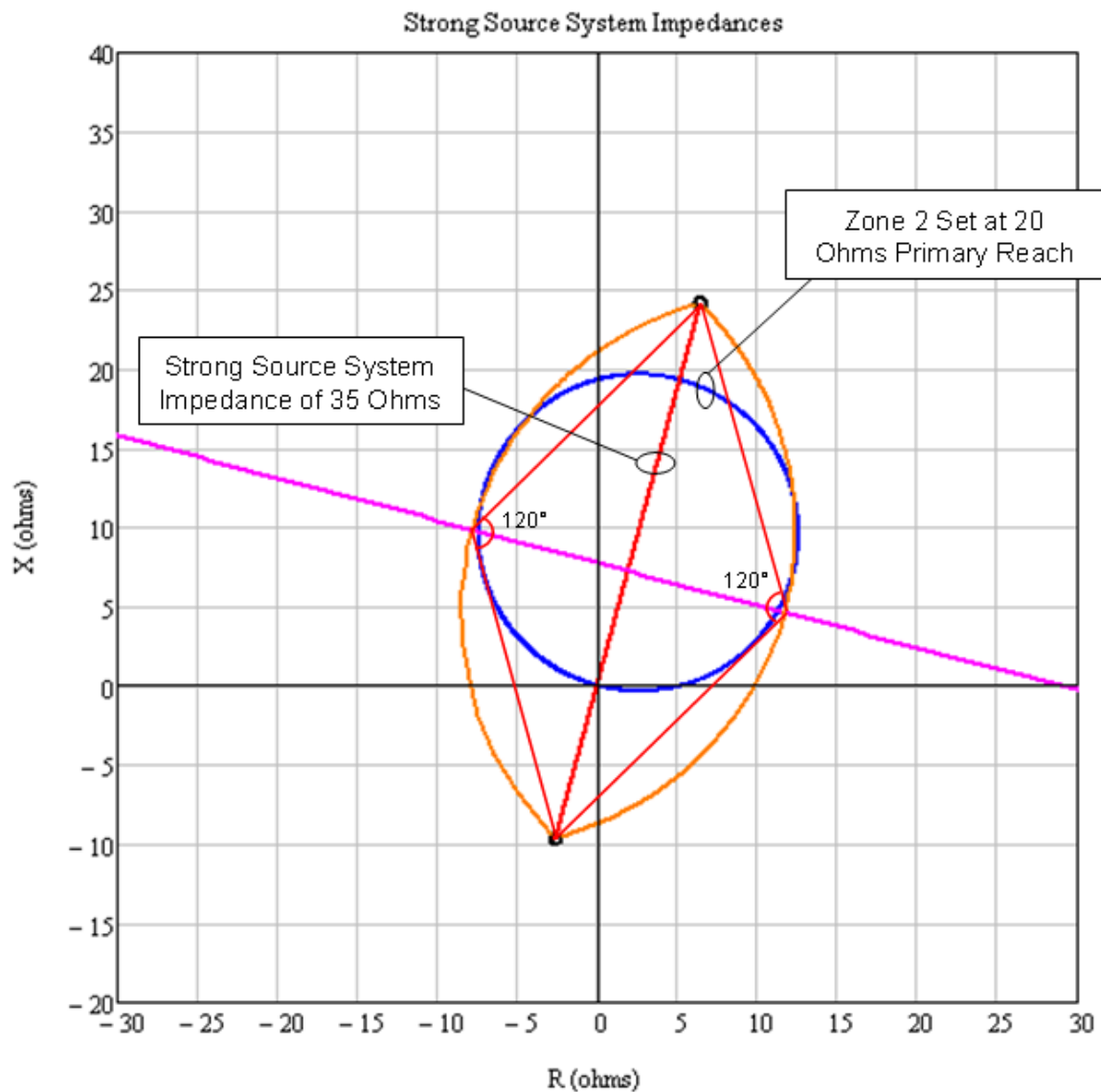


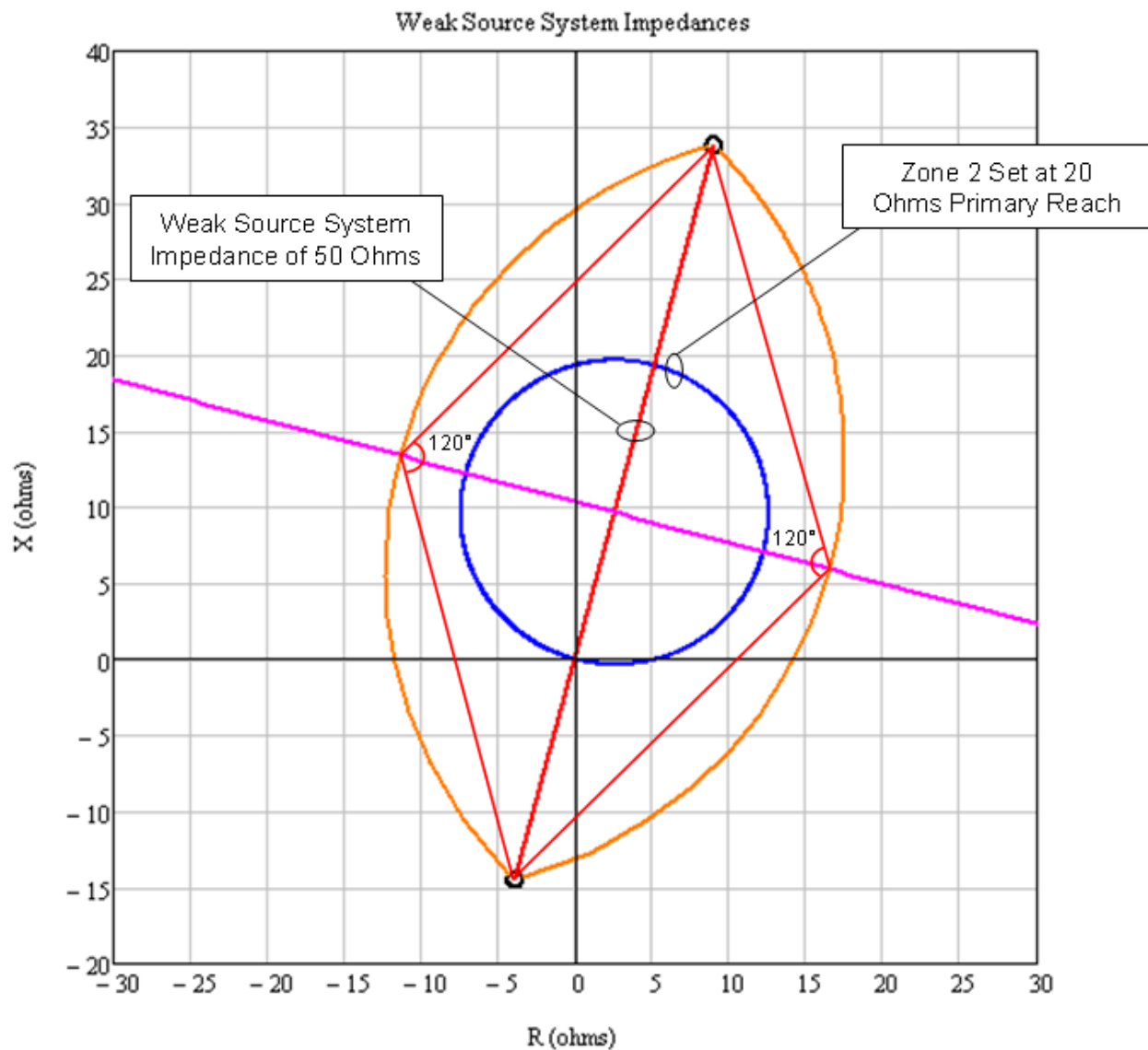
Application Guidelines

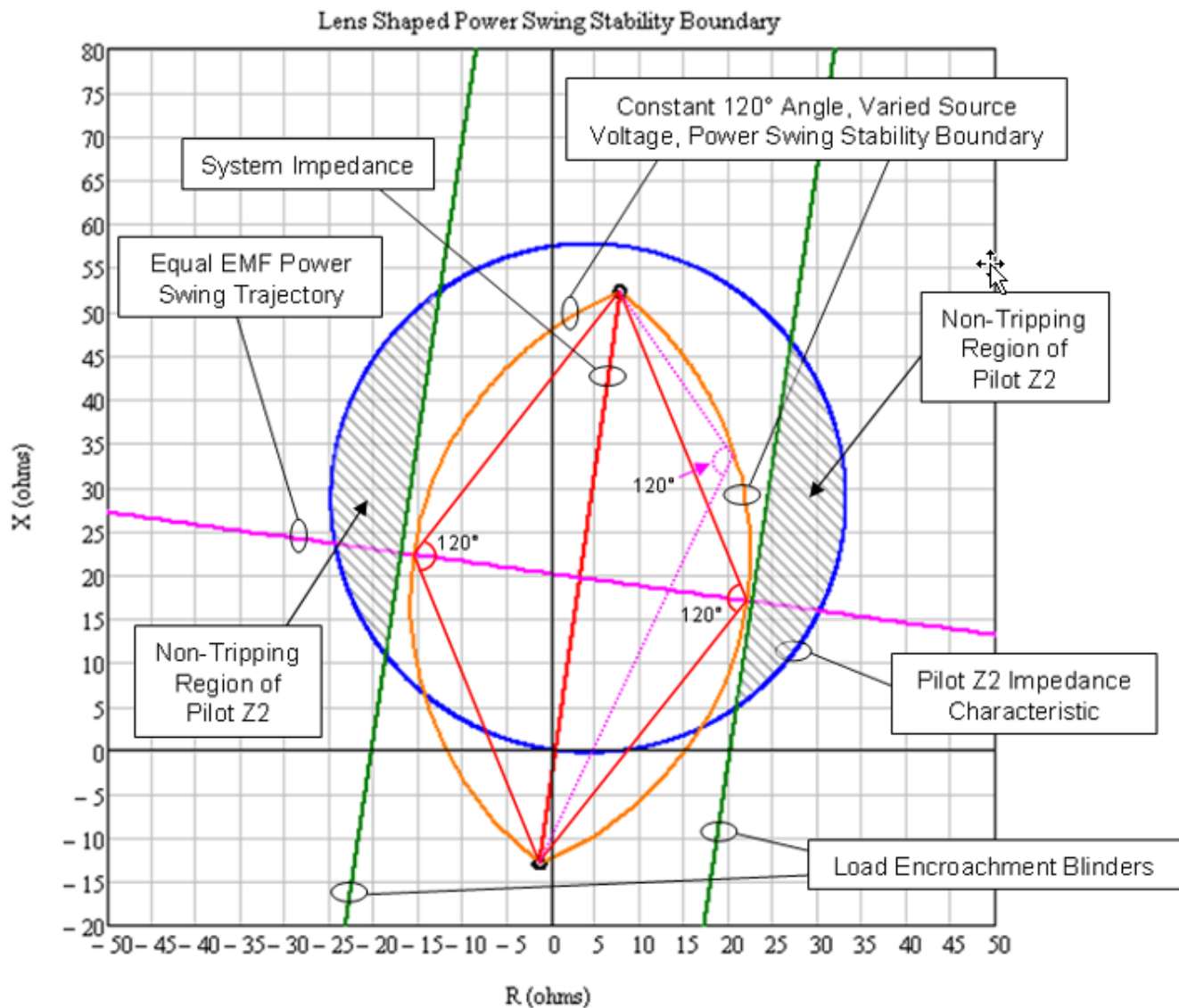




$$Z_{\text{Total}} = Z_S + \frac{Z_L \cdot Z_{TR}}{Z_L + Z_{TR}} + Z_R$$









Other Posted Documentation

- Implementation Plan
 - Creates a January 1 starting date
 - Minimum one complete (full) year
 - For example:

Approval	+12 months	Effective	Total Time
2/10/2015	2/10/2016	1/1/2017	~23 months
11/20/2015	11/20/16	1/1/2017	~13 months

- Violation Risk Factors and Violation Severity Level Justifications
- Consideration of Issues and Directives
- RSAW (NERC Compliance effort)



Closing Remarks

- The SDT in-person meeting – June 16-20, 2014
 - Westminster, CO at Tri-State G&T Association (north Denver metro area)
 - At www.nerc.com – See Program Areas, Standards calendar for details
- Following Consideration of comments
 - Additional comment period and ballot late June 2014
 - SDT Meeting late August 2014
 - Final ballot September 2014
 - Present to NERC Board of Trustees in November 2014

- 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

- 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
 - Ballot begins on May 30
 - The comment/ballot period (**ends 8:00 p.m. ET on Monday, June 9, 2014**)

- NERC Standard Developer, Scott Barfield-McGinnis
 - Email at scott.barfield@nerc.net
 - Telephone: 404-446-9689
 - To receive project announcements and updates
 - Request to be added to PSRPS_Plus
- RSAW Development
 - Posting expected on May 16
 - RSAW posting will run contemporaneously with standard
- Webinar slides and recording will be posted to project page
 - In about 24 hours following webinar under “Related Files”
 - Link will be provided in the next “Standards Bulletin”
- Thank you for participating