

**NERC**

NORTH AMERICAN ELECTRIC  
RELIABILITY CORPORATION

# Project 2010-05.2 – Special Protection Systems (SPS)

## Phase 1 – Definition of Remedial Action Scheme

SPS Standard Drafting Team

Industry Webinar

June 30, 2014

**RELIABILITY | ACCOUNTABILITY**



- Welcome and Introductions
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  - Webinar Format
- Presenters and Standard Drafting Team (SDT) Members
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- RAS Definition Overview
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- Project Timeline and Coordination with Undervoltage Load-Shedding Standard Project
- Questions and Answers

## NERC Antitrust Guidelines

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## Disclaimer

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- Wording in this presentation is used for illustrative purposes and may not reflect the exact draft of the posted standard.

- Two-hour webinar
  - Presentation
    - Project Scope and Background
    - Definition Overview
  - Informal Question and Answer Session
    - You may submit questions at any time via the chat feature or when the operator-assisted phone line is opened after the presentation
    - Presenters will attempt to address each question
    - Some questions may require SDT discussion

- Industry Stakeholders
  - SDT Members
- NERC Staff
  - Al McMeekin, Standards Developer – Standards
  - Bill Edwards, Counsel, Standards – Legal
  - Phil Tatro, Principal Engineer – Reliability Initiatives and System Analysis

Member	Entity
Gene Henneberg (Chair)	NV Energy / Berkshire Hathaway Energy
Bobby Jones (Vice Chair)	Southern Company
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Charles-Eric Langlois	Hydro-Quebec TransEnergie
Robert J. O'Keefe	American Electric Power
Hari Singh	Xcel Energy



# Project Scope and Background

Al McMeekin, NERC Standards Developer



## Phase 1

- The SDT will revise the NERC Glossary of Terms definition for a Special Protection System (SPS) or Remedial Action Scheme (RAS)

## Phase 2

- The SDT will address the six existing SPS-related standards:
  - PRC-012-0 Special Protection System Review Procedure
  - PRC-013-0 Special Protection System Database
  - PRC-014-0 Special Protection System Assessment
  - PRC-015-0 Special Protection System Data and Documentation
  - PRC-016-0.1 Special Protection System Misoperations
  - PRC-017-0 Special Protection System Maintenance and Testing

- NERC Project 2010-05.2 Special Protection Systems is phase 2 of Protection Systems
  - NERC Standards Committee (SC) requested Planning Committee (PC) research
  - System Protection and Control Subcommittee (SPCS) and System Analysis and Modeling Subcommittee (SAMS) issued technical report
  - NERC SC appointed the SDT on February 12, 2014
  - Standards Authorization Request (SAR) posted for a 30-day informal comment period February 18–March 19, 2014
  - The SPCS/SAMS straw-man definition of SPS posted for a 30-day informal comment period March 11–April 9, 2014
  - The first draft of the revised definition of RAS posted for a 45-day formal comment and ballot period June 11–July 25, 2014



# **RAS Definition Overview**

Gene Henneberg, SDT Chair

An automatic protection system designed to detect abnormal or predetermined system conditions, and take corrective actions other than and/or in addition to the isolation of faulted components to maintain system reliability. Such action may include changes in demand, generation (MW and Mvar), or system configuration to maintain system stability, acceptable voltage, or power flows. An SPS does not include (a) underfrequency or undervoltage load shedding or (b) fault conditions that must be isolated or (c) out-of-step relaying (not designed as an integral part of an SPS). Also called Remedial Action Scheme.

- Existing definition lacks clarity and specificity to identify what is or is not SPS/RAS
- Existing definition lacks clarity in actions (very broad), so many common schemes may be inadvertently included as RAS
- Confusion has led to inconsistent application of the Reliability Standards across the eight NERC Regions

- Use a single term to promote consistency
- Retain “Remedial Action Scheme” (RAS)
- Retire “Special Protection System” (SPS)

- RAS is more descriptive of the scheme purpose
- The term RAS eliminates confusion associated with the two defined terms “Special Protection System” and “Protection System”
  - Protection components are often used to build RAS

- The SDT used the proposed definition from the NERC SAMS/SPCS technical report as a straw-man for this effort
- The SAMS/SPCS definition included RAS classification “Types”
  - The SDT decided not to include these in the definition; they will be considered when the standards are revised
- The SAMS/SPCS definition featured a list of certain exclusions. The SDT adopted this approach but made changes:
  - Some exclusions were absorbed in the main definition
  - Some exclusions were modified or combined
  - More exclusions were added



- The SAMS/SPCS technical report proposed four classification “Types” of RAS
  - Planning Significant (PS)
  - Planning Limited (PL)
  - Extreme Significant (ES)
  - Extreme Limited (EL)
- The SDT postponed consideration of “Types” until the standard writing effort
  - “Types” are not needed to provide clarity in the proposed RAS definition
  - Avoids potentially iterative process of aligning the Types and the standard requirements

- **Schemes that prevent high line voltage by automatically switching the affected line**
  - The scheme and exclusion is addressed by the newly proposed exclusions “e” (high voltage) and “i” (open end transfer trip). These schemes as applied in the utility industry are commonly not considered RAS and the SDT accepts this practice.

- **Protection schemes that operate local breakers other than those on the faulted circuit to facilitate Fault clearing, such as, but not limited to, opening a circuit breaker to remove infeed so protection at a remote terminal can detect a Fault or to reduce fault duty**
  - The scheme described here is a traditional, though perhaps less commonly used, Protection System used for safe and reliable fault clearing.
  - These schemes are addressed by a change to the main definition.

- **Blanket exclusion for sub-synchronous resonance (SSR) protection schemes**
  - The proposed definition excludes schemes that directly detect sub-synchronous quantities and take corrective actions
  - SSR mitigation schemes that detect specific System configurations and loading conditions (that studies have shown may make a generator vulnerable to SSR), and take corrective actions, are classified as RAS.

- **A Protection System that includes multiple elements within its zone of protection, or that isolates more than the faulted element because an interrupting device is not provided between the faulted element and one or more other elements**
  - The scheme described in this suggested exclusion is a traditional, though perhaps less commonly used, Protection System used to clear faults by operating the minimum number of interrupting devices.
  - These schemes are addressed by a change to the main definition.

## *Remedial Action Scheme (RAS)*

A scheme designed to detect predetermined System conditions and automatically take corrective actions that may include, but are not limited to, curtailing or tripping generation or other sources, curtailing or tripping load, or reconfiguring System(s).

RAS accomplish one or more of the following objectives:

- Meet requirements identified in the NERC Reliability Standards;
- Maintain System stability;
- Maintain acceptable System voltages;
- Maintain acceptable power flows;
- Limit the impact of Cascading; or
- Address other Bulk Electric System (BES) reliability concerns.

These schemes are not Protection Systems; however, they may share components with Protection Systems.

The following do not individually constitute a RAS:

- a. Out-of-step tripping and power swing blocking
- b. Automatic underfrequency load shedding (UFLS) programs
- c. Undervoltage Load Shedding Programs (UVLS Programs)
- d. Autoreclosing schemes
- e. Schemes applied on an Element for non-Fault conditions such as, but not limited to, generator loss-of-field, transformer top-oil temperature, high voltage, or overload to protect the Element against damage by removing it from service
- f. Controllers that switch or regulate series or shunt reactive devices, flexible alternating current transmission system (FACTS) devices, phase-shifting transformers, variable-frequency transformers, tap-changing transformers, or generation excitation, and that are located at and monitor quantities solely at the same station as the Element being switched or regulated

- g. FACTS controllers that remotely switch static shunt reactive devices located at other stations to regulate the output of a single FACTS device
- h. Schemes or controllers that remotely switch shunt reactors and shunt capacitors for voltage regulation that would otherwise be manually switched
- i. Schemes that automatically de-energize a line for a non-Fault operation when one end of the line is open
- j. Schemes that provide anti-islanding protection (e.g., protect load from effects of being isolated with generation that may not be capable of maintaining acceptable frequency and voltage)
- k. Automatic sequences that proceed when manually initiated solely by an operator
- l. Modulation of HVdc or FACTS via supplementary controls such as angle damping or frequency damping applied to damp local or inter-area oscillations
- m. Sub-synchronous resonance (SSR) protection schemes that directly detect sub-synchronous quantities (e.g., currents or torsional oscillations)





# Proposed Definition: Exclusions

SDT Members

- **a. Out-of-step tripping and power swing blocking**
  - Out-of-step (tripping) relaying is a protective function
  - Power swing blocking was added to reflect current industry terminology
- **b. Automatic underfrequency load shedding (UFLS) programs**
  - UFLS programs are protective functions and are addressed by existing NERC Standard PRC-006-1

(Both **a** and **b** above are excluded in the existing definition of SPS/RAS, and the SDT has maintained the exclusions)

- **d. Autoreclosing schemes (1 or 3 Pole)**
  - Typical autoreclosing schemes are used to minimize system impacts and restoration efforts by System Operators
  - Autoreclosing, in itself, is not a RAS
  - However, if integrated into a larger scheme that performs additional corrective actions to accomplish the objective(s) listed in the RAS definition, then it would be part of a RAS

- **c. Undervoltage Load Shedding Programs (UVLS Programs)**
  - Intent is to maintain the *undervoltage load shedding* exclusion in the existing SPS/RAS definition, but provide more clarity on what kind of UVLS implementation does (or does not) constitute this exclusion (recognizing that UVLS is not a defined glossary term)
  - Adopted the proposed new glossary term “UVLS Program” developed by the SDT for Project 2008-02 – Undervoltage Load Shedding because
    - “UVLS Program” excludes *centrally controlled undervoltage-based load shedding*—agree that these characteristics are consistent with typical RAS objectives and its corrective actions (should not constitute a RAS exclusion)
    - Capitalize on industry’s vetting and acceptance of proposed new term
  - Both the proposed definition of UVLS Program (part of PRC-010-1) and the revised definition of RAS are being posted concurrently

- **e. Schemes applied on an Element for non-fault conditions . . . to protect the Element against damage by removing it from service**
  - Essentially, these are protective schemes/functions that prevent equipment damage by tripping the Element based on detection of abnormal operating conditions not caused by a system fault
  - Protective scheme examples (. . .such as, but not limited to . . .)
    - Generator Loss-of-Field.....Device Function # 40
    - Transformer Top-Oil (high) Temperature.....Device Function # 26
    - High (terminal) Voltage.....Device Function # 59
    - (Equipment) Thermal Overload.....Device Function # 49, 26

- **f. Controllers that switch or regulate series or shunt reactive devices, FACTS devices, phase-shifting transformers, variable-frequency transformers, tap-changing transformers, or generation excitation, and that are located at and monitor quantities solely at the same station as the Element being switched or regulated**
  - Per industry practice, these are not historically regarded as RAS
    - Continuously acting; not remedial in the sense of being a correction to a predetermined System condition, but all conditions
    - Actions not usually associated with RAS actions as listed in definition

- **g. FACTS controllers that remotely switch static shunt reactive devices located at other stations to regulate the output of a single FACTS device**
  - Per industry practice, these are not generally regarded as RAS
    - Continuously acting; not remedial in the sense of being a correction to a predetermined System condition, but all conditions
    - Actions not usually associated with RAS actions as listed in definition
    - Geographic reach is limited by effect of shunt reactive devices on FACTS device

- **h. Schemes or controllers that remotely switch shunt reactors and shunt capacitors for voltage regulation that would otherwise be manually switched**
  - Restricted to the automation of switching that an operator or dispatcher could perform
  - Again:
    - Continuously acting; not remedial in the sense of being a correction to a predetermined System condition, but all conditions
    - Actions not usually associated with RAS actions as listed in definition



- **i. Schemes that automatically de-energize a line for a non-Fault operation when one end of the line is open**
  - When one end of a transmission line is open, unacceptable voltage levels can occur
  - Opening the remote terminal(s) to de-energized the transmission line is done to remove the voltage rise
  - The SDT accepts this exclusion consistent with industry practice

- **j. Schemes that provide anti-islanding protection (e.g., protect load from effects of being isolated with generation that may not be capable of maintaining acceptable frequency and voltage)**
  - When islanding occurs, these schemes protect the load in the electrical island by dropping load/generation to facilitate restoration and prevent the operation of load in the island at an unacceptable frequency and/or voltage
  - Actions taken on islanded facilities will not impact the interconnected BES because they are already isolated
  - The SDT accepts this exclusion consistent with industry practice

- **k. Automatic sequences that proceed when manually initiated solely by an operator**
  - Automatic sequences created to simplify the actions of an operator are not RAS because the decision to activate the sequence of events is left to the operator
  - The operator can step through the pre-program sequences manually if the automatic sequences failed to initiate
  - The SDT accepts this exclusion consistent with industry practice

- **I. Modulation of HVdc or FACTS via supplementary controls such as angle damping or frequency damping applied to damp local or inter-area oscillations**
  - The function of such control is similar to that of a Power System Stabilizer (PSS), which is a component of excitation
  - The SDT accepts this exclusion consistent with industry practice

- **m. Sub-synchronous resonance (SSR) protection schemes that directly detect sub-synchronous quantities (e.g., currents or torsional oscillations)**
  - The SDT contends that directly detected SSR conditions and related mitigation are not RAS
  - The SDT accepts this exclusion consistent with industry practice



# Implementation Plan and Impacts

Bill Edwards, NERC Counsel



# Project Timeline and Coordination

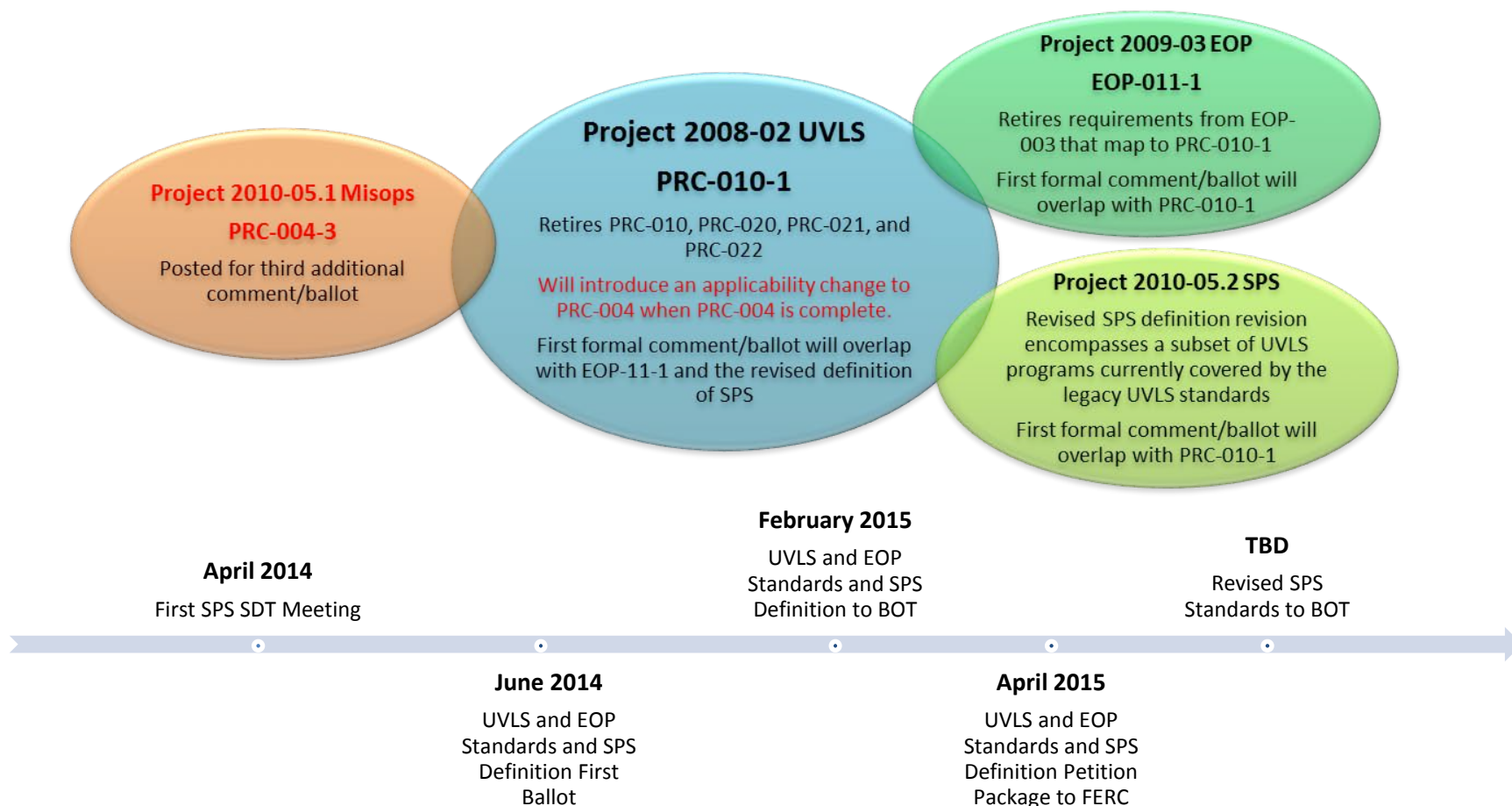
Al McMeekin, NERC Standards Developer

The timeline for the development process is as follows:

- Developed the SAR – 02/2014
- Posted SAR (30-day comment period) – 02/18–03/19/2014
  - Posted straw-man definition (30-day comment period) – 03/11–04/09/2014
  - Developed definition and associated documents – 04/15–05/30/2014
- Posted definition (45-day comment; last 10 days is initial ballot) – 06/11/2014
  - Included final SAR
  - Will review comments and revise definition
- Repeat 45-day comment and additional ballot, if necessary, to achieve consensus
- Post definition for final ballot (no comment period)
- Present to NERC Board of Trustees for adoption – 11/2014
- File with applicable regulatory authorities for approval – 12/2014



# UVLS Standard Project Coordination





# Questions and Answers

- Early consensus-building is our top priority.
- We encourage stakeholders to follow our effort, attend outreach events, and provide constructive feedback.
- Project information is available on the [Project 2010-05.2 SPS \(Phase 2 of Protection Systems\)](#) project page.
- Please contact Al McMeekin with any questions or to be added to the project's email distribution list.
  - Email: [al.mcmeekin@nerc.net](mailto:al.mcmeekin@nerc.net)
  - Telephone: (404) 446-9675



**Thank you!**