"Remedial Action Scheme" Definition Development

Background and Frequently Asked Questions

Project 2010-05.2 – Special Protection Systems

June 2014

Table of Contents

Introduction

The Project 2010-05.2 – Special Protection Systems Standard Drafting Team (SDT) thanks all commenters who submitted comments on the proposed revision to the NERC Glossary term "Special Protection System" ("SPS") or "Remedial Action Scheme" ("RAS") definition from the SAMS-SCPS SPS Technical Reference report. The revised definition was posted for a 30-day informal comment period from March 11, 2014 through April 9, 2014. NERC asked stakeholders to provide feedback on the proposed definition through a special electronic comment form.

The SDT appreciates the stakeholder comments on the revised definition. The SDT reviewed all of the comments and made numerous changes to the definition based on the feedback received. These changes are reflected in the first formal posting of the proposed revised definition for comment and ballot. The SDT developed this background and Frequently Asked Questions (FAQ) document to explain the key concepts incorporated in the revised definition, as well as the team's approach and intent.

Contact the Standards Developer, Al McMeekin, at 404-446-9675 or at al.mcmeekin@nerc.net with any comments or questions.

Background – RAS Definition Development

Existing NERC Glossary of Terms Definitions

The existing NERC Glossary of Terms defines **SPS** or **RAS** as: "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."

The NERC Glossary of Terms defines a **Protection System** as:

- Protective relays which respond to electrical quantities,

- Communications systems necessary for correct operation of protective functions,

- Voltage and current sensing devices providing inputs to protective relays,

- Station dc supply associated with protective functions (including batteries, battery chargers, and non-battery-based dc supply), and

- Control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices.

Revision of the NERC Glossary of Terms Definition

Purpose of Revision of the NERC Glossary Terms SPS or RAS
The existing NERC Glossary of Terms definition for an SPS or RAS lacks the clarity and specificity necessary to consistently identify what equipment or schemes qualify as an SPS or RAS across the eight NERC Regions. This confusion leads to inconsistent application of the SPS or RAS-related NERC Reliability Standards.

The existing definition also lacks clarity in the actions stipulated as characteristics of an SPS or RAS. The actions listed in the definition are so broad that the definition may unintentionally include schemes whose purpose is not expressly related to preserving system reliability in response to predetermined system conditions. Inclusion of any scheme taking "corrective action other than isolation of faulted components to maintain system reliability" could be interpreted to mean that devices such as voltage regulators and switching controls for shunt capacitors should be included. This inclusion would then make these devices subject to requirements such as those addressing single-component failure considerations (sometimes referred to as redundancy considerations) in the SPS or RAS-related NERC Reliability Standards.

Recommendation to Change the Term to RAS Only
Currently, both terms, SPS and RAS, are used in the eight NERC Regions. The SDT contends that a single term promotes consistency. The SDT therefore recommends that the term RAS be retained as the industry-recognized term and that the term SPS be retired. The term RAS is more descriptive of the purpose for which the scheme is installed.

The term RAS also eliminates the confusion associated with the two defined terms, "Special Protection System" and "Protection System." The inclusion of Protection System in the term Special Protection System implies that SPS are a subset of Protection Systems. RAS are not Protection Systems; however, they may share components with Protection Systems.

Effects of Using Only the Term RAS in the Existing NERC Reliability Standards
The existing NERC Reliability Standards and NERC Glossary of Terms use the terms, SPS and RAS interchangeably. In most cases, both terms are included in the standards and written as: "SPS or RAS." The SDT evaluated the existing standards and recommended any necessary revisions to retain the single term, RAS. Many of the same changes would be required regardless of which single term is retained. A summary of the occurrences of the terms is included in the posted document *Uses of "Special Protection System" and "Remedial Action Scheme" in Reliability Standards.*

Proposed Definition of RAS

Remedial Action Scheme: 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 a 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)

Exclusion List Explanations

a. **Out-of-step tripping and power swing blocking**

The existing NERC Glossary of Terms definition of SPS or RAS excludes out-of-step relaying because it is a protective function. The SDT maintained the exclusion but changed the wording from "out-of-step relaying" to "out-of-step tripping and power swing blocking" to reflect current industry terminology.

b. **Automatic underfrequency load shedding (UFLS) programs**

The existing NERC Glossary of Terms definition of SPS or RAS excludes UFLS because it is a protective function that has unique design and implementation considerations that are covered by NERC Reliability Standard PRC-006-1. The SDT maintained the exclusion.

c. **Undervoltage Load Shedding Programs (UVLS Programs)**

The existing NERC Glossary of Terms definition of SPS or RAS excludes undervoltage load shedding (UVLS) because it is a protective function. The SDT maintained the exclusion but is using the new term UVLS Program proposed by the SDT for NERC Project 2008-02 – Undervoltage Load Shedding. UVLS Programs are addressed in proposed NERC Reliability Standard PRC-010-1.

d. **Autoreclosing schemes**

Autoreclosing schemes, whether single-pole or three-pole, 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. For example, a scheme that rejects or runs back generation to avoid instability or thermal overloads in addition to initiating autoreclosing would constitute a RAS.

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**

The SDT contends that these schemes are applied on an Element to protect it from damage. They are protective functions and are not RAS. The SDT accepts this exclusion consistent with industry practice.

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**

The SDT contends these devices are not RAS. The SDT accepts this exclusion consistent with industry practice.

g. **FACTS controllers that remotely switch static shunt reactive devices located at other stations to regulate the output of a single FACTS device**

The SDT contends these devices are not RAS. The SDT accepts this exclusion consistent with industry practice.

h. **Schemes or controllers that remotely switch shunt reactors and shunt capacitors for voltage regulation that would otherwise be manually switched**

Schemes or controllers that assist a System Operator in coordinating the switching of shunt reactors and shunt capacitors that would otherwise be manually switched are not remedial in the sense of being mitigations in response to predetermined System conditions, but are for general application to all System conditions.

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 line is open, unacceptable voltage levels can occur. Opening the remote terminal(s) to de-energize the transmission line removes this voltage rise. These schemes have not historically been regarded as RAS, and 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)

These schemes are designed to protect load in an electrical island that might otherwise operate at an off-nominal frequency or voltage, or facilitate restoration. Actions taken on islanded facilities will not impact the interconnected BES because they are isolated. The SDT accepts this exclusion consistent with industry practice.

k. Automatic sequences that proceed when manually initiated solely by an operator

Automated sequences created to simplify the actions of an operator are not RAS because the decision to activate a specific sequence is left to the operator. If the automated sequence fails to execute correctly, the operator has the option to manually set those actions in motion. The SDT accepts this exclusion consistent with industry practice.

l. Modulation of HVdc or FACTS via supplementary controls such as angle damping or frequency damping applied to damp local or inter-area oscillations

Modulation of HVdc and FACTS via supplementary controls is occasionally used for damping local or inter-area oscillations. They perform a similar function as a Power System Stabilizer (PSS), which is a component of excitation controls in a generating unit. PSS are not classified as RAS. 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.

Explanations Regarding Changes from the Exclusion List Cited in the SAMS-SPCS Report

The SDT revised the straw man definition proposed in the SAMS-SPCS report; however, the proposed definition is consistent with the SAMS-SPCS intent. The drafting team revised the definition in response to stakeholder comments from the informal posting. As a result, it is no longer necessary to explicitly state some of the exclusions.

1. **Schemes that prevent high line voltage by automatically switching the affected line**

   This scheme is now addressed by exceptions "e" (protection from high voltage) and "i" (automatic de-energization of a line when one end is open) in the proposed definition.

2. **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 in this exclusion is a Protection System. The proposed definition excludes Protection Systems from RAS.

3. **Blanket exclusion for SSR protection schemes**

   The proposed definition excludes schemes that directly detect sub-synchronous quantities; however, SSR mitigation schemes installed to detect distinct System configurations and loading conditions (that studies have shown may make a generator vulnerable to SSR), and take action to trip the generator or bypass the series capacitor, are classified as RAS.

4. **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 exclusion is a Protection System. The proposed definition excludes Protection Systems from RAS.

Frequently Asked Questions

Why does the proposed definition have an exclusion list?
The definition must be broad enough to include the variety of System conditions monitored and corrective actions taken by RAS. Without the exclusions, equipment and schemes that should not be considered RAS could be subject to the requirements of the RAS-related NERC Reliability Standards. The exclusion list also assures that commonly applied protection and control systems are not unintentionally included as RAS.

Why did the SDT not propose a screening process to identify RAS?
The SDT contends that a comprehensive definition with specific exclusions is the best way to achieve consistency and immediacy in RAS identification. The SDT asserts that a study-based screening process would be labor-intensive and dependent on assumptions that could vary among the entities performing the studies.

Why does the proposed definition not include the classification types suggested in the SPCS-SAMS report?
The classification of a RAS is not necessary for defining whether or not a scheme qualifies as a RAS. Informal feedback from many stakeholders indicated uncertainty about the classification types. Therefore, the SDT decided not to include RAS classification types within the definition. The classifications are more appropriately addressed concurrently with revisions to the RAS-related Reliability Standards.

Why did the SDT not specifically reference the Transmission Planning (TPL) standards in the proposed definition?
The SDT acknowledges that many RAS are installed to address the performance requirements of the TPL standards; however, they are also installed to address other reliability concerns.

Would automatic actions taken by an Energy Management System (EMS), Supervisory Control and Data Acquisition (SCADA), or Distribution Control System (DCS) be considered a RAS?
The above-mentioned control systems support and enable grid operations by issuing control commands mostly to geographically distributed power System devices. In this normal application, these systems are not considered to be RAS. However, if these systems are configured to detect predetermined conditions and take corrective actions consistent with the RAS definition, these automatic functions would be considered RAS. The identification of RAS is not dependent upon the specific hardware or platform utilized in the scheme.

What are the Implementation Plan time frames?
The Implementation Plan provides RAS owners a minimum of twelve (12) months beyond the date of approval by a governmental authority to evaluate their current schemes for determining whether they are RAS, based on the new definition. The drafting team contends that twelve (12) months is an adequate period of time to review existing schemes to determine whether they are RAS.

The Implementation Plan also provides owners of newly identified RAS twenty-four (24) calendar months beyond the date of approval by a governmental authority to be fully compliant with all standards applicable to the revised definition of Remedial Action Scheme. The drafting team contends that twenty-four (24) calendar months provides the RAS owner sufficient time to become compliant with the revised standards proposed in the Implementation Plan.

Coordination with Project 2008-02 – Undervoltage Load Shedding

As part of the current development of PRC-010-1, the Project 2008-02 UVLS SDT is introducing a new NERC Glossary term, UVLS Program, to clearly establish applicability of PRC-010-1:

Undervoltage Load Shedding Program (UVLS Program): An automatic load shedding program consisting of distributed relays and controls used to mitigate undervoltage conditions leading to voltage instability, voltage collapse, or Cascading impacting the Bulk Electric System (BES). Centrally controlled undervoltage-based load shedding is not included.

Note that the definition excludes centrally controlled undervoltage-based load shedding. The UVLS SDT maintains that the design and characteristics of centrally controlled undervoltage-based load shedding are commensurate with RAS (wherein load shedding is the remedial action) and, as such, centrally controlled undervoltage-based load shedding should be subject to RAS-related Reliability Standards.

The Project 2010-05.2 SPS SDT agrees with the Project 2008-02 UVLS SDT that the design and characteristics of centrally controlled undervoltage-based load shedding are more appropriately categorized as RAS. The SPS SDT has therefore revised the definition of RAS to clarify that the definition is exclusive of only the newly defined term UVLS Program, and is therefore inclusive of centrally controlled undervoltage-based load shedding. The SDT is coordinating this change with the Project 2008-02 UVLS SDT. Collectively, the two definitions will promote consistency in the identification of centrally controlled undervoltage-based load shedding as a RAS. As a result, all NERC Reliability Standards that include the term RAS will be applicable to centrally controlled undervoltage-based load shedding upon the effective date of the revised definition of RAS.

Attachment A – SDT Members

	Project 2010-05.2 – Special Protection Systems SDT	
	Participant	**Entity**
Chair	Gene Henneberg	NV Energy / Berkshire Hathaway Energy
Vice Chair	Bobby Jones	Southern Company
Member	Amos Ang	Southern California Edison
	John Ciufo	Hydro One Inc.
	Alan Engelmann	ComEd / Exelon
	Davis Erwin	Pacific Gas and Electric
	Sharma Kolluri	Entergy
	Charles-Eric Langlois	Hydro-Quebec TransEnergie
	Robert J. O'Keefe	American Electric Power
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	Bill Edwards (Legal Counsel)	NERC