NERC Standard

PRC-012-2 Remedial Action Schemes

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***Abstract*— The Federal Energy Regulatory Commission (FERC) Order 693 described the original PRC-012-0, 013-0, and 014-0 Special Protection System (SPS) standards as "fill in the blank" as well as objecting to the assignment of responsibilities to inappropriate Regional Entities, and therefore ruled the proposed standards unenforceable. FERC did approve PRC-015, 016 and 017, which applied to SPS owners as well as a definition for SPS, which was cross referenced to RAS.**

After several years' experience and further feedback from the industry and FERC, North American Electric Reliability Corporation (NERC) initiated Project 2010-5.2 Phase 3 of Protection Systems: Special Protection Schemes. This project first developed a new RAS definition, which has since been approved by FERC and will go into effect April 1, 2017.

The second part of the project developed a new PRC-012-2 standard to cover all remaining aspects of RAS. The proposed new standard has been approved by the utility industry, NERC Board of Trustees, and has been filed with FERC for its approval. The new PRC-012-2 assigns responsibilities to appropriate specific users, owners, and operators of the Bulk-Power System, and incorporates the reliability objectives of all the previous RAS-related standards, including a RAS review and approval process. The new standard will promote consistency of RAS review and applications continent wide.

I. Introduction

NERC initiated the project based on the findings of a System Analysis and Modeling Subcommittee (SAMS) and System Protection and Control Subcommittee (SPCS) report [1] in 2013. The Report noted the lack of clarity of the SPS definition, the inconsistent use of the terms SPS and RAS across the eight Regions, and the impact this inconsistent usage would have on the identification and assessment of SPS/RAS.

The Report noted how the Regions applied their PRC-012, 013, and 014 responsibilities, even though not enforceable. The Report noted that every Region used their own review process, several used different definitions of SPS/RAS than the NERC Glossary, which precluded consistent application or reliability standards to SPS/RAS. The Report recommended development of a new SPS/RAS definition and standards to promote consistency and address all reliability aspects of SPS/RAS applications.

NERC developed a Standards Authorization Request (SAR) and formed a standard drafting team (SDT) in early 2014 to address these issues. The team consisted of industry experts from 6 of the 8 North American Regions.

This paper describes the results of the SDT efforts and summarizes the salient issues.

Among FERC's significant objections to the original PRC-012-0 was that the standard required Regional development of SPS/RAS reviews with very little definition of the contents of the resulting "fill in the blank" process. The other major FERC concern to PRC-012-0, 013-0, and 014-0 was that all assigned responsibility to the Regions, which were deemed to have a potential conflict of interest with their primary reliability responsibility to audit and enforce all NERC standards among the Entities within their Region.

An overview of North American installation of RAS can be found in the following table, primarily derived from [1] and updated with more recent WECC numbers:

Regional RAS in North America		
Region	**Quantity**	**Percentage**
FRCC	20	3.6%
MRO	36	6.5%
NPCC	117	21.2%
RFC	47	8.5%
SERC	20	3.6%
SPP	6	1.1%
TRE	24	4.3%
WECC	282*	51.1%
Total	**552**	**100%**

* From WECC RAS database, April 2016

II. RAS Definition

The terms RAS and SPS have been used interchangeably and are cross-referenced within the NERC Glossary of Terms. Some Regions used the term RAS, and others SPS. Several Regions supplemented the NERC definition with their own interpretations, which emphasized that the original NERC definition was ambiguous. The SDT revised of the NERC glossary definition for SPS to:

1. Retain the term Remedial Action Scheme (RAS)
2. Draft a new definition for RAS.
3. Revise the SPS definition to reflect the new RAS definition.
4. Substitute RAS for SPS in other standards

The SDT concluded that ambiguity would be minimized by retaining only a single term for these schemes. Use of a term not previously used within NERC, such as the IEEE approved System Integrity Protection Scheme (SIPS), would have introduced new ambiguities. SIPS includes various schemes such as UVLS, UFLS (and others) which NERC has not included in SPS or RAS, and are covered by separate NERC standards. The term RAS seemed more descriptive than SPS and avoids the inference that these schemes are subset of Protection Systems. These schemes can be all, or in part, assemblages of Protection System components, but considering their impact to system reliability, are covered by separate NERC standards.

The new RAS definition [2] begins with:

A scheme designed to detect predetermined system conditions and automatically take corrective actions that may include, but are not limited to, adjusting or tripping generation (MW and Mvar), tripping load, or reconfiguring a System(s). RAS accomplish objectives such as:

Meet requirements identified in the NERC Reliability Standards;

1. ***Maintain Bulk Electric System (BES) stability;***
2. ***Maintain acceptable BES voltages;***
3. ***Maintain acceptable BES power flows;***
4. ***Limit the impact of Cascading or extreme events.***

The diversity of RAS in both action and objective required a practical approach to formulating the definition. The resulting definition is broad enough to include the variety of System conditions monitored and corrective actions taken by a RAS. The broad inclusive portion of the definition is shown above. The RAS definition continues by listing fourteen exclusions describing specific schemes and systems that do not individually constitute a 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 assures that commonly applied protection and control systems are not unintentionally included as RAS. If a scheme or protective system is not explicitly defined as an exclusion, it is not by default a RAS. To be classified as a RAS, the scheme must meet the definition in its entirety. The RAS definition FAQ found in reference [2] provides a complete list of exclusions and drafting team explanations for each.

The term and definition change required an update to many standards. More than 40 existing NERC standards included the term SPS. Many of the standards could be readily changed, while others required additional time. All of these changes needed to be approved by industry, NERC, and FERC. In order to accommodate the "RAS" definition change across all impacted standards, a "new" SPS definition was needed as a cross reference for those standards which could not be immediately modified.

The new SPS definition [3] is: "**see RAS**", which in effect, will apply to those existing NERC standard requirements which could not be immediately modified from SPS to RAS.

III. PRC-012-2 Applicability

The various requirements of the new standard apply to the Reliability Coordinator (RC), Planning Coordinator (PC) and RAS-entity. The RC and PC are identified in the NERC Functional Model with specified characteristics. The RAS-entity was derived from the usage in the original PRC-012 – 017 standards to include any Transmission Owner, Generator owner, or Distribution Provider that owns all or part of a RAS.

Many of the standard requirements apply to the RAS-entity. The RAS entity owns the equipment and is responsible for decisions that require a financial investment. The general responsibilities of the RAS-entity include scheme design, submission of RAS data for review, installation, operational analysis, repairs and upgrades when needed, and testing.

Any level of RAS equipment ownership also identifies that owner as a RAS-entity. When several entities own parts of a RAS, each RAS-entity has compliance obligations. When one RAS-entity takes the lead in compliance activity, other RAS-entities' obligations may also be satisfied by a single report or other documentation that identifies all RAS-entities that participate in that activity. In any case, the compliance obligation of a RAS-entity with partial RAS ownership is limited to the RAS equipment that they own.

IV. PRC-012-2 REQUIREMENTS

The new PRC-012-2 standard will replace all of the existing SPS (RAS) related standards, PRC-012 – PRC-016 (PRC-017 is already scheduled for retirement). It includes nine requirements generally organized in six areas:

1. R1 – R3: Review process for new and modified RAS
2. R4: Periodic Planning review of existing RAS
3. R5: Review of actual RAS operations
4. R6 – R7: Corrective Action Plans to address deficiencies found in existing RAS via R4, R5, or R8
5. R8: RAS periodic functional testing
6. R9: RAS database

While all the Regions have historically addressed SPS/RAS issues somewhat differently under the non-enforceable PRC-012, 013, and 014 standards, all focused on the reliability requirements. Therefore the SDT tried to maintain the intent of the original PRC-012 – 017 requirements with the new standard requirements while assigning responsibilities to appropriate entities.

Requirement R1

For a new RAS, the RAS-entity begins the RAS review process by providing information defined in Attachment 1 to the RC responsible for the area impacted by the proposed RAS (see Appendix B for the Attachment 1 data request). Attachment 1 is designed to collect enough detailed information to allow an adequate reliability review by the RC. The most common reliability objective of the RAS is to meet the System performance requirements of applicable NERC

standards, most commonly TPL-001-4 (current version of the NERC Transmission Planning reliability standard). The RAS-entity has the flexibility to obtain or develop the necessary Attachment 1 data from any combination of resources such as the PC, Transmission Planners (TP), Transmission Operators (TOP), protection engineers, telecommunication engineers, or others.

Functional modifications of existing RAS are reviewed through this same process, though the review may cover just the scheme modifications when adequate background information is provided by the RAS-entity.

A functional modification consists of any of the following:

- Changes to System conditions or Contingencies monitored by the RAS
- Changes to the actions the RAS is designed to initiate
- Changes to RAS hardware beyond in-kind replacement; i.e., match the original functionality of existing components
- Changes to RAS logic beyond correcting existing errors
- Changes to redundancy levels; i.e., addition or removal

RAS retirements are also reviewed through this process, though will usually only need to show that System performance is satisfactory without scheme operation.

Requirement R2

The reviewing RC receives Attachment 1 from the RAS-entity and schedules a review of the scheme using the process outlined in Attachment 2 [3]. The RC is allowed up to four months for the review, though this period can be shorter or longer when agreed between the RC and RAS-entity. For example, the RC may schedule RAS review meetings three times per year on an announced schedule, or provide reviews through conference calls as needed to meet project schedules. Individual review meetings may include review of a single RAS, or separate RAS from multiple RAS-entities.

Attachment 2 provides general guidance for the review, but the RC may ask for any information which has a bearing on scheme reliability, even if not specifically described in Attachments 1 or 2. The RC provides written feedback to the RAS-entity for the proposed RAS.

Requirement R3

The RC review is intended to identify reliability issues that must be resolved before the RAS can be put in service. The RC feedback to the RAS-entity specifies reliability concerns identified during the review. The RAS is approved and can be placed in service when the RC has no reliability concerns, or the RAS-entity has satisfied the RC that all reliability concerns have been satisfactorily resolved.

Requirement R4

Planning Coordinators must perform RAS evaluation at least every five years to verify the continued effectiveness and coordination of the RAS. A periodic evaluation is required because changes in System topology or operating conditions may change the effectiveness of a RAS or the way it impacts the BES. The periodic RAS evaluation will typically lead to one of the following outcomes: 1) affirmation that the existing RAS is effective; 2) identification of changes needed to the existing RAS; or, 3) justification for RAS retirement.

RAS vary in complexity and impact on the reliability of the BES. Therefore the reviewing RC may designate a RAS as having limited impact.

A RAS designated as limited impact cannot, by inadvertent operation or failure to operate, cause or contribute to BES Cascading, uncontrolled separation, angular instability, voltage instability, voltage collapse, or unacceptably damped oscillations.

The periodic evaluation of limited impact RAS must verify whether the limited impact designation remains applicable.

As seen in Regional RAS table, together WECC and NPCC have over 70% of the RAS in North America. These two regions also use categorization systems that reasonably approximate the limited impact designation, so those RAS which WECC has deemed as Local Area Protection Scheme (LAPS) or NPCC has designated as Type III will be initially categorized as limited impact under the new PRC-012-2.

For RAS which are not limited impact, the periodic evaluation confirms that an inadvertent operation resulting from a single component malfunction will meet the performance requirements for which the RAS was designed, or if the design did not have performance requirements, then it would meet the performance requirements that are common to all planning event contingencies identified in TPL-001-4 Table 1, P0-P7. This evaluation confirms that the RAS does not introduce reliability issues more severe than those which the RAS is intended to resolve.

This analysis would assume that the original implementation met the single component failure criteria, and only an evaluation of that implementation's continued performance is necessary. (Single component failure criteria is discussed later).

In general, all RAS must be modeled in pertinent power flow, stability, and other studies to identify the System events and conditions that the RAS must mitigate. For studies associated with the RAS itself, several basic studies should be performed:

1. Demonstrate that the proposed RAS actions satisfy System performance objectives for the System events and conditions that the RAS is intended to remedy.
2. Demonstrate System performance resulting from a single RAS component inadvertent operation. (Knowledge of the RAS implementation is necessary)
3. A description of the System performance resulting from a single RAS component failure to operate. (Knowledge of the RAS implementation is necessary)
4. Show that RAS operation coordinates with other RAS, Protection Systems, and control systems.

Requirement R5

RAS-entities must evaluate all RAS operations and failures of a RAS to operate when intended. The operational performance analysis evaluates whether

1. The System events and/or conditions appropriately triggered the RAS.
2. The RAS responded as designed.

3. The RAS was effective in mitigating BES performance issues it was designed to address.
4. Determine if the RAS operation resulted in any unintended or adverse BES response.

Failure of a single scheme of a redundant scheme to take action, as long as the correct operation of the other redundant scheme still results in satisfactory System performance, is not an incorrect operation. Similarly, a failure to arm or disarm if system conditions do not also call for actual remedial action is not a RAS operation or failure to operate.

A RAS entity should retain documentation of each operational performance analysis. Only if the RAS operational performance analysis identifies any deficiencies, a copy of the analysis must be provided to the RC. The timing of the analysis is consistent with PRC-004 requirements.

Requirement R6

RAS-entities must develop a Corrective Action Plan (CAP) when RAS performance does not satisfy R4, R5, or R8 requirements. A properly prepared CAP will include proposed actions and timeline for each action. The timing for the CAP development is consistent with PRC-004 requirements and once established, is submitted to the RC.

Requirement R7

RAS-entities must complete CAPs and notify the RC if the CAP actions or timelines change. The RC is notified when the CAP is completed. This Requirement does not specify a time table for CAP completion because that is an integral component of the CAP itself.

Requirement R8

RAS-entities must perform functional testing of RAS components that are not tested as part of the PRC-005 requirements. RAS controllers can be an example of non-Protection System components that are subject to this requirement.. Failure of the functional test results in notifying the RC and development of a CAP.

RAS functional tests are different than the maintenance testing of Protection Systems described in PRC-005. The RAS tests are intended to discover latent failures that could cause an incorrect operation of the RAS.

Functional testing may be accomplished with end-to-end testing or a segmented approach. For segmented testing, each segment of a RAS must be tested. Overlapping segments can be tested individually, minimizing the need for complex maintenance schedules and outages. A successful functional test of a segment resets the test interval clock for that segment.

As an example of segment testing, consider a RAS controller implemented using a PLC that receives System data, such as loading or line status, from distributed devices. These distributed devices could include meters, protective relays, or other PLCs. In this example RAS, a line protective relay is used to provide an analog metering quantity to the RAS control PLC. A functional test would verify that the System data is received from the protective relay by the PLC, processed by the PLC, and that PLC outputs are appropriate. There is no need to verify the protective relay's ability to measure the power system quantities, as this is a requirement for Protection Systems used as RAS in PRC-005.

A RAS-entity may count a correct operation of a RAS as a functional test for those RAS segments that operated. If an event causes a partial operation of a RAS, the segments without an operation will require a separate functional test within the maximum interval with the starting date determined by the previous successful test of the segments that did not operate.

RAS which have been categorized as limited impact require functional testing at least every 12 years, while all other RAS must be tested every 6 years.

Requirement R9

A RAS database is established and maintained at least annually by the RC. Attachment 3[3] lists the minimum data to be included in the RAS database, though the RC may also require additional data when determined to be helpful to maintain System reliability.

A summary of the Requirements, interactions, applicability, and measures of acceptable evidence to demonstrate compliance can be found in the flow chart in Appendix A.

V. Single Component Failure immunity

Scheme implementation is often discussed in terms of "redundancy". It may be more appropriate to consider a scheme's "immunity to single component failure".

The objective of any RAS is to assure that System performance following identified contingencies or System conditions remains within the requirements specified in the NERC reliability standards, most commonly TPL-001-4, even when a single RAS component fails to operate. This objective is documented in the original PRC-012-0 R1.3 [7]

> … "*to demonstrate that the SPS shall be designed so that a single SPS component failure, when the SPS was intended to operate, does not prevent the interconnected transmission system from meeting the performance requirements defined in Reliability Standards TPL-001-0, TPL-002-0, and TPL-003-0.*"

This same concept is carried over to the new PRC-012-2 in Requirement R4, for periodic Planning evaluations in R4.1.5

> … "*Except for limited impact RAS, a single component failure in the RAS, when the RAS is intended to operate does not prevent the BES from meeting the same performance requirements (defined in Reliability Standard TPL-001-4 or its successor) as those required for the events and conditions for which the RAS is designed.*"

The requirement is carried into RAS implementation at the component design level in Attachment 1, Section III.4.

Single Component Failure immunity can be implemented in many different ways. Duplication or redundancy is most commonly considered, but other methods include:

- Overarming

- Thermal, undercurrent, or outage detection relays at both ends of a transmission line
- Use of traditional breaker failure schemes (if studies show that system performance is acceptable and no additional reliability concerns are created)
- RAS breaker failure, (the RAS trips the high side of a transformer if low side fails to trip)
- Frequency Diversity on a microwave telecommunication route
- Over and under build of Optical Ground Wire equipment

Industry best practices for design can be found in references [5] and [6].

VI. INADVERTENT OPERATION

An issue related to single component failure, though slightly different, is inadvertent operation of a RAS. The original PRC-012-0 R1.4 [7] required

> … *"that the inadvertent operation of an SPS shall meet the same performance requirement (TPL-001-0, TPL-002-0, and TPL-003-0) as that required of the contingency for which it was designed, and not exceed TPL-003-0."*

The new PRC-012-2 retains this idea, but clarifies that the concern is the inadvertent operation of a single RAS component and specifies that the resulting System performance must align with the requirements that are common to all contingencies listed in TPL-001-4, Table 1. This can allow use of a RAS to mitigate extreme events, for which there are no performance requirements, while encouraging designs that implement security features for such schemes, e.g. 2 of 3 voting, rather than redundancy, per se.

VII. LIMITED IMPACT DESIGNATION

A scheme designated by the Reliability Coordinator (RC) as "limited impact" meets the following criteria:

> …*"A RAS designated as 'limited impact' cannot, by inadvertent operation or failure to operate, cause or contribute to BES Cascading, uncontrolled separation, angular instability, voltage instability, voltage collapse, or unacceptably damped oscillations*".

The word "contribute", within the description of "limited impact", is necessary to adequately describe that the RAS alone may not be the sole cause of "BES Cascading, uncontrolled separation, …" but the RAS could be one of many factors, where if any individual factor were removed, would prevent the event from occurring.

An example of a scheme that an RC could recognize as a limited impact RAS is a load shedding or generation rejection scheme used to mitigate an overload of a BES transmission line. The inadvertent operation of such a scheme would cause the loss of either a certain amount of generation or load. The evaluation by the RAS-entity should demonstrate that the loss of this amount of generation or load, without the associated contingency for RAS operation actually occurring, is acceptable and not detrimental to the reliability of BES; e.g., in terms of frequency and voltage stability. The failure of that scheme to operate when intended could potentially lead to the overloading of a transmission line beyond its acceptable rating. The RAS-entity would need to demonstrate that this overload, while in excess of the applicable Facility Rating, is not detrimental to the BES outside the contained area, (predetermined by studies), affected by the contingency.

VIII. PRESENT STATUS AND IMPLEMENTATION PLANS

The new RAS definition was approved by industry vote in November 2014, by NERC Board of Trustees at their November 2014 meeting, and by FERC in November 2015.

The new PRC-012-2 was approved by industry vote on April 30, 2016 and the NERC Board of Trustees at their May 2016 meeting. The proposed standard was filed with FERC on August 5, 2016 and is awaiting final approval.

Assuming the proposed standard is approved by FERC, there will be a three-year implementation period to transfer the RAS review responsibilities from the Regions to the various RCs. This provides adequate time to assure a smooth transition with no adverse reliability impacts. During the transition, the Regions and RAS owners will continue to perform their various RAS-related duties. The timing for the Planning evaluations and functional testing are consistent with the periods identified in each requirement.

IX. SUMMARY

NERC has developed a new definition for Remedial Action Scheme (RAS) that is being applied throughout North America. NERC also wrote a new standard for RAS applications throughout North America that describes and assigns responsibilities to appropriate entities having Planning, ownership, or Operating responsibilities. Individual requirements are derived from the original PRC-012 – PRC-017 standards to the extent that the drafting team could do so. The new standard remedies the "fill-in-the-blank" designation without lowering the reliability bar established in the previous RAS/SPS standards.

X. ACKNOWLEDGEMENTS

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XI. REFERENCES

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[3] Project 2010-05.3 Phase 3 of Protection Systems: Remedial Action Schemes (RAS) (PRC-012-2), www.nerc.com/pa/Stand/Pages/Project-2010-05_3-Remedial-Action-Schemes_Phase-3-of-Protection-Systems.aspx

[4] NERC Glossary of Terms, http://www.nerc.com/files/glossary_of_terms.pdf

[5] NERC Technical Paper "Protection System Reliability Redundancy of Protection System Elements", January 2009

[6] IEEE PSRC, WG I 19 "Redundancy Considerations for Protective Relaying Systems", 2010

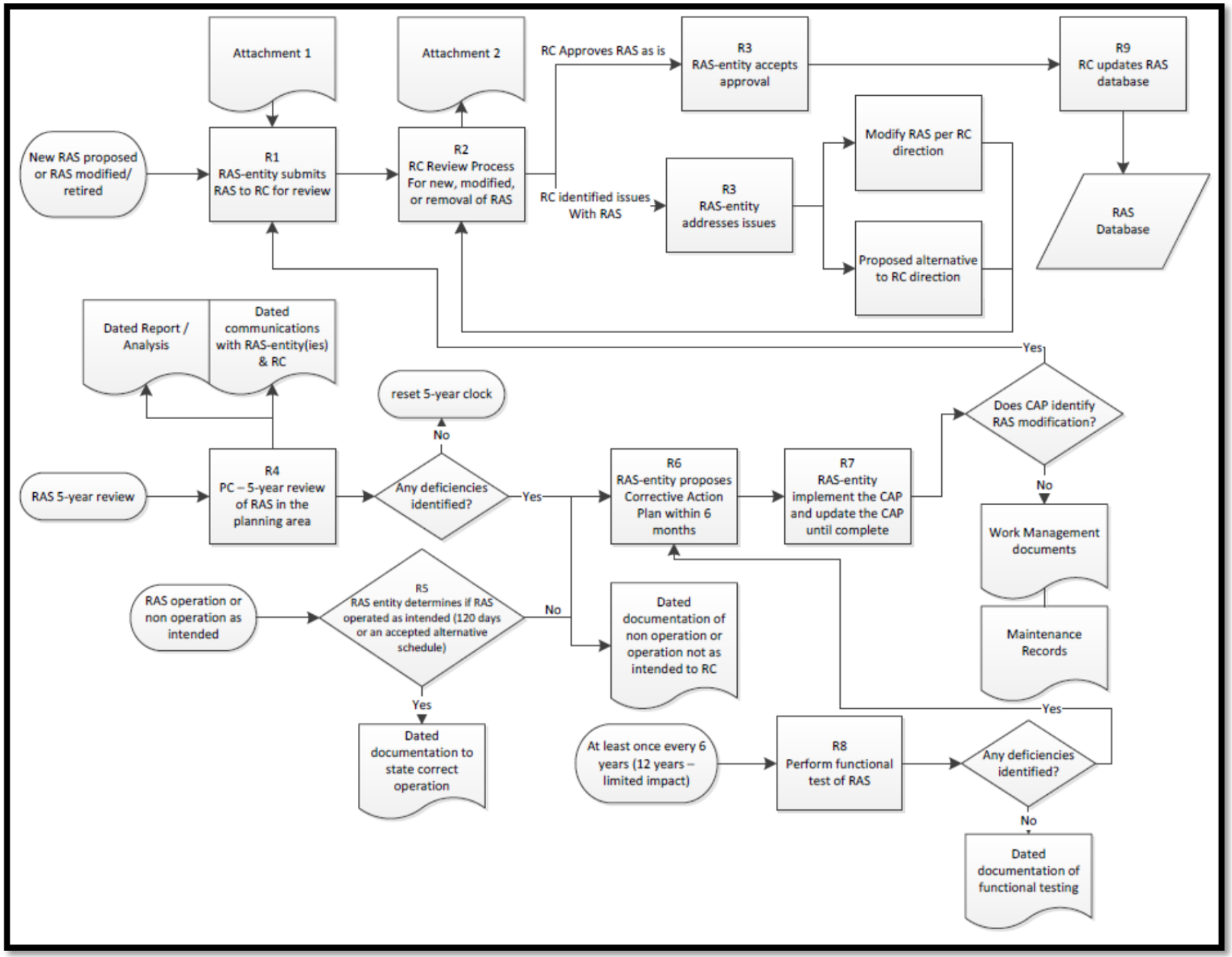
[7] NERC Standard PRC-012-0 Special Protection System Review Procedure http://www.nerc.com/files/PRC-012-0.pdf

XII. Biographies

Gene Henneberg earned a BSE from Walla Walla College and MSEE from Washington State University and has more than 38 years utility experience with NV Energy in Transmission Planning, substation construction and operations, and System Protection. He was the chair of the NERC drafting team for PRC-012-2. He is a member of IEEE Power System Relaying Committee, vice chair of C subcommittee and member of numerous working groups including C-21, "IEEE Guide for Engineering, Implementation, and Management of System Integrity Protection Schemes." He is a member of the WECC Relay Work Group and chair of the WECC Remedial Action Scheme Reliability Subcommittee. He is a registered professional engineer in Nevada.

Davis Erwin received his BSEE and MSEE in 1997 and 1998 respectively from New Mexico State University. He is a registered professional engineer in California and has been with PG&E system protection since 1999 supporting 500 kV Protection and implementation of Remedial Action Schemes. He was a member of the NERC drafting team for PRC-012-2 and serves as an alternate member of the WECC Remedial Action Scheme Reliability Subcommittee.

XIII. APPENDIX-A



XIV. APPENDIX-B

Attachment 1
Supporting Documentation for RAS Review

The following checklist identifies important Remedial Action Scheme (RAS) information for each new or functionally modified2 RAS that the RAS-entity must document and provide to the reviewing Reliability Coordinator(s) (RC). If an item on this list does not apply to a specific RAS, a response of "Not Applicable" for that item is appropriate. When RAS are submitted for functional modification review and approval, only the proposed modifications to that RAS require review; however, the RAS-entity must provide a summary of the existing functionality. The RC may request additional information on any aspect of the RAS as well as any reliability issue related to the RAS. Additional entities (without decision authority) may be part of the RAS review process at the request of the RC.

I. General

1. Information such as maps, one-line drawings, substation and schematic drawings that identify the physical and electrical location of the RAS and related facilities.
2. Functionality of new RAS or proposed functional modifications to existing RAS and documentation of the pre- and post-modified functionality of the RAS.
3. The Corrective Action Plan (CAP) if RAS modifications are proposed in a CAP.
4. Data to populate the RAS database:
    a. RAS name.
    b. Each RAS-entity and contact information.
    c. Expected or actual in-service date; most recent RC-approval date (Requirement R3); most recent evaluation date (Requirement R4); and date of retirement, if applicable.
    d. System performance issue or reason for installing the RAS (e.g., thermal overload, angular instability, poor oscillation damping, voltage instability, under- or over-voltage, or slow voltage recovery).
    e. Description of the Contingencies or System conditions for which the RAS was designed (i.e., initiating conditions).
    f. Action(s) to be taken by the RAS.
    g. Identification of limited impact3 RAS.
    h. Any additional explanation relevant to high-level understanding of the RAS.

II. Functional Description and Transmission Planning Information

1. Contingencies and System conditions that the RAS is intended to remedy.
2. The action(s) to be taken by the RAS in response to disturbance conditions.
3. A summary of technical studies, if applicable, demonstrating that the proposed RAS actions satisfy System performance objectives for the scope of System events and conditions that the RAS is intended to remedy. The technical studies summary shall also include information such as the study year(s), System conditions, and Contingencies analyzed on which the RAS design is based, and the date those technical studies were performed.
4. Information regarding any future System plans that will impact the RAS.
5. RAS-entity proposal and justification for limited impact designation, if applicable.
6. Documentation describing the System performance resulting from the possible inadvertent operation of the RAS, except for limited impact RAS, caused by any single RAS component malfunction. Single component malfunctions in a RAS not determined to be limited impact must satisfy all of the following:
    a. The BES shall remain stable.
    b. Cascading shall not occur.
    c. Applicable Facility Ratings shall not be exceeded.
    d. BES voltages shall be within post-Contingency voltage limits and post-Contingency voltage deviation limits as established by the Transmission Planner and the Planning Coordinator.
    e. Transient voltage responses shall be within acceptable limits as established by the Transmission Planner and the Planning Coordinator.
7. An evaluation indicating that the RAS settings and operation avoid adverse interactions with other RAS, and protection and control systems.
8. Identification of other affected RCs.

III. Implementation

1. Documentation describing the applicable equipment used for detection, dc supply, communications, transfer trip, logic processing, control actions, and monitoring.
2. Information on detection logic and settings/parameters that control the operation of the RAS.
3. Documentation showing that any multifunction device used to perform RAS function(s), in addition to other functions such as protective relaying or SCADA, does not compromise the reliability of the RAS when the device is not in service or is being maintained.
4. Documentation describing the System performance resulting from a single component failure in the RAS, except for limited impact RAS, when the RAS is intended to operate. A single component failure in a RAS not determined to be limited impact must not prevent the BES from meeting the same performance requirements (defined in Reliability Standard TPL-001-4 or its successor) as those required for the events and conditions for which the RAS is designed. The documentation should describe or illustrate how the design achieves this objective.
5. Documentation describing the functional testing process.

IV. RAS Retirement

The following checklist identifies RAS information that the RAS-entity shall document and provide to each reviewing RC.

1. Information necessary to ensure that the RC is able to understand the physical and electrical location of the RAS and related facilities.
2. A summary of applicable technical studies and technical justifications upon which the decision to retire the RAS is based.
3. Anticipated date of RAS retirement.