Midwest Reliability Organization Procedure for PRC-012-1 and PRC-014-1

A. Introduction

This procedure, developed and maintained by MRO staff for the MRO Special Protection Systems Working Group, is considered a technical guideline and should be followed as good utility practice. The terms Special Protection System (SPS) and Remedial Action Scheme (RAS) are used interchangeably in this procedure. This procedure is an interim procedure for PRC012-1 and PRC-014-1 until RAS reviews transition to the Planning Coordinators (PC) and Reliability Coordinators (RC) as identified in PRC-012-2, which was FERC-approved on September 20, 2017.

PRC-012-2, which has an effective date (transition date) of January 1, 2021, states that the RC is responsible for reviewing and approving new, modified, or retiring RASs (these reviews were previously assigned to regional entities per PRC-012-1). PRC-012-2 also states that the PC will be responsible for the periodic review of existing RASs on a five year cycle (these reviews were previously assigned to regional entities per PRC-014-1). MRO will continue to review RASs according to this procedure until the transition to the PCs and RCs has been successfully completed.

B. RAS Owner Submittals

The following submittal process shall be followed by RAS owners:

- For a new or functionally modified RAS, the RAS owner shall submit a report to MRO, at least 90 calendar days prior to installation or modification going into service.

- For an existing RAS, the RAS owner shall submit a report to MRO, within 90 calendar days following an MRO request for review.

- For the retirement of an existing RAS, the RAS owner shall notify the MRO of the planned retirement, provide a summary of the conditions or changes that allow the retirement, and provide the planned date of the retirement at least 30 calendar days prior to the retirement.

- RAS owners shall provide to the MRO on a quarterly basis, documentation of all normal RAS operations.

- RAS owners shall also provide to the MRO on a quarterly basis, documentation of the analysis of all RAS misoperations and the associated corrective action plans. The following shall be used when determining if an event is a misoperation:

    - Failure to Operate – Any failure of operation when it is required.
    - Incorrect Operation – Any operation performed by the RAS that was not as the system design intended.
    - Slow Operation – RAS operates slower than the system design intended.
    - Unnecessary Operation – Any operation for system conditions for which the RAS was not required to operate.

    These misoperation events do not include operations caused by human error during system installation and maintenance (not considered an indication of deficiency in the RAS).

C. Definitions

Remedial Action Schemes (also Special Protection Systems) – The NERC definition of a RAS according to the NERC Glossary of Terms (dated January 1, 2018) is:

"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;*
- *Maintain Bulk Electric System (BES) stability;*
- *Maintain acceptable BES voltages;*
- *Maintain acceptable BES power flows;*
- *Limit the impact of Cascading or extreme events.*

*The following **do not** individually constitute a RAS:*

a. Protection Systems installed for the purpose of detecting Faults on BES Elements and isolating the faulted Elements.
b. Schemes for automatic underfrequency load shedding (UFLS) and automatic undervoltage load shedding (UVLS) comprised of only distributed relays.
c. Out-of-step tripping and power swing blocking.
d. Automatic reclosing 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, overvoltage, or overload to protect the Element against damage by removing it from service.
f. Controllers that switch or regulate one or more of the following: series or shunt reactive devices, flexible alternating current transmission system (FACTS) devices, phase-shifting transformers, variable-frequency transformers, or tap-changing transformers; 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 a System 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).
n. Generator controls such as, but not limited to, automatic generation control (AGC), generation excitation [e.g. automatic voltage regulation (AVR) and power system stabilizers (PSS)], fast valving, and speed governing."

Appendix A
MRO Procedure for Special Protection System Review

During the transition period to PRC-012-2, the MRO will perform a review of all new or functionally modified RASs within its region. The MRO will also review all RASs within the region on a five year basis. The retirement of an RAS will be handled by reviewing the conditions or circumstances that will allow the retirement of the RAS and its removal from the MRO RAS active database. The MRO reserves the right to review any RAS in its region at any time for the purposes of assessing regional reliability or for event analysis purposes.

The review process shall be:

- The RAS Owner prepares a RAS information package containing the necessary information as identified in the below RAS Information Checklist Tables 1 through 4 below.
- The RAS Owner submits the RAS information package electronically to the MRO.
- MRO review of the RAS information package has been delegated to an RAS (SPS) Working Group (SPSWG). MRO staff will work with the SPSWG and serve as coordinator for the group and the RAS Owner.
- The SPSWG will hold a conference call within 14 days of receiving the RAS information package submittal to review the material for completeness.
- After the RAS information package is determined to contain the necessary information, the SPSWG will schedule a meeting, if necessary, with the RAS owner no later than 45 calendar days after the RAS information package was submitted. The purpose of this meeting will be to give the RAS Owner an opportunity to present the RAS to the working group and to answer any questions the working group members may have.
- Once the RAS review is completed, the SPSWG and MRO Staff will prepare a completion letter for the RAS Owner. MRO staff will submit the completion letter to the RAS Owner to indicate that the RAS review process has been completed in accordance with the MRO Procedure.
- Upon completion of the review process, MRO staff will update the MRO RAS database.

For the retirement of an existing RAS, the process shall be:

- The RAS Owner shall inform the MRO of the planned retirement of an existing RAS at least 30 calendar days prior to the retirement. The RAS Owner shall include provide a summary of the conditions or changes that allow the retirement and the planned date of the retirement. The RAS Owner shall inform any neighboring Entities that are impacted by the RAS that the RAS is being retired along with the retirement date.
- The MRO will acknowledge the receipt of the planned retirement and update the MRO RAS database to record the retirement.
- It is up to the RAS Owner to ensure that the system resulting from the retirement of an RAS remains in compliance with NERC Standards.

RAS Information Package Checklist

Table 1- RAS General Information:

ITEMS	DESCRIPTION	APPLICABLE DOCUMENTS
Name of RAS:	The name of the RAS as given by the owner and used by operating and planning personnel.	
Primary Owner:	The name of the company that owns and maintains the RAS. This company will be the point of contact for this RAS when multiple entities are involved.	
In-Service date:	The planned or scheduled in-service date for new RASs. Identify original in-service date if RAS is existing.	
Location:	A summary of the generating stations, substations, and facilities that are involved with the RAS. Include geographic maps, substation drawings and one lines as necessary to ensure that the reviewer is able to understand the physical and electrical location of the RAS and the facilities involved.	
Description:	A narrative overview on how the RAS functionally operates, when it operates, and for what conditions. A one-line diagram showing the status changes of the associated facilities should be included.	

Table 2- RAS Planning Study Checklist:

ITEMS	DESCRIPTION	APPLICABLE DOCUMENTS
Overview of RAS and the Surrounding BES:	Provide a brief summary of the operational aspects of the BES where the RAS is installed. Describe general system conditions, the generation profile, the directional flow of key facilities, etc., that will help the reviewer understand the nature of the BES in the area of the RAS. Provide a brief summary of the functional operation of the RAS and how it relates to that portion of the BES.	
Need for RAS:	If the RAS is a new/proposed RAS, identify the conditions that caused the need for the RAS. If the RAS is being modified, describe the conditions or circumstances that resulted in a need to modify the RAS.	
Entities Involved:	Identify all companies who have ownership of facilities involved with the functional operation of the RAS.	
Entities Impacted:	Identify all companies who are impacted by the operation of the RAS and have operating knowledge of the RAS and its associated Operating Guides.	
IROL Involved	Identify whether an IROL is involved with or mitigated by the RAS.	
Study Model Information:	Identify all BES models used for studying the RAS, including model building series, years studied, season, and load level. Identify any changes made to the base models, such as interchange modifications, generation dispatch changes, or topology changes.	
Sensitivity Analyses:	Identify any sensitivity or scenario analysis that was performed and the reason for the analysis.	
Facilities Involved:	Clearly identify all monitored and contingency facilities. Identify both their normal and emergency ratings of monitored facilities for the applicable season. Identify their operating limit if it is less than the thermal limit.	
Voltage Monitoring:	Identify any pertinent voltages that were beyond operating limits and that required mitigation.	
Modified RAS:	If the RAS is being modified, clearly identify what functional changes are being made to the existing RAS and the cause of the modification.	
Analysis Results:	Display the results of the analysis in tabular form. For each model or scenario, clearly show pre-contingent flows and contingency flows before and after the RAS operates. Provide both MW and MVA flows. Compare the MVA flow of each monitored facility with the applicable rating/limit to illustrate overloads. Highlight all overloads (and voltage excursions) in bold or red font. A table similar to Table 4 below should be used.	
RAS Redundancy:	Based on the contingency analysis, identify if the RAS is needed for TPL-001-4 performance criteria (therefore making redundancy a requirement). If it is, complete the below Table 3, “System Protection and Redundancy”.	
Inadvertent Operation:	Verify that the inadvertent operation of the RAS (unnecessary operation during system conditions for which the RAS was not required to operate) will not result in any unacceptable operating conditions.	
Coordination with other RASs:	Discuss what analysis was done to verify that the RAS coordinates with other neighboring RASs or any other unique system protection schemes in the area of study.	
Operating guides:	Provide any associated Operating Guides.	
Conclusion:	Provide a brief summary conclusion of the results of the planning study report.	

Table 3- System Protection and Redundancy: (Redundancy not required if RAS has limited impact as defined in PRC-012-2)

ITEMS	DESCRIPTION	APPLICABLE DOCUMENTS
Separate VT Secondary Sources:	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 due to single RAS component failure.	
Separate CT Secondary Sources:	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 due to single RAS component failure.	
Redundant Logic Devices:	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 due to single RAS component failure.	
Redundant Control Outputs:	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 due to single RAS component failure.	
Redundant Communication Channels:	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 due to single RAS component failure. Shall have physically separate communication paths.	
Summary Description of Functional Testing:	With methods and schedules or a statement that this scheme is tested along with all other protective relays.	
RAS Settings:	Existing and/or proposed settings that will control its operation including all intentional and operational delays and relay application documentation.	
Detailed Drawings:	Showing hardware and/or logical connections.	

Table 4- Example Table for Displaying Planning Analysis Results

Case/Model Name (Identify Model Series, Year, Season, Load Level, etc.)										
					Pre-RAS Operation:			Post-RAS Operation:		
Contingent Element:	**Monitored Element:**	**Rate A:**	**Rate B:**	**Rate C:**	**MW flow:**	**MVA Flow:**	**% Rating**	**MW flow:**	**MVA Flow:**	**% Rating**
System Intact	Line A	100 MVA SN	120 MVA SE	N/A	82 MW	85 MVA	85% SN	64 MW	65 MVA	65%
Line X	Line A	100 MVA SN	120 MVA SE	N/A	121 MW	128 MVA	107% SE	92 MW	96 MVA	80% SE
Line Y	Line A	100 MVA SN	120 MVA SE	N/A	117 MW	124 MVA	103% SE	86 MW	92 MVA	77% SE
	Line B									
	Line B									
	Line B									
	Etc.									

The above Table 4 is one example of how to present the results in tabular form. The RAS is intended to operate for loss of either Line X or Y to prevent over loading of Line A, B, or others. In this example, the entries for Post – RAS Operation under system intact conditions illustrate the inadvertent operation of the RAS for the case studied.

The RAS owner should customize their table as appropriate for various types of RAS. The table should clearly and concisely show the results of the analysis for all relevant cases. It should show pre-contingent conditions and post-contingent conditions before and after the RAS operate. The RAS Owner should also provide any additional information that will help the review team better understand the functional operation of the RAS and the conditions that require it to operate.

A table similar to the above should be provided for RAS retirements indicating that conditions are acceptable without the RAS operation.