**ERCOT Nodal Operating Guides**

**Section 8**

**Attachment K**

**Remedial Action Scheme (RAS) Template**

**October 1, 2020**

This attachment provides a template to be used by an entity for the proposal, modification or deactivations and/or retirement of a Remedial Action Scheme (RAS). If an item in this template does not apply to a specific RAS, a response of “Not Applicable” for that item is appropriate. All submittals related to RAS must be emailed to ras\_cmp@ercot.com.

**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 if RAS modifications are proposed in a corrective action plan.

4. Data to populate the RAS database:

 a. RAS name;

 b. RAS Entity and contact information;

 c. Expected or actual in-service date, most recent ERCOT approval date, most recent ERCOT evaluation date, and date of retirement;

 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 recover;

 e. Description of the contingencies or system conditions for which the RAS was designed;

 f. Action(s) to be taken by the RAS;

 g. Identification of Limited Impact RAS; and

 h. Any additional explanation relevant to high-level understanding of 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 RAS designation.

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 a Limited Impact RAS must satisfy the requirements in paragraph (3)(f) of Section 11.2, Remedial Action Schemes.

7. An evaluation indicating that the RAS settings and operation avoid adverse interactions with other RASs, and protection and control systems.

8. Identification of other affected non-ERCOT Control Areas.

**III. Implementation**

1. Documentation describing the applicable equipment used for detection, dc supply, communications, transfer trip, logic processing, control applications, 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 Supervisory Control and Data Acquisition (SCADA), does not compromise the reliability of the RAS when the device is not in service or is being maintained.

4. For a RAS not designated as a Limited Impact RAS, documentation describing the system performance resulting from a single component failure in the RAS, except for a Limited Impact RAS, when the RAS was intended to operate. A single component failure in a RAS not designated as a Limited Impact RAS must not prevent the bulk electric system from meeting the same performance requirements 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**

1. Information necessary to ensure that ERCOT 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; and

3. The anticipated date of RAS retirement.

**11.2 Remedial Action Schemes**

(1) Remedial Action Schemes (RASs) are designed to detect abnormal predetermined ERCOT System conditions and automatically take corrective actions to maintain a secure system.

(2) The following do not individually constitute a RAS:

(a) Protection systems installed for the purpose of detecting faults on Transmission Elements and isolating the faulted Transmission Elements;

(b) Schemes for automatic Under-Frequency Load Shedding (UFLS) and automatic Under-Voltage 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 a Transmission Element for non-fault condition, such as, but not limited to, generator loss-of-field, transformer top-oil temperature, overvoltage or overload to protect the Transmission 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 Transmission 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-faults 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 high voltage, direct current (HVDC) or FACTS via supplementary controls, such as angle damping or frequency damping applied to damp local or inter-area oscillation;

(m) Sub-synchronous resonance protection schemes that directly detect sub-synchronous quantities (e.g. currents or torsional oscillations); or

(n) Generation controls such as, but not limited to, Automatic Generation Control (AGC), generation excitation (e.g. Automatic Voltage Regulation (AVR) and Power System Stabilizers (PSSs)), fast valving, and speed governing.

 (3) In addition to the requirements in the Protocols and applicable North American Electric Reliability Corporation (NERC) Reliability Standards, RASs shall also meet the following requirements:

(a) A RAS may be proposed by a Transmission Service Provider (TSP) or Resource Entity, and be approved by ERCOT and the TSP(s) and/or Resource Entity(ies) included in the RAS prior to implementation;

(b) The design, implementation, and testing of the RAS shall be coordinated within the RAS Entity;

(c) The RAS shall be automatically armed when appropriate;

(d) The RAS shall not operate unnecessarily;

(e) A RAS designated as a Limited Impact RAS shall be reviewed according to the process described in paragraph (4)(e) below and subject to ERCOT approval;

(f)        For a RAS not designated by ERCOT as a Limited Impact RAS, the possible inadvertent operation of the RAS, resulting from any single RAS component malfunction satisfies all of the following as determined by the review process in paragraph (4)(e) below and subject to ERCOT approval:

(i) The ERCOT System shall remain stable;

(ii) Cascading shall not occur;

(iii) Applicable Facility Ratings shall not be exceeded;

(iv) ERCOT System voltages shall be within post-contingency voltage limits and post-contingency voltage deviation limits;

(v) Transient voltage responses shall be within acceptable limits.

(g) To avoid unnecessary RAS operation, the RAS Entity may provide a Real-Time status indication to the owner of any Generation Resource controlled by the RAS to show when the flow on one or more of the RAS monitored Facilities exceeds 90% of the flow necessary to arm the RAS. The cost necessary to provide such status indication shall be the responsibility of the RAS Entity;

(h) The status indication of any automatic or manual arming/activation or operation of the RAS shall be provided as Supervisory Control and Data Acquisition (SCADA) alarm inputs to the owner(s) of any Facility controlled by the RAS;

(i) When a RAS is removed from service, the RAS Entity or a Designated Agent shall immediately notify ERCOT;

(j) When a RAS is returned to service, the RAS Entity or its Designated Agent shall immediately notify ERCOT. ERCOT shall modify its reliability constraints to recognize the availability of the RAS;

(k) The RAS Entity shall telemeter the status indication of the following items by SCADA to ERCOT for incorporation into ERCOT systems:

(i) Any automatic or manual arming/activation or operation of the RAS;

(ii) The in-service/out-of-service status of the RAS; and

(iii) Any additional related telemetry that already exists pertinent to the monitoring of the RAS (e.g. status indication of communications links between associated RAS equipment and the owner’s control center, arming limits of associated RAS equipment); and

(l) The TSP may receive telemetry for a Resource Entity owned RAS through ERCOT or through the RAS Entity, at the option of the TSP. The RAS Entity, at its own cost, must provide telemetry for Resource Entity owned RASs to the TSP upon request.

(4) The RAS Entity shall submit to ERCOT documentation of an existing, modified, proposed, or retiring RAS for review and compilation into an ERCOT RAS database using the form in Section 8, Attachment K, Remedial Action Scheme (RAS) Template. The documentation shall detail the design, operation, modeling, functional testing, and coordination of the RAS with other RASs, Automatic Mitigation Plans (AMPs), protection and control systems.

(a) ERCOT shall conduct a review of each proposed RAS, each proposed modification and proposed indefinite deactivation and/or termination of an existing RAS. Additionally, it shall conduct a review of each existing RAS at least once every five years or as required by changes in system conditions. Upon receipt, ERCOT shall initiate a 30 Business Day review period to evaluate each proposal in accordance with paragraph (e) below. ERCOT shall coordinate any additional time needed for the evaluation with the RAS Entity.

(b) The review of a proposed RAS shall be completed before the RAS is placed in service. The timing of placing the RAS into service must be coordinated with and approved by ERCOT. The implementation schedule must be confirmed through submission of a Network Operations Model Change Request (NOMCR) to ERCOT.

(c) Existing RASs that have already undergone at least one review shall remain in service during any subsequent review. Modifications to existing RASs may be implemented upon approval by ERCOT.

(d) The schedule for placing a RAS into service must be coordinated among ERCOT and the RAS Entity, and shall provide sufficient time to perform any necessary functional testing prior to its being placed in service.

(e) ERCOT review of a RAS shall:

(i) Validate that RAS actions, designed timing, and arming conditions mitigate the system condition(s) or contingency(ies) for which it was designed;

(ii) Identify any conflicts with the Protocols, NERC Reliability Standards, and this Operating Guide;

(iii) Validate that transient voltage responses are within acceptable limits as established by ERCOT;

(iv) Evaluate and document the consequences of misoperation, incorrect operation, unintended operation, or failure of a RAS. Additionally, validate that the RAS is designed to meet the requirements in paragraphs (3)(e) and (3)(f) above.

(v) Validate that the proposed RAS facilitates periodic testing and maintenance;

(vi) Determine whether or not the RAS is a Limited Impact RAS;

(vii) Validate that the proposed RAS avoids adverse interactions with other RASs, AMPs, protection and control systems, and applicable emergency procedures;

(viii) Evaluate the effects of future bulk electric system modifications on the design and operation of the RAS where applicable;

(ix) Validate the implementation of RAS logic appropriately correlates desired actions (outputs) with events and conditions (inputs);

(x) Validate the mechanism of procedure by which the RAS is armed is clearly described, and is appropriate for reliable arming and operation of the RAS for the conditions and events for which it is designated to operate;

(xi) Evaluate future transmission project(s) that will eliminate the need for the RAS; and

(xii) Validate that for proposed RAS retirements, system performance and security will not be affected.

(f) Upon completion of ERCOT’s RAS review, ERCOT shall provide all results and underlying studies to the RAS Entity and each impacted TSP.

(g) If deficiencies are identified for a new, functionally modified, or retiring RAS by ERCOT or other parties’ comments, the RAS Entity shall either submit an amended RAS proposal or withdraw the RAS proposal. The amended RAS proposal shall undergo the review process specified in paragraph (4)(e) above using the 30 Business Day RAS review timeline in paragraph (4)(a) above until the identified deficiencies have been resolved to the satisfaction of ERCOT.

(h) As part of the ERCOT review, ERCOT may notify the Steady State Working Group (SSWG), the Dynamics Working Group (DWG), and the System Protection Working Group (SPWG) of the RAS proposal, and each working group or any member of each working group may provide any comments, questions, or issues to ERCOT. ERCOT may work with the owner(s) of Facilities affected by the RAS as necessary to address all issues.

(i) ERCOT shall develop a method to include the RAS where practicable in Security-Constrained Economic Dispatch (SCED), Outage coordination, and Reliability Unit Commitment (RUC).

(j) ERCOT’s review shall provide an opportunity for and include consideration of comments submitted by Market Participants affected by the RAS.

(k) ERCOT shall update the RAS database at least once every twelve calendar months.

(5) ERCOT shall conduct an evaluation of each RAS at least once every five years to determine the following:

(a) The RAS mitigates the system condition(s) or contingency(ies) for which it was designed;

(b) The RAS avoids adverse interactions with other RAS, and protection and control systems; and

(c) The RAS meets the requirements in paragraphs (3)(e) and(3)(f) above.

(6) ERCOT shall provide the results of the RAS evaluation including any identified deficiencies to the RAS Entity and impacted TSPs. Within six calendar months, the RAS Entity shall develop and submit a corrective action plan, subject to ERCOT approval, to correct the deficiencies. For each plan developed, the RAS Entity shall implement the approved plan, update the plan if actions or timetables change, and notify ERCOT via email at ras\_cmp@ercot.com if plan actions or timetables change and when the plan is completed.

(7) The RAS Entity shall perform a functional test of each of its RAS to verify the overall RAS performance and the proper operation of non-protection system components at least once every six calendar years for a RAS not designated as a Limited Impact RAS, and once every 12 calendar years for a RAS designated as a Limited Impact RAS. For any identified deficiencies, the RAS Entity shall develop and submit a corrective action plan within six calendar months, and subject to ERCOT approval, to correct the deficiencies. For each plan developed, the RAS Entity shall implement the approved plan, update the plan if actions or timetables change, and notify ERCOT via email at ras\_cmp@ercot.com if plan actions or timetables change and when the plan is completed.

***11.2.1 Reporting of RAS Operations***

(1) RAS Entity shall notify ERCOT of all RAS operations. Documentation of RAS failures or misoperations shall be provided to ERCOT using the Relay Misoperation Report form as an email to ras\_cmp@ercot.com. Within 120 calendar days, the RAS Entity shall conduct an analysis of all RAS operations, misoperations, and failures. If deficiencies are identified, the RAS Entity shall develop and submit a corrective action plan within six calendar months, and subject to ERCOT approval, correct the deficiencies. For each plan developed, the RAS Entity shall implement the approved plan, update the plan if actions or timetables change, and notify ERCOT via email at ras\_cmp@ercot.com if plan actions or timetables change and when the plan is completed. Analysis of RAS operational performance shall include, but is not limited to:

(a) Determination of whether system events or conditions appropriately armed or triggered the RAS;

(b) Determination of whether the RAS responded as designed;

(c) Determination of whether the RAS was effective in mitigating the performance issues it was designed to address; and

(d) Determination of whether the RAS operation resulted in any unintended or adverse system response.

(2) ERCOT shall report all RAS operations and misoperations to the Reliability Monitor for review. RAS arming or activation that ramps generation back is not considered an operation or misoperation with respect to reporting requirements to the Reliability Monitor and the NERC Regional Entity. A misoperation of a RAS with respect to reporting requirements to the Reliability Monitor and the NERC Regional Entity occurs when one of the items specified in paragraph (4) of Section 6.2.3, Performance Analysis Requirements for ERCOT System Facilities, occur. RAS Entities will provide a monthly report to ERCOT by the 15th of each month describing each instance a RAS armed/activated and reset during the previous month. The report will include the date and time of arming/activation and reset. ERCOT shall consolidate the monthly reports and forward to the Reliability Monitor and NERC Regional Entity on a quarterly basis.

(3) If a RAS which removes generation from service operates more than two times within a six month period and the operations are not a direct result of an ERCOT System disturbance or a contingency operation, ERCOT may require the Generation Resource entity(ies) to decrease the available capability on the affected Generation Resource(s). The amount of available capacity to be decreased shall be determined by ERCOT. The decreased available capacity on the Generation Resource(s) shall remain until the Generation Resource entity(ies) provides documentation that demonstrates the Generation Resource(s) can properly control output in a pre-contingency or normal ERCOT System condition.

(4) For each RAS, the RAS Entity shall either identify a preferred exit strategy or explain why no exit strategy is needed to ERCOT. Once an exit strategy is complete and a RAS is no longer needed, the RAS Entity shall notify ERCOT, whenever the RAS is to be permanently disabled, and shall do so according to a timetable coordinated with and approved by ERCOT and the owners of all Facilities controlled by the RAS.