ISO Planning Standards

Remedial Action Scheme Guidelines Update

Revised Issue Paper

July 15, 2022

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ISO Planning Standards: Remedial Action Scheme Guidelines Update

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1. Introduction

The ISO initiated a stakeholder process in June 2021[1] to discuss revisions to the ISO Remedial Action Scheme (RAS) guidelines which are part of the California ISO Planning Standards (ISO Standards).[2] The RAS guidelines, along with the other requirements in the Planning Standards, complement the existing NERC/WECC Reliability Standards and ensure a secure and reliable ISO infrastructure development. During the initiative discussions, it was discovered that the modeling of the RAS within the ISO Market needed to be fully considered as part of this RAS guidelines update, so the initiative was put on hold to allow time for this additional scope. After further discussions within the ISO-focused on modeling RAS in the ISO Market, this revised issues paper has been prepared.

Section 2 provides an issues discussion of modeling RAS in the ISO Market and possible changes to the RAS guidelines. Section 3 provides a discussion on additional changes to the RAS guidelines beyond the discussion in Section 2.

The current RAS guidelines section has 17 guidelines. Each of these guidelines provides a good engineering practice-based framework from the inception to the ultimate design and operation of the RAS originated from various planning processes.

Although these guidelines have helped the ISO extensively in designing multiple RAS, there is a need to update these guidelines considering several new drivers such as RAS modeling within the ISO Market, new updated reliability standards (TPL-001-5 and PRC-012-2), and a significant expected increase in the number of RAS proposed through planning processes.

The ISO has developed this revised issues paper to provide stakeholders with the required background, the need to update, and the potential impacts based on the proposed modifications. This paper and the subsequent stakeholder engagement sessions will be utilized to review and refine some proposed modifications as well as to seek additional feedback on other potential changes from the stakeholders.

2. Refinement of RAS Modeling in the ISO Market

Prior to the initial implementation of the Generator Contingency and RAS Modeling initiative (GCARM) [3], the ISO had several mechanisms for consideration of Remedial Action Schemes.

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[1] A stakeholder meeting was held on June 24, 2021, and an Issue Paper was posted: http://www.caiso.com/InitiativeDocuments/IssuePaper%E2%80%93PlanningStandards-RemedialActionSchemeGuidelinesUpdate.pdf. Presentation slides were also provided: http://www.caiso.com/InitiativeDocuments/Presentation-PlanningStandards-RASGuidelinesUpdate-Jun242021.pdf

[2] http://www.caiso.com/Documents/ISOPlanningStandards-September62018.pdf

[3] http://www.caiso.com/informed/Pages/StakeholderProcesses/CompletedClosedStakeholderInitiatives/GeneratorContingency_RemedialActionSchemeModeling.aspx

1. Those RAS that on their own met the reliability requirements without the need for coordination with market operations could be left outside of market modeling, with transmission limits established based on the anticipated RAS operation.

2. For those RAS that did require greater coordination with market operation, they were modeled in the ISO Market using nomograms. However, using this approach, the market did not distinguish between generators connected to RAS from generators not connected to RAS in the curtailment of those generators due to the nomogram modeling of the transmission flow that can come from either generators groups. In other words, the variables of the nomogram are transmission flows rather than the injection from generators. This type of transmission nomogram modeling can to some extent defeat or limit the effectiveness of the RAS and potentially result in over curtailment of generation, unless ISO operators perform a manual work around.

In 2019 the ISO introduced GCARM – Generation Contingency and Remedial Action Scheme Modeling. GCARM was developed to allow the dropping of generators as part of a contingency, and it was expected to help with the modeling of RAS – to improve the level of market integration of remedial action schemes where RAS interactions with market operations was particularly important.

In implementing GCARM, however, it became apparent that the level of logic complexity through combining multiple features that were acceptable individually could compound to a level that cannot be integrated into market operation while still adhering to the established market clearing rules. Thus, there are limits to the extent GCARM can be relied upon and limits to its ability to replace the use of nomograms.

The ISO is therefore examining what the practical implications are of certain logical challenges in market solution through the use of GCARM either necessitating continuing to rely on existing measures or limiting the use of RAS for certain applications altogether within the established market structure and economic clearing rules.

Issues:

To consider the practical market operation related limitations to implementing GCARM, it is necessary to consider the level of logic complexity through combining multiple features that were acceptable individually but that could compound to a level that cannot be integrated into market operation. In considering the characteristics of RAS features that could be inconsistent with effective market solutions, it is also helpful to explore the differences between RAS modeling that may be viable in real-time contingency analysis (outside the market) and in the market operation itself.

The RAS processing in real-time contingency analysis (outside the market framework) is defined to be very flexible. Flexible in terms of conditions that can be monitored, actions that can be taken, and in terms of conditions for arming the RAS at a particular moment of time. It should not be expected that the market software which is mainly look-ahead in nature will be able to support the full flexibility associated with RAS processing, so it will be necessary to consider RAS on an individual basis. RAS that have the following principles would seem problematic:

- Any aspect that changes the problem formulation from one iteration to the next iteration.
- Arming conditions that might be evaluated differently from one iteration to the next iteration.
- Conditional actions that change the topology (and therefore potentially the calculated shift factors) during the iterations.
- Conditional actions in the RAS logic that cannot be modeled well in the market optimization formulation, such as actions that cannot be represented by linear constraints or those that present discontinuities in the variables or the constraints.

An overarching concern common to the above issues is that oscillatory behavior in the market converging on a solution could be introduced. For example, a resource is scheduled with a relatively high output and creates a binding constraint that triggers the RAS. At the same time, the resources may also be scheduled at a lower value to mitigate the same binding constraint. At this lower value the monitored condition would not be violated in the next market iteration and so the RAS may no longer be applied. Then, without the RAS applied, the resource is again scheduled at a high output and the cycle repeats.

Consideration of these issues suggests that the following types of RAS characteristics may not reasonably be accommodated in GCARM implementation:

- RAS operation (generation tripping) within the RAS controller is tied to the tripping of a critical element AND a pre-contingency flow using distribution factors to estimate post-contingency flow which is then compared to the emergency facility limit to determine the amount of needed generation tripping.
- RAS monitoring actual post contingency flows and keep tripping resources in blocks until some flow objective is achieved.
- Actions such as bypassing series caps with modifying flows through resource curtailment could also be problematic.

In the course of the review of the GCARM capabilities, the ISO also identified the need to consider issues that arose in the implementation of existing RAS. Several of these issues may necessitate changes in how existing RAS are implemented, as well as providing lessons that will also be taken into consideration in designing future RAS.

Existing modeled RAS in the market has been recently designed to include all generation that is reasonably effective in order to address market pricing issues for generation at the same bus, with the expectation that only the needed amount of generation dropping would be armed, and that the amount armed would not exceed planning guidelines. As a result, the amount of generation that was connected and available to be armed to these RAS exceeds the planning guidelines. In actuality, all of the connected generation is being armed for dropping, and this may result in large movements from the market base solution which can result in power flow divergence for some of these GCARM contingencies.

In addition to the conceptual challenges discussed earlier, these more specific implementation issues suggest the following also need to be considered for possible adoption on a case by case basis:

1. Modify existing RAS by selecting a fixed set of the most effective generation to be on the RAS up to the 1150/1400 MW tripping limits**.** While this may be necessary to improve the overall reliability and security of the system and improve the efficacy of the RAS, it may raise concerns with generators perceiving different treatment in market dispatch as a result, particularly if they funded their integration into the existing RAS.
2. Further, consider basing the 1150/1400 MW tripping limits on Pmax and not Pgen which leads to dynamically adding or removing generators from RAS arming based on their output – which in itself is a market outcome. As this will lower the actual amount of generation shed by the RAS, a consequence is that it would put downward pressure on the relevant path rating.
3. Consider selecting hybrid/co-located resources and energy storage projects first as part of the 1150/1400 MW limit rather than stand-alone solar and wind in order to not degrade Resource Adequacy (RA) Deliverability.
4. For the Market Model, where some generators on a bus are connected to RAS and others are not, separate fictitious buses may be created as needed, so that generation on RAS is not on the same bus as generation that is not on RAS**.**

With the above considerations, GCARM can be superior to using nomograms to implement RAS under certain conditions by aligning market and real time operations, and better manage market curtailment while protecting the effectiveness of the RAS. However, as noted above, the ISO will need to consider on a case by case basis whether:

- RAS needs to be modeled in the market at all if it addresses the need without further market coordination being required;
- RAS would better be modeled through the use of nomograms;
- RAS would best be modeled with GCARM capabilities;
- If other market constraints could be applied to market operation to achieve GCARM benefits on a more limited and focused basis;
- What gaps can be tolerated between RAS operation in real time and modeling relied on in market operation.

These considerations will be taken into account by the ISO, in addition to the existing guidelines along with proposed updates to those guidelines for RAS implementation in the ISO's Planning Standards, both in assessing the feasibility and design of future RAS, and in reviewing current RAS applications where operational challenges are emerging.

3. Other Issues

The ISO RAS guidelines were intended to encourage and allow the use of RAS to maximize the use of existing transmission facilities while maintaining system reliability and operability of the ISO controlled grid. Over the years, utilizing the guidelines, the ISO has selected RAS over new transmission facility primarily due to faster implementation timeline, lower costs, increased utilization of existing facilities and a more efficient use of scarce transmission resources associated with the RAS. The guidelines and their utilization have helped keep costs down for integrating new generation into the grid and/or addressing reliability concerns under various studied system conditions. However, the increased transmission system utilization that is partly made possible with implementation of the RAS also potentially results in increased exposure of not meeting system performance criteria if the RAS fails or inadvertently operates. Transmission outages can become more difficult to schedule due to increased flows across a larger portion of the year; and during a planned or forced outage of nearby facilities that affect the distribution of flows on the system. Additionally, the change in the effectiveness of the RAS during outages also adds to the operational complexity. The system can become more difficult to operate due to proliferation of the RAS that may cause coordination concern among the RAS in close proximity with other RAS in the vicinity area.

Besides the potential concerns with the numerous existing and proposed RASs, there have been other changes such as major updates to the NERC TPL and PRC standards, ISO initiatives (e.g. GCARM) and planned retirement of Diablo Canyon units. These changes require updating some of the existing guidelines to align with the changes and ensure any future RAS proposed through the process do not adversely impact the reliability of the ISO grid. The following paragraphs will discuss each of the changes and the proposed updates to the ISO guidelines.

There are several terms and multiple guidelines which despite their usefulness over the years have now become redundant with some of the requirements in the mandatory NERC TPL and PRC Standards. For instance, the use of terms such as the single, double and credible double contingency in the current guideline does not align with the use of these terms in the NERC TPL Standards and needs to be updated. These terms, when originally used, were consequence oriented. For example, single contingency will align closely with current NERC TPL-001-5 P1 category (Loss of one transmission circuit, transformer etc.). Similarly, the term double contingency, as used in the guideline, will closely align with the current NERC TPL-001-5 category P7 and in some instances credible 500 kV common corridor P6 contingencies. The term double contingency is not used in the latest TPL standards, and therefore needs to be replaced with the appropriate NERC TPL contingency category type. Besides these terms, some of the guidelines originally established to provide a good engineering practice framework to address issues such as failure, redundancy and inadvertent operation of the RAS have also now become redundant with the NERC PRC-012-2 Standard requirements.

In addition to the usage of terms that do not align with the NERC Reliability Standards, there are other terms used in the guideline elsewhere that need to be either defined or removed altogether. First of all, the ISO Planning Standards currently use the term SPS rather than RAS. The two terms mean the same thing, but the term SPS will be replaced by the term RAS going forward. However, since the existing RAS guidelines use the term SPS that term will be used when referring to the existing guidelines.

The ISO SPS 6 guideline related to the maximum number of contingencies and maximum number of monitored system variables uses the term 'Local contingencies' that is not defined in the existing RAS guideline. The ISO is still considering the feedback it has received on this item. The ISO SPS 6-C guideline related to specifying the maximum electrical distance of the monitoring facility to clarify the scope of local contingencies. Additionally, the current RAS guideline such as ISO SPS 6 may not provide adequate information for the design of the new RAS, particularly complicated RAS that includes remote monitoring of line contingencies and limiting elements and curtailing remote generation that may not be adequately effective. Increased complexity in the RAS operation may pose significant challenges in ensuring reliable operation of the RAS and preventing its potential mis-operation.

With the increased implementation of battery energy storage system (BESS) in the ISO-controlled grid, the RAS guideline may need to be updated to reflect increased complexity in implementing RAS to mitigate potential reliability concern due to volatile power injections and withdrawal for BESS, depending on its mode of operation. The RAS may become more complex due to the need to monitor flow directions as well as a larger number of contingencies that may cause reliability concerns.

There have also been other development such as the planned retirement of the Diablo Canyon generating facility. This will directly impact the RAS guideline related to the amount of generation curtailment and maintaining the spinning reserve requirement. The current ISO guideline for the maximum amount of generation that can be curtailed for a single contingency via the use of RAS cannot exceed the maximum capacity of one Diablo Canyon unit at 1150 MW. The guideline for double contingency is 1400 MW and these limits were based on the minimum amount of spinning reserves that ISO has historically been required to carry. Considering the scenario with the planned retirement of Diablo Canyon generating facility, the guideline for the maximum amount of generation curtailment in a RAS needs to be reviewed and updated as necessary.

4. Next Steps

Due to the issues and challenges outlined above, the ISO is planning to propose changes to the current guidelines in order to provide further clarity for RAS development, and also explore opportunities to potentially limit the use of future RAS in an area that is saturated with existing RAS. This revised issue paper serves to resume the process by identifying some of the key issues. The ISO will seek comments from the stakeholders to identify any current and additional issues as feedback to this revised issue paper. The ISO will consider potential solutions to address these issues in the first straw proposal.

5. Stakeholder Engagement

The ISO is proposing the following schedule to engage the stakeholders for this initiative.

Table 1 lists the proposed schedule for the review and updates to the current ISO RAS guidelines.

Table 1 Schedule

Item	Date
Post Revised Issue Paper	July 15 2022
Stakeholder Call	July 22, 2022
Stakeholder Comments Due	August 4, 2022
Post Straw Proposal	August 31, 2022
Stakeholder Call	September 7, 2022
Stakeholder Comments Due	September 21, 2022
Post Revised Straw Proposal (tentative)	October 26, 2022
Stakeholder Call (tentative)	November 2, 2022
Stakeholder Comments Due (tentative)	November 16, 2022
Post Draft Final Proposal	January 4, 2023
Stakeholder Call	January 11, 2023
Stakeholder Comments Due	January 25, 2023

The ISO proposes to present its proposal to the ISO Board of Governors in February 2023. The ISO is committed to providing additional opportunities for stakeholder input as required to support the goals of this initiative. Stakeholders can submit written comments through the ISO's commenting tool.