NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Technical Rationale

Project 2022-03 Energy Assurance with Energy-Constrained Resources
Reliability Standard BAL-007-1 | May 2024

BAL-007-1– Near-term Energy Reliability Assessments

Introduction

This document explains the technical rationale and justification for the proposed Reliability Standard BAL-007-1. It provides stakeholders and the Electric Reliability Organization (ERO) Enterprise with an understanding of the technical requirements in the Reliability Standards. This Technical Rationale and Justification for BAL-007-1 is not a Reliability Standard and should not be considered mandatory and enforceable.

Updates to this document include the Project 2022-03 Energy Assurance with Energy-Constrained Resources Drafting Team's (DT's) intent in drafting new requirements.

Overview

Inconsistent output from variable energy resources, coincident with unassured deliverability of fuel supplies and volatility in load, can result in insufficient amounts of energy available from the Bulk Power System (BPS) needed to serve electrical demand, maintain sufficient Operating Reserve, and ensure the reliable operation of the BPS. As part of ongoing operations planning, many entities have started incorporating some limited assessments of energy reliability into studies that produce key metrics; however, there is inconsistency among entities on how the assessments are performed. To achieve the level of consistency needed across the industry, to reliably predict the energy needed to serve the load, energy reliability assessments for the operations time horizon and the minimization of identified risks are mandated and codified in these new standards. Project 2022-03 proposes two new Reliability Standards, BAL-007-1 and BAL-008-1, and the Energy Reliability Assessment (ERA) definition. The purpose of the proposed Reliability Standard BAL-007-1 is to identify and minimize the risks of forecasted Energy Emergencies in the operations planning time horizon by analyzing the expected resource mix availability and the expected availability of fuel.

Rationale for BAL-007-1

As the BPS becomes more reliant upon energy constrained and variable resources, traditional capacity-based planning methods and strategies are being stretched and potentially do not identify energy-related risks to reliably operate and maintain the system. BAL-007-1 is being proposed as a step toward reducing these potential risks and to begin the transition to energy-based planning methods and strategies that incorporate critical time-based variables that are not captured in capacity-based processes. BAL-007-1 is intended to provide Balancing Authorities (BAs) and Reliability Coordinators (RCs) with the tools necessary to successfully navigate increasingly energy-constrained and variable system operations. BAL-007-1 Operating Plan(s), which are not intended to replace or supersede TOP-002 and EOP-011 Operating Plans,

are intended to provide a list of actions over a longer-term/earlier time period that can reduce the severity of or fully mitigate the need to implement TOP-002 and/or EOP-011 plans.

The new Reliability Standards can be separated into three basic activities:

- Developing and documenting an ERA process, Scenarios or a method for creating them, and Operating Plans (Requirements 1-7).
- Performing ERAs and comparing to forecasted Energy Emergency circumstances (Requirement 8).
- If forecasted Energy Emergency circumstances are identified, implementing Operating Plan(s) to minimize energy reliability risks and communicating that implementation (Requirements 9-10).

The purpose of the standard is to assess energy risk in the Operations Planning time horizon, determine if the identified risks are acceptable, and take actions to minimize the impacts. It should be noted that the standard offers the flexibility to allow for either a deterministic or probabilistic implementation of an ERA process. This has been left up to the BA to determine which method is right for their region. This standard improves reliability through identifying energy risks earlier and being able to implement longer lead time activities to mitigate those risks.

The diagram below gives an overview of the process with actions and communication between entities outlined.

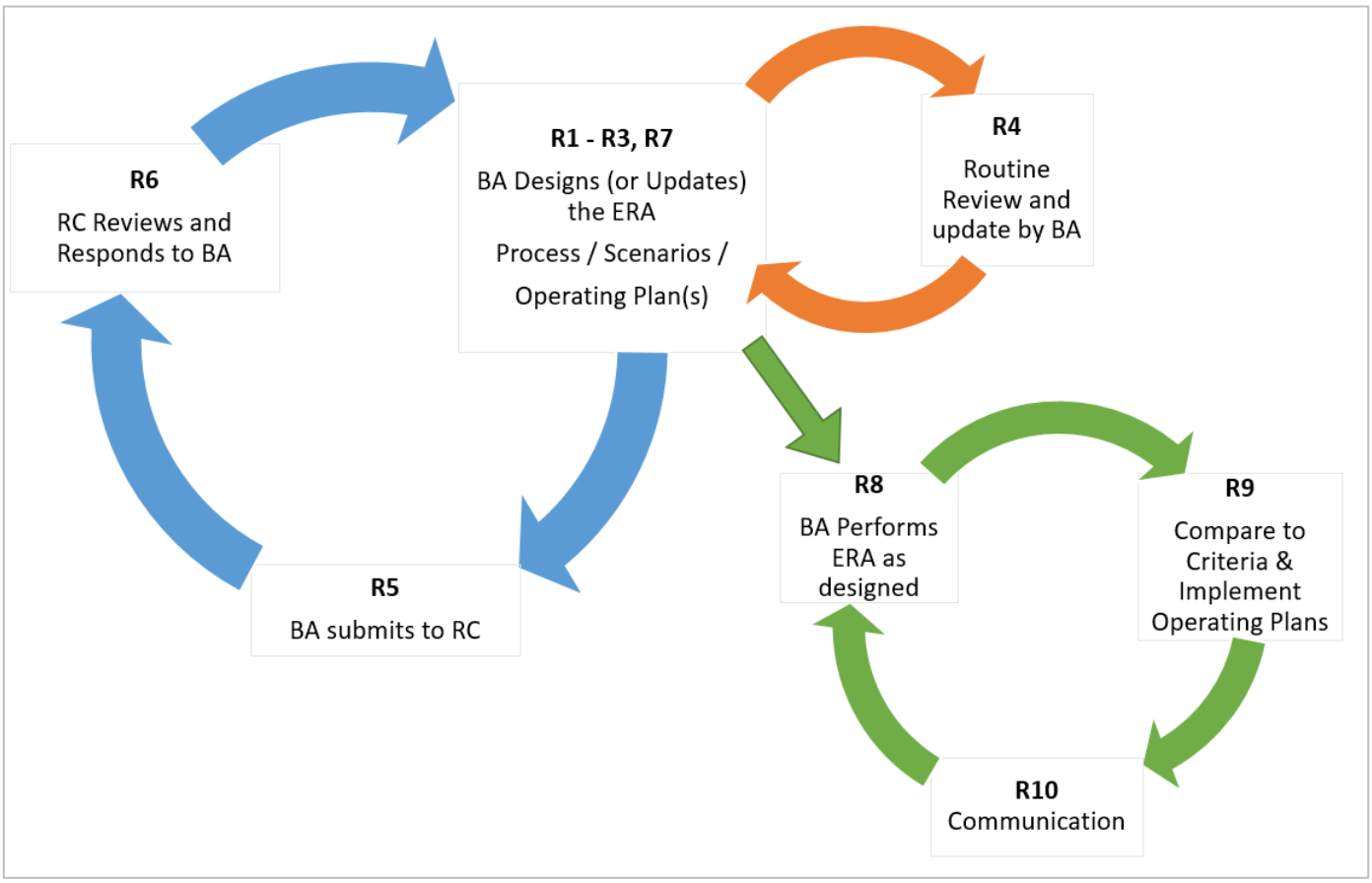

Figure 1. Process Diagram of ERA Requirements

Relationship to Other Standards

While the proposed standard has similarities to other standards, especially TOP-001, TOP-002, and EOP-011 standards, the proposed standard addresses reliability risks due to gaps in the existing reliability standards by focusing on different time horizons than current standards and energy risks which are not clearly addressed. In many cases, the language is intentionally similar to language in those requirements but applicable to different time horizons. The BAL-007-1 standard looks at a near-term time horizon which is longer than other operations planning assessment requirements. In terms of addressing energy risks, BAL-007-1 more clearly outlines the assessment requirements to look at energy over an assessment period rather than capacity assessments generally used to comply with current standards.

TOP-001 and TOP-002 provide requirements for assessments and Operating Plans in real-time and operations planning time horizons, but their requirements are limited to, at most, the next day which limits the options that Balancing Authorities may take to respond. BAL-007-1's proposed language extends this outlook to at least greater than five days and up to six weeks ahead, so BAs have time to implement mitigation actions with longer lead times (e.g., reschedule outages, conserve consumable fuel, source additional fuel) and have better situational awareness of potential reliability risks.

TOP-002, EOP-011, and BAL-007-1 all require Operating Plans to minimize or mitigate reliability risks, but they would likely differ in what actions that a BA would deem appropriate to be included in each. Since BAL-007-1 is assessing a longer time horizon, the projected conditions are more uncertain, and the Operating Plans developed should reflect that. Instead of identifying specific actions that must be taken, the Operating Plans under BAL-007-1 are expected to have more general processes than Operating Plans in TOP-002. BAL-007-1 Operating Plans are not intended to replace TOP-002 and EOP-011 Operating Plans but to identify additional actions that can be implemented when potential risks are identified with a longer lead time. The goal of these longer-term Operating Plans is to reduce the likelihood or the severity of an actual Energy Emergency occurring, which would require an EOP-011 Operating Plan. Actions that are taken as outlined in the BAL-007-1 Operating Plans would then lead into the real-time and day-ahead Operating Plans, through the establishment of more favorable initial conditions, rather than overlapping them. An example timeline of how BAL-007-1 and EOP-011 would interact is below when the BAL-002 associated Operating Plans are not sufficient to avoid an Energy Emergency. Ideally, the longer-term Operating Plan(s) would result in the EOP-011 Operating Plan not being needed but if an Energy Emergency still occurs, the Operating Plans should have reduced the severity of the Energy Emergency.

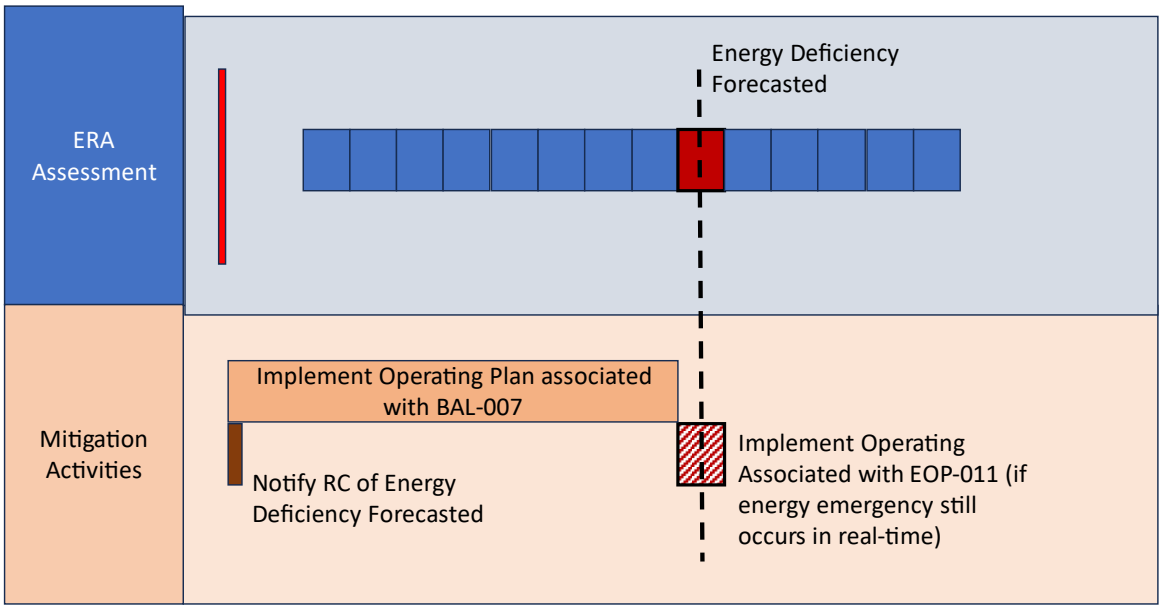

Figure 2. Timeline of ERA performance and Operating Plan Implementation if the forecasted energy deficiency is not fully mitigated when EOP-011 Operating Plan is still required.

Additionally, the BAL-007-1 assessments require considering energy risk which can only be performed by looking at an assessment over a time period with multiple time steps and considering the depletion of stored energy and the production from just-in-time, variable energy resources. While EOP-011 Requirement R2 includes "Energy Emergencies" as a risk that Operating Plans must address, these assessments have generally been performed as capacity assessments, or potentially a series of capacity assessments in succession, which do not necessarily include variable energy and fuel risk, especially over a longer period of time. BAL-007-1 explicitly requires including these elements in an assessment and set criteria regarding when risks need to be addressed through Operating Plans.

The Balancing Authority (BA) may require additional data from other entities and should consider this when documenting the process. While BAL-007-1 does not require other entities to provide necessary data, TOP-003 requires the BA to "maintain a documented specification for the data necessary for it to perform its analysis functions…" in Requirement R2 and requires the other entities to provide the data in Requirement R5. Since these TOP-003 Requirements broadly give the BA the ability to request data "to perform its analysis functions" and does not limit that to assessments to a specific time horizon, TOP-003 should provide a mechanism for BAs to request and receive the necessary data for ERAs.

Proposed New Terms:

Energy Reliability Assessment (ERA)
Evaluation of the resources to reliably supply the Electrical Energy required to serve Demand and to provide Operating Reserves for the Bulk Power System throughout the associated evaluation period.

Rationale
The ERA definition was added to allow for Energy Reliability Assessments to be performed in different time horizons using similar processes prescribed by NERC standards, but also through other processes while maintaining a consistent understanding of what an ERA is. These assessments are intended to look at the wide variety of resources available to serve load's energy requirements not only in the near-term but also in other time horizons including the long-term planning horizon. ERAs go beyond the existing scope of the capacity assessments that have traditionally been performed to look more closely at energy needs.

Requirements:

Requirement R1
Requirement R1 identifies the basis for defining what an ERA is. Time horizons and basic input assumptions in the near-term are specifically designed by each BA according to their risks and their supply and demand profiles. Because of differences in risks and in supply and demand profiles between regions, rather than requiring a set of prescriptive elements to assess, each BA is provided with minimum assessment requirements which they will use to define the scope for performing their ERAs and document a rationale.

Balancing Authorities may perform the required ERAs for just their area or a group of BAs may jointly perform their ERAs. Should a deficiency be identified, the BAs, regardless of whether they performed their assessment jointly or individually, can utilize their energy reserve sharing group of available resources. The goal of the ERA is to determine if sufficient energy is available. A review of the energy reserve sharing group should be performed to verify that it is sufficient to meet the groups combined needs. Again, the goal of the ERAs is to improve reliability for the system and the load.

The ERA process will include definitions for a duration, frequency, how they account for the necessary parameters to determine energy needs, what resources can be used, and when to meet them. The duration can be within a specified range for the near-term assessments as identified by the BA, again providing for regional flexibility. It is understood that specific regions will have a different set of concerns and risks. Some regions have a resource mix that may include a large percentage of variable energy resources. Others may have risks due to either a non-firm fuel supply issue (e.g. non-firm gas supply) or non-firm transmission service due to system congestion. For example, a region that is heavily dependent on resources requiring more maintenance may need to look further into the future to manage these outages to confirm that there will be sufficient energy available. An entity with more variable energy resources with possible congestion may need to look more closely at the weather forecast and review their energy supply mix more frequently. The process is intended to ensure that as changes in the resource mix or demand profiles become reality, they are captured appropriately and intentionally. New resource types are being introduced into the power

system more frequently compared to years past, a trend that is expected to continue. Each new resource type comes with subtleties of how they perform and operate that may require a change to the way resources are portrayed in an ERA. Forecasted weather events that occur within a BA's footprint (e.g., droughts, storms, calm and cloudy stretches) will also change the expected resource availability when an ERA is performed. Near-term ERAs are intended to be performed on a routine basis and look at the time period that covers the next several days to weeks, with an emphasis on beginning the day after the next day (i.e., after the end of the current TOP-002 associated Operating Plan).

Demand profiles will be determined by the BA as well. Entities will have a number of items to consider prior to determining their Demand profile. It is up to the BA to determine exactly how Demand will be modeled, including considerations for a variety of how demand response is treated. A BA may choose to include market based or dispatchable demand response but it is recommended that other forms of demand response should not be included, which would leave load reduction options as a last resort (e.g., voltage reduction, load cycling, etc.). Each BA will need to identify what their type of demand response is and when, if ever, to consider it. Load shed should only be identified as part of a plan if this is the last resort.

ERAs must ensure that every period of time is assessed. For example, performing a two-week long ERA every two weeks would meet the near-term requirement. The determination of how long to study will be based on several factors such as system or generation outage recall timing, accuracy of forecast information beyond the next few days, or lead time for fuel replenishment. A minimum amount of information that must be included in every ERA is identified in the standard. Based on the region of the BA performing the ERA, more information might be needed than for others. The standard does not contain an all-inclusive list. If other parameters are necessary for a BA to fully model the energy landscape for the ERA, they should be included and documented with a rationale for inclusion and selection.

Requirement R2

Requirement R2 outlines a minimum set of Scenarios that must be included in an ERA. The intent is to provide a mechanism for each BA to gauge how close to an Energy Emergency they may be in certain situations. Credibility of the Scenarios is for the BA to define and document.

There are four types of scenarios, three for supply and one demand, that can be varied independently or in combination with each other. At least one parameter should be varied enough to stress the system to determine if the (remaining) available resources are robust enough to meet the Demand and Operating Reserves. A possible load Scenario could be raising Demand from a 50/50 profile to a higher profile, such as a 90/10 or maximum load scenario, to measure the impact to the system and determine if shortfalls are detected. There are three supply side Scenarios to be studied. The first is a credible energy contingency that removes one of the largest energy resources from the base case and runs it again. Large energy resources may be the same as large capacity resources, but not necessarily in all cases. The second supply Scenario removes a credible set of resources that are supplied by the same fuel supply. This is traditionally thought of as natural gas supplying multiple generating stations and may be just that, but could also be a set of wind turbines that are closely situated where a storm could render them unavailable for a period of time or solar

panels that are covered by snow or smoke from a fire. The final scenario is a generator outage for an unplanned outage. Regardless of the chosen energy and fuel Scenarios, it is up to the BA to determine which resource or set of resources are included in the ERA. The choices by the BA in Scenarios should be documented and identified in their rationale.

In addition to the above defined scenarios, Requirement R2 specifies the consideration of "Other Scenarios with a credible or historical risk of occurring based on the best information available at the time of Scenario creation." An example of these Scenarios in a near-term ERA includes a Scenario that stressed the System such as the impacts of a winter storm that occurred within the previous five years. It is credible that a similar storm could occur during near term ERAs that cover this season.

Requirement R3

The near-term time horizon specified in BAL-007-1 offers a different vantage point than next day and real-time assessments. The actions that a BA can take due to an identified risk of an energy shortfall are different when identified days to weeks earlier than if waiting for a next day or real-time assessment. An example of actions that could be taken based on the results of a near-term assessment that may not be available for a next day or real-time assessment include requesting for energy resources or transmission facilities to return from maintenance or construction outages earlier than planned or to postpone a planned outage. If an entity were to wait for the next day studies to identify a risk, fewer options for the BA to avoid an energy risk in real time would be available.

Requirement R3 requires BAs to develop Operating Plans prior to forecasting Energy Emergencies through ERAs to minimize their effects. These Operating Plans are developed so that in the event that an ERA shows that a BA may have insufficient energy, they will have an Operating Plan ready to implement, per Requirement R3, that has been reviewed and updated before system conditions are unfavorable and be ready for later implementation. Operating Plans are expected to include actions that can be performed by the BA within the time horizon for which the ERA is designed, near-term. The actions that BAs may include in Operating Plans will also provide information to the BA regarding how long the assessment period of the ERA might need to be (Requirement R1) such that they can have time to accomplish the actions identified. For example, if actions that could minimize potential Energy Emergencies take two weeks to accomplish, the ERA should be looking at least two to three weeks into the future.

As discussed in the Relationship to other Standards section, the Operating Plans developed based on this requirement are not intended to supersede Operating Plans associated with TOP and EOP standards but to complement them and include actions that will reduce the likelihood or severity of an energy deficiency occurring in real-time. To that end, the BA develops an appropriate Operating Plan for a forecasted Energy Emergency that is identified by an ERA. Depending if the ERA is completed weeks or days prior to the Energy Emergency, the BA decides on suitable plans to reduce the impact. Since the Operating Plans are being implemented based on assessments looking days to weeks ahead, considering the associated uncertainty of the results, BAs may decide to exclude actions in the BAL-007-1 Operating Plans which would only need to occur much closer to the projected event or only plan to implement those actions if the projected

conditions of the ERA appear that they will still occur. For example, an Operating Plan may include increasing the frequency of performing ERAs in order to monitor whether the forecasted Energy Emergency is more or less likely as the uncertainty of input data to the assessment decreases and other actions in the Operating Plan have been implemented. Again, the goal of performing an ERA is to identify those times when a forecasted Energy Emergency might occur. The developed Operating Plan should have steps that can be taken to minimize, or mitigate, the forecasted Energy Emergency.

The ERA Operating Plans should be designed to be adaptable to unfolding conditions and proactive enough to possibly avoid an energy shortage through advanced actions. As an example, to illustrate the Operating Plan uses, when an ERA is performed two weeks ahead of a calculated shortfall then potential actions have a two-week timeline to perform the appropriate action plans as well as monitor if the identified risk conditions have changed. For instance, if the results from a two-week duration ERA during an extremely cold period determines an Energy Emergency may occur, the BA's Operating Plan could include the following actions:

- Survey scheduled outage system to determine if any generation currently out for maintenance can return earlier than planned.
- Survey if any transmission outages affect either generation deliverability or import capability. If yes, can they be returned to service prior to the forecasted Energy Emergency.
- Survey if generation and transmission scheduled to go out can defer their outages until after the event.
- Notify RC and relevant entities of the projected risk (e.g., relevant government authorities for assessing the need and strategy for public appeals or other BAs to account for expected imports or exports).
- Make sure all energy storage units can be fully available to help mitigate energy shortfalls.
- Increase frequency of performance of ERAs, including possibly daily, and assess energy availability and have Operating Plan actions conditional on the level of risk.
- If ERA results still indicate unacceptable risk of energy deficiency two days prior to projected event, instruct thermal plants to warm up leading up to event to avoid outages due to ice formation and cold-start issues.

Ideally, these actions will minimize or prevent an Energy Emergency that might occur in real-time. However, if the Energy Emergency still occurs, these actions should reduce the energy deficiency and prepare the BAs to implement an emergency Operating Plan. This scenario is intended only to be one simple illustrative example that does not reflect all potential Operating Plan actions or actions that BAs in all regions can do.

While scheduling increased imports can be a part of the Operating Plan, it is imperative that the BA verify that the resources they have scheduled will continue to be there to solve their Energy Emergency. It should not be assumed that once imports are scheduled, this energy is a firm supply. Both BAs may be impacted

by the event causing an Energy Emergency for both areas. The supplying entity may not be able to honor their agreement to provide this energy.

Requirement R4

Requirement R4 requires that the BA review their process, Scenarios, and Operating Plans, in Requirements R1 through R3, to determine if any changes are needed. The BA shall review this documentation no less than once every 24 months. Due diligence during the design and review phases by the BA is required to identify potential risks and possible actions that could minimize those risks that would lead to an energy shortfall in the near-term timeframe.

Requirement R5

Requirement R5 provides a channel of communication between a BA and their associated RC. Requirement R5 is simply a BA providing their ERA process documentation, as defined by R1, R2, and R3, to the RC. The BA and the RC shall develop a mutually agreed-upon schedule, no greater than every 24 months. Depending on the RC, this may be requested more frequently. The designed process, along with the base condition, Scenarios or method for their creation, and Operating Plan(s) are all part of the package that needs to be reviewed.

Requirement R6

Providing ERA information to the RC under Requirement R5 is paired with this Requirement for the RC to review each package within 60 days of receipt. The RC review is intended to identify risks that may not have been considered for Wide Area reliability and ensure all identified risks are communicated to the BA. Coordination is required to ensure that there are no conflicting assumptions between BAs. Once a review is complete, the RC notifies the BA, and any necessary changes occur within Requirement R6. For example, an assumption by two BAs, sharing a common transmission interface, each identifying an import condition during the same time period would result in an infeasible allocation of energy resources and would trigger an RC notification. The RC review provides additional reliability benefits, by comparing the BA's ERA information to that of other BAs, allowing for identification and clarification of discrepancies and/or opportunities for enhancements to strengthen the contents of a BA's ERA package.

It is the intention for implementing BAL-007-1 that the routine review of each ERA by the RC can be accomplished within the required timeframe. However, it is understood that when ERAs are newly designed, along with Scenarios and Operating Plans, that more time will be needed by the RC to perform a thorough review. For this reason, implementation of Requirements 4 through 10 have an additional six months.

Requirement R7

Requirement R7 is the third part of the communication between the RC and BA where the BA is required to address any issues identified by the RC and resubmit their ERA process, Scenarios or the method for creation, and Operating Plan(s). This requirement ensures the closing of the communication loop and documentation that the RC's review comments generated in Requirement R6 are addressed. Requiring the BA to address and document responses to feedback generated by the RC review ensures that the reliability

benefits described in Requirement R6 of an RC's cross-comparison of packages from multiple BAs are enshrined and potential Wide Area reliability risks are minimized or avoided.

Requirement R8

Requirement R8 specifies that the near-term ERA be performed as designed, reviewed, and approved.

Requirement R9

Requirement R9 specifies what constitutes three different circumstances that identify a forecasted Energy Emergency. The forecasted Energy Emergency conditions are intended to be a clear threshold where the ERA results identify levels of impending risk and require actions be performed to minimize the potential they will occur. The definitions of what constitutes a forecasted Energy Emergency are in alignment with the Energy Emergency Alert (EEA) definitions in EOP-011. The difference for BAL-007-1 is that instead of being a real-time Energy Emergency, these would be forecasted events. The goal here is that if an Energy Emergency is forecasted in an ERA, the associated Operating Plan will have targeted steps to help minimize the forecasted Energy Emergency before it gets to be an Energy Emergency in the next day and real-time timeframes.

There are three EEA levels and three levels of forecasted Energy Emergencies. The criteria for forecasted Energy Emergency apply also to Scenarios identified in Requirement 2 and studied in Requirement 8. This level of granularity allows for the BA to design an Operating Plan that fits the specific situation. Given Scenarios may be expected to enter the lower levels of an Energy Emergency, and the actions in an Operating Plan should be appropriate for that combination.

Finally, by leveraging the existing terms used in EOP-011 for EEA, clear and well-understood definitions are already in place which require little to no training, beyond the advanced timing associated with BAL-007-1. BAs have existing interpretations of how they respond when nearing or entering an EEA and the existing interpretations are expected to be used, including those that involve interaction with Reserve Sharing Groups.

Requirement R10

After receipt of notification from the BA that an Operating Plan is being implemented, Requirement 10 requires communication between the RC and Transmission Operators, other BAs within their footprint, and neighboring RCs. The time requirements for the notifications for near-term ERAs is 24 hours. The purpose of these communication requirements is to provide situational awareness from the RC to other entities that may be impacted by a forecasted Energy Emergency in a BA. With this information, other BAs and Transmission Operators can better plan for their own reliability risk, especially if they expected to rely on neighboring BAs for imports. Additionally, the RC receiving this information from multiple BAs allows the RC to have a wide area view of the energy risk and provide any insight they may have to minimize it. This communication is required only after the RC receives notification, which is one of the provisions required in the development of Operating Plans in Requirement R3.