NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Technical Rationale

Project 2022-03 Energy Assurance with Energy-Constrained Resources
Reliability Standard BAL-007-1 | September 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 studies of energy reliability assessments 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 this new standard. Project 2022-03 proposes two new Reliability Standards, BAL-007-1 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.

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) with the tools necessary to successfully navigate a system that has both variable load and resources.

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 Standard can be separated into three basic activities:

- Developing and documenting an ERA process, Scenarios or a method for creating them, and Operating Plans (Requirements 1-3).
- Performing ERAs as documented (Requirement 4).
- Comparing to forecasted Energy Emergency conditions and, if identified, implementing Operating Plan(s) in response to energy reliability risks (Requirement 5).

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 action when appropriate. 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.

Relationship to Other Standards

While the proposed standard has similarities to other standards, especially TOP-001, TOP-002, and EOP-011, 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 and with an energy component of the assessment. 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 day-ahead Operating Plans and real time, 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 shown below in *Figure 1* when the TOP-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.

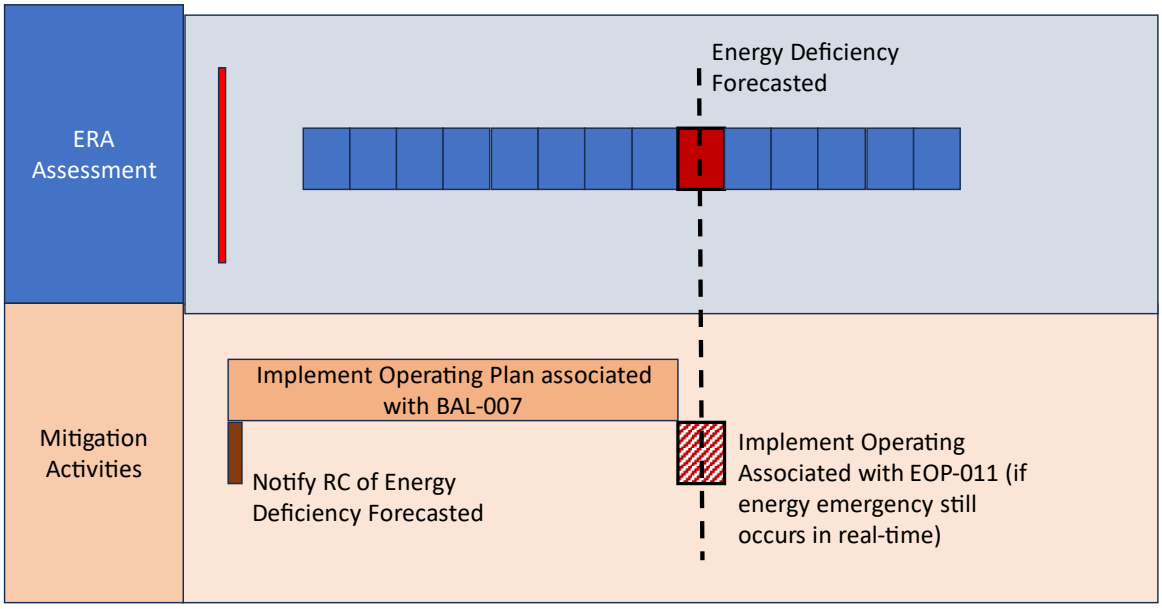

Figure 1. Timeline of ERA performance and Operating Plan Implementation if the forecasted energy deficiency is not fully mitigated when EOP-011 Operating Plan is still required.

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 fuel supply 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. To provide further clarity in TOP-003, "Near-term Energy Reliability Assessments" has been added to the list of activities for which the Balancing Authorities maintain and distribute a data specification for which applicable entities are required to provide.

Proposed New Terms:

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

Near-Term Energy Reliability Assessment – An Energy Reliability Assessment with an assessment period that begins no later than two days after the operating day and has a minimum duration of five days and a maximum duration of six weeks.

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.

The definition for Near-Term Energy Reliability Assessment provides further details for this specific type of ERA. Within the definition are requirements for the duration of a Near-Term ERA. It is the intent that Near-Term ERAs are performed on a routine basis and look at the time period that covers the next several days to weeks, and that all time periods will be effectively covered by some iteration of a Near-Term ERA. Assessments would be repeated as no later than when one expires to extend the outlook for the BA performing the ERA. To that end, in the interest of maintaining relevancy of the ERA, a five-day to six-week limit is placed on the duration. While six weeks is a long period of time, it gives regions the flexibility to assess the energy landscape over a period of time that encompasses the energy risks that they deem to be pertinent. It is expected that most Balancing Authorities will update their Near-Term ERAs on a more frequent basis, but the baseline requirement is flexible to allow for longer periods. The minimum duration of five days gives the Balancing Authority the foresight to evaluate fuel constraints and weather anomalies. Fuel constraints, specifically natural gas scheduling timelines, typically extend through a single day (e.g., today for tomorrow) during the week, and three-day strips over weekends. Holidays introduce a longer strip than the typical weekends. Five-day strips are traded at least once per year and sometimes more than once depending on where holidays fall on the calendar. That construct is one example of the factors that set the minimum of five days for Near-Term ERAs. Weather dependent resources, where prevalent, would drive the consideration for longer-duration assessments. Doldrums in wind and solar production will have a historical expectation for how long they typically last and should be considered with determining the minimum duration of the Near-Term ERA. Finally, there is a requirement that the initialization data being used to perform a Near-Term ERA be current. This is spelled out as "an assessment period that begins no later than two days after the operating day", the operating day being the day on which the ERA is being performed, or started, or completed. One interpretation that meets this requirement is that the first day of the Near-Term ERA is the current day, which is no later than two days out and provides good initialization of the models being used to perform the assessment. What this is intended to prevent is performing all

Near-Term ERAs in a single assessment at the start of a year or season, maintaining current, relevant, and useful information for the BA to make sound decisions.

Requirements:

Requirement R1

Requirement R1 identifies the basis for defining what a Near-Term ERA is. Basic input assumptions are specifically designed by each BA according to their risks and their supply resource mix and demand profiles. Because of differences in risks and in resource mixes 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 their 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. This is consistent with existing partnerships (e.g., Reserve Sharing Groups or resource adequacy collaboratives) between BAs that are used for other operations or planning activities and real time operations, and should be reflected in Near-Term ERAs and their associated Operating Plan(s). Should a deficiency be identified, the BAs, regardless of whether they performed their assessment jointly or individually, are expected to utilize all of their available resources, including those in other BA areas. The goal of the ERA is to determine if sufficient energy is available to meet demand at all times.

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 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.

The heart of an ERA is the modeling of resource capabilities and their fuel supplies. This modeling includes constrained fuel supplies such as natural gas, inventoried fuels such as oil, coal, liquefied natural gas and some hydro, and just-in-time fuels like wind, solar, and run-of-river hydro. ERAs look at the production from generating resources over a period of time, which will impact their operation. Constrained fuels will deplete, limiting the operation of generation (i.e., fuel). All of these considerations go into modeling resource capabilities and operational limitations, including fuel supply.

Energy transfers with other Balancing Authorities is required to be modeled as well. This modeling is simply the interchange between areas that BAs count on in their day-to-day operation of their systems. It is recommended that BAs coordinate these assumptions to ensure consistencies on the common interface, but may not be required depending on the scope of the ERA as it is defined.

Finally, known Bulk Electric System (BES) Transmission constraints, that limit the ability of generation to deliver their output to load, are required to be included in the Near-Term ERA. This requirement was carefully worded such that a power flow or load flow analysis is NOT required to be performed, however

when a system has a known constraint that causes area generation to always be limited under certain specific conditions, and those conditions are expected to occur, then that generation should be reduced in the ERA as well.

ERAs should ensure that every period of time is evaluated, and document the frequency and duration that meets that intent. For example, performing a two-week long ERA every two weeks would meet the 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. Each Balancing Authority will conduct a Near-Term ERA for all time periods unless the BA demonstrates that a Near-Term ERA is not necessary. This can be accomplished via screening tools that evaluate all of the factors above for risk and show that risk is low for that period of time. This requires documentation of the methods used to make that determination as well as the evaluation of the factors considered.

Requirement R2

Requirement R2 outlines a minimum set of Scenarios that must be included in a Near-Term ERA. The intent is to provide a mechanism for each BA to gauge whether or not they are close to an Energy Emergency. Credibility of the Scenarios is for the BA to define and document. The selected Scenarios are intended to stress the system, but may fall short of causing an Energy Emergency on their own. For example, raising demand during light load periods may not result in stressed system conditions, but would meet the intent of stressing the system. The BA is in full control of determining what Scenarios are appropriate.

There are four types of Scenarios, two for supply, one for Demand, and a combination of the two based on historically observed conditions that could occur again. Each of the Scenarios 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 Scenario for Demand profiles 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 energy shortfalls are forecasted. There are two supply side Scenarios to be included in the ERA. The first is an energy supply contingency that effectively removes 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. Typically, the results of the base Scenario will show the analyst what the largest source of energy is, which would be removed from the energy supply contingency Scenario. The second supply Scenario removes a 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 or lull could render them unavailable or with a very low production for a period of time. It could also include the loss of energy from solar panels that are covered by snow or smoke from a fire. The final Scenario is more versatile and can be tailored by the BA based on actual events that happened and could happen again within the horizon being assessed. This Scenario should be specific to the region, the time of year, the forecasted conditions, and any other expected conditions that the BA includes in the Near-Term ERA. For example, modeling a snow storm that covers solar panels during the winter months in a location where snow is prevalent makes sense but modeling the same storm during the

summer is unreasonable and is not expected to be done. It is possible that this Scenario is simply documented that there are no historical events that fit the current forecasted conditions, or that the Scenario is the same as those described in R2.1.1 through 2.1.3. When this occurs, the Balancing Authority should include that description in their process.

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 must be identified and documented.

Requirement R3

The time horizon specified in the Near-Term ERA definition offers a different vantage point than next day and real-time capacity 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 capacity assessment. They are also different when comparing the energy aspect of the ERA to a capacity assessment. An example of actions that could be taken based on the results of a Near-Term ERA 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. Additional actions that could be considered for an energy shortfall that would be overlooked in a capacity assessment is the conservation of stored fuel or the optimization of energy storage (e.g., pumped storage hydro or batteries). 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.

Provisions for communication with the Reliability Coordinator is simply a documented process including the forecasted conditions when the RC will be alerted to the results of the Near-Term ERA and/or the implementation of Operating Plans. Many of the actions that are included in Operating Plans will not require communication of any kind (e.g., waiting for better forecasts), but some may require that communication (e.g., recall of transmission facilities). The procedure used to document the performance of Near-Term ERAs including a section that clearly defines what communications are required by the BA meets this requirement.

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 developed and communicated 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 could 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 forecasted 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 reduce, 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.
- Communication with Reliability Coordinator and other relevant entities of the projected risk (e.g., government authorities for assessing the need and strategy for public appeals for conservation, or other BAs to account for expected imports or exports and potentially facilitate higher transfers).
- Ensure 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 reduce 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 specifies that the near-term ERA be performed as designed.

Requirement R5
Requirement R5 specifies what constitutes two 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, two of which are associated with forecasted Energy Emergencies. The criteria for forecasted Energy Emergency apply also to Scenarios identified in Requirement 2. This level of granularity allows for the BA to design an Operating Plan that fits the specific situation. Some 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 R6
Requirement R6 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 at least 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.