Technical Rationale

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

BAL-007-1– 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 ERO Enterprise with an understanding of the technical requirements in the Reliability Standard. This Technical Rationale and Justifications 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 Standards Drafting Team's (SDT's) intent in drafting new requirements.

Overview

Project 2022-03 proposes a new Reliability Standard BAL-007-1 and the Energy Reliability Assessment (ERA) definition. The proposed Reliability Standard purpose is to address and mitigate the risks of energy emergencies in the operations planning time horizon by analyzing the expected resource mix availability and the expected availability of fuel during the study period. Unassured deliverability of fuel supplies, coincident with inconsistent output from variable energy resources and volatility in forecasted load, can result in insufficient amounts of energy available from the Bulk Electric System (BES) needed to serve electrical demand and ensure the reliable operation of the BES throughout each hour of the time period being evaluated. As part of ongoing operations planning, many entities have started incorporating some limited energy reliability assessments into reliability studies that produce key metrics; however there is inconsistency among entities and how the assessments are performed. To achieve the level of consistency needed across the industry, energy reliability assessments for the operations time horizon and the mitigation of identified risks are mandated and codified in this new standard.

Rationale for BAL-007-1

As the BES becomes more reliant upon energy constrained and variable resources, traditional capacity-based planning methods and strategies are being stretched and potentially not identifying 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 Coordinator (RCs) with the tools necessary to successfully navigate increasingly energy constrained and variable system operations. BAL-007-1 Operating Plans, while not intended to replace or supersede TOP-002 and/or EOP-011 Operating Plans, are intended to provide a list of actions implementable 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 ERA process, scenario, and Operating Plans (Requirements 1-6)
- Performing ERAs and comparing to Energy Reserve Margin (Requirements 7-8); and
- If Energy Reserve Margins are not met, implementing Operating Plan to mitigate energy reliability risks (Requirements 9-11)

The purpose of this standard is to assess energy risk in Operations Planning time horizon, determine if the risks are acceptable, and take actions to mitigate. This standard should improve reliability through identifying energy risk 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.

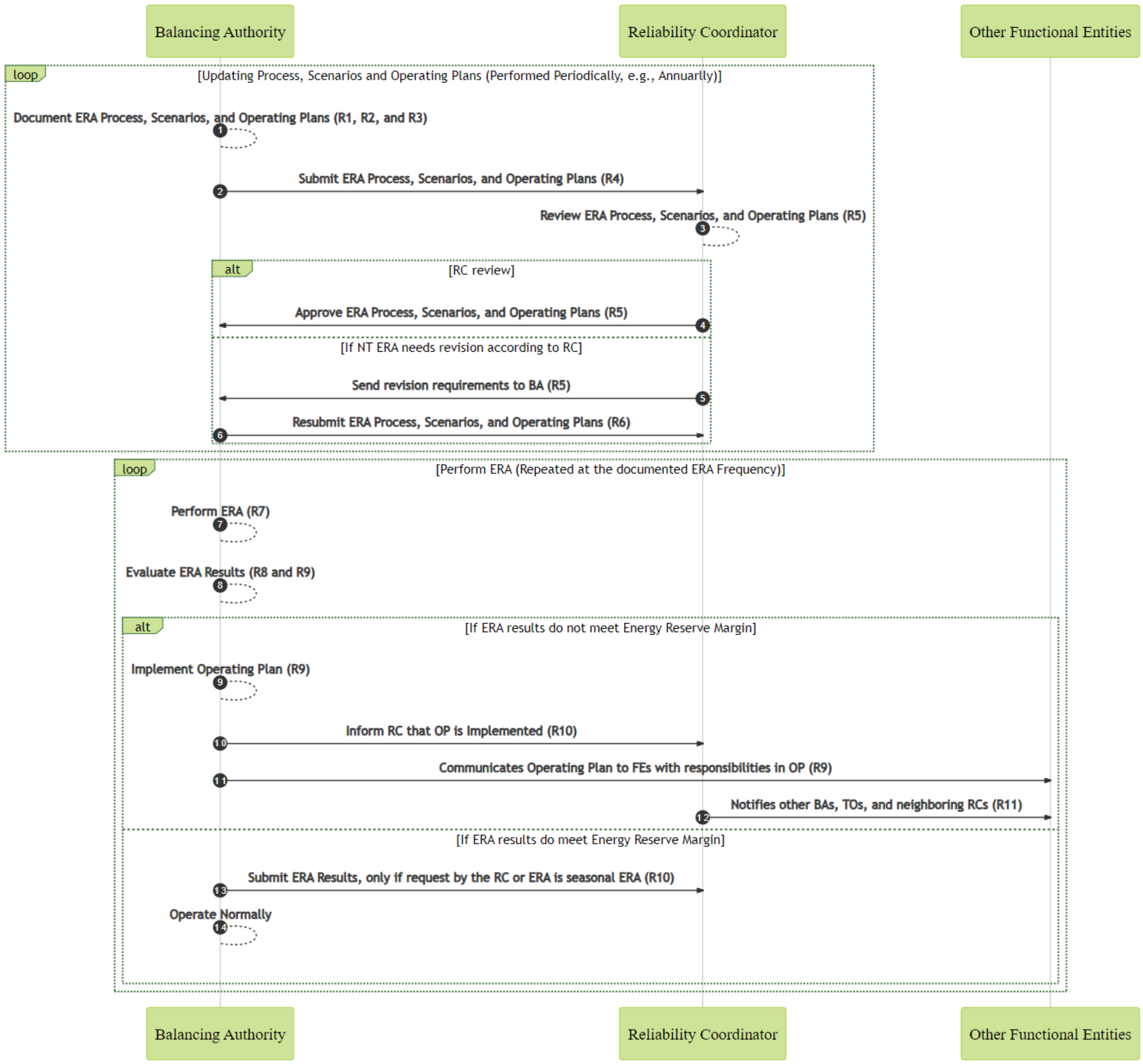

Figure 1. Process Diagram of ERA Requirements

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 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 and a seasonal 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 assessment and Operating Plans in real-time and operations planning time horizons, but their requirements are limited to less than one day ahead which limits the options that Balancing Authorities must respond. BAL-007-1's proposed language extends this outlook to greater than five days, so BAs have the time to implement mitigations actions with longer lead times (e.g., conserve consumable fuel, source additional fuel, reschedule outages) and have better situational awareness of potential reliability risks.

TOP-002, EOP-011, and BAL-007-1 all require Operating Plans to mitigate reliability risks, but they would be different in what actions are included in each. Since BAL-007-1 is assessing a longer time horizon, the projected conditions are more uncertain, and the Operating Plans developed under BAL-007-1 should reflect that. Instead of specifying specific steps that must be taken, the Operating Plan can have more general processes and incorporate longer lead time activities than Operating Plans in TOP-002. BAL-007-1 Operating Plans are not intended to replace TOP-002 and EOP-011 developed Operating Plans but to implement actions that can only 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 of an actual energy emergency occurring which would require an EOP-011 Operating Plan or at least, reduce the severity of the energy emergency. Actions in the BAL-007-1 Operating Plans should lead into the real-time and day-ahead Operating Plans rather than necessarily overlapping. This idea is similar between the seasonal and near-term ERAs; the seasonal assessments give situational awareness about a longer time horizon and allow for longer lead time activities which should reduce the risk of identifying risks in the near-term ERA. An example timeline of how BAL-007-1 and EOP-011 would interact is below when the BAL-002 associated Operating Plan is not sufficient to avoid an energy emergency. Ideally, the longer-term Operating Plan would result in the EOP-011 Operating Plan not being needed but if an energy emergency still occurs, the Operating Plans should reduce the severity of the energy emergency.

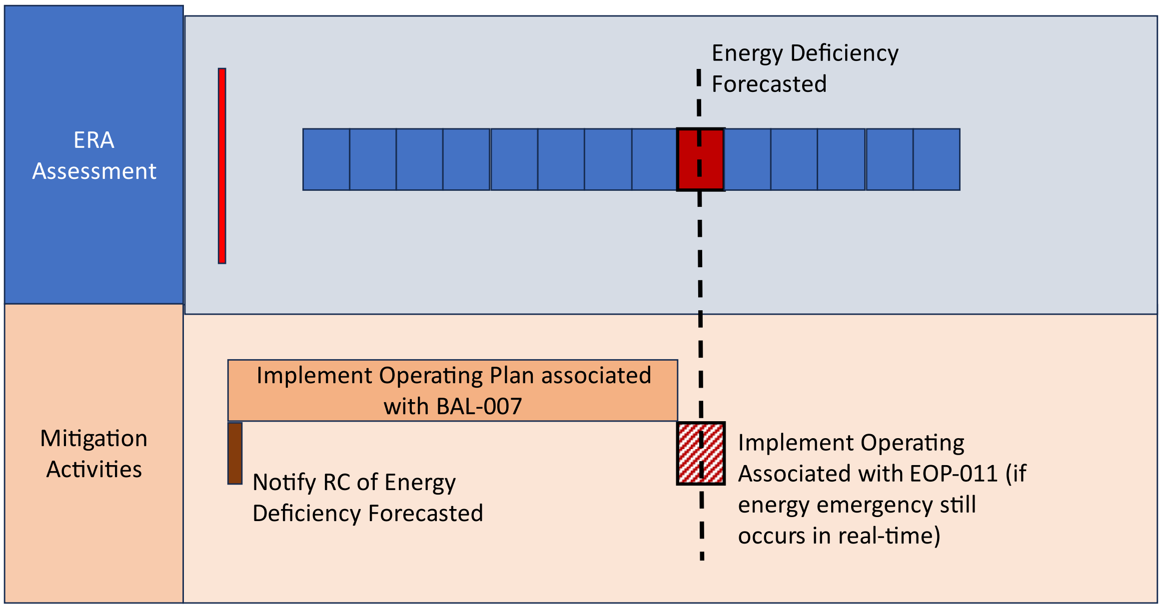

Figure 2. Timeline of ERA performance and Operating Plan Implementation if the forecasted energy deficiency is not fully mitigated when EOP-011 Operating Plan is still required.

Additionally, the BAL-007-1 assessments require considering energy risk which can only be performed by looking at an assessment over a period with multiple timesteps and considering stored energy and just-in-time energy sources. While TOP-002 Requirement 4 includes "energy reserve requirements" as a risk that Operating Plans must address, these assessments have generally been performed as capacity assessments which do not include the fuel risk especially over a longer period of time. The BAL-007-1 explicitly requires including these elements in an assessment and sets criteria regarding when risks need to be addressed through Operating Plans.

Requirement 1

Requirement 1 forms the basis for defining and requiring what ERAs are. Since ERAs are a new concept, more detail is needed in order to ensure that the intent is met. ERAs go beyond the existing scope of capacity assessments that have traditionally been performed. This intent begins with the work products generated by the NERC Energy Reliability Assessment Task Force (ERATF)[1] starting with the white paper (Ensuring Energy Adequacy with Energy Constrained Resources)[2], through the approval of the two Standard Authorization Requests (SARs) which handed the work off to the Standard Development Team

[1] Currently the Energy Reliability Assessment Working Group (ERAWG)
[2] https://www.nerc.com/comm/RSTC/ERATF/ERATF%20Energy%20Adequacy%20White%20Paper.pdf

(SDT) for Project 2022-03[3]. Requirement 1 is simply defining the minimum standards by which ERAs will be performed.

Requirement 1.1 starts the standard off with the definition of timelines for performing ERAs. Annual review of the process is intended to ensure that any changes in the resource mix or demand profiles are captured appropriately and intentionally. New resource types are being introduced into the power system routinely compared to years past. Each new resource comes with subtleties of how they perform and operate that may require an analyst to change the way they think about how the resources are portrayed in their energy reliability assessments. Events that occur on the system (e.g., droughts, storms, calm and cloudy stretches) will also change the basis of how an ERA is performed. As each year passes, a review of the ERA process will give some assurance that the ERA is useful and provides good data for system operators. There are two types of ERAs that are required in this standard. The first is near-term and the second is seasonal. 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. Two-time horizons offer a different vantage point on a common timeframe (i.e., looking at the same week from a distance and again up close), resulting in different available actions that can be taken when issues are discovered, and more precision and accuracy when needed. Seasonal ERAs will tend to be more of a risk assessment with a wide array of possible conditions which a BA or RC can evaluate and begin to formulate actions that may take months to design, develop, and implement. Near-term ERAs will offer more precision and accuracy that offer a BA or RC enough detail to take specific actions, some of which are made possible because of the actions that were taken as a result of a seasonal ERA.

Requirement 1.1.1.1 outlines the minimum required time that an ERA must cover, between the next five days and the next six weeks. It is understood that every specific region will have a different set of concerns and risks. Some regions have a resource mix that makes for an ERA that extends past a few days unreasonable. Others may have longer term risks that require a longer assessment. For example, a region that is heavily dependent on long-lead-time fuel replenishment may need to look further into the near-term future (i.e., six weeks) in order to have the appropriate amount of time to react.

Requirement 1.1.1.2 requires an overlap between near-term ERAs, which will ensure that no period of time is left unassessed. Performing a two-week study every week will meet this requirement. Performing a six-week study every month will meet this requirement. The determination of how long to study will be based on several factors such as lead time to fuel replenishment or outage recall and accuracy of forecast information. The figure below gives an example of the timeline of performing near-term ERAs.

Seasonal ERAs are required to be performed at least twice per calendar year and look at the upcoming seasons, or representative samples of the season that would provide reasonable assurance that the expected conditions of the remainder of the season are understood. It is not requiring that a full 90-120 day season is included in an ERA, but does require that the BA performing the ERA document the rationale for why the time horizon and duration were selected.

[3] https://www.nerc.com/pa/Stand/Pages/Project2022-03EnergyAssurancewithEnergy-ConstrainedResources.aspx

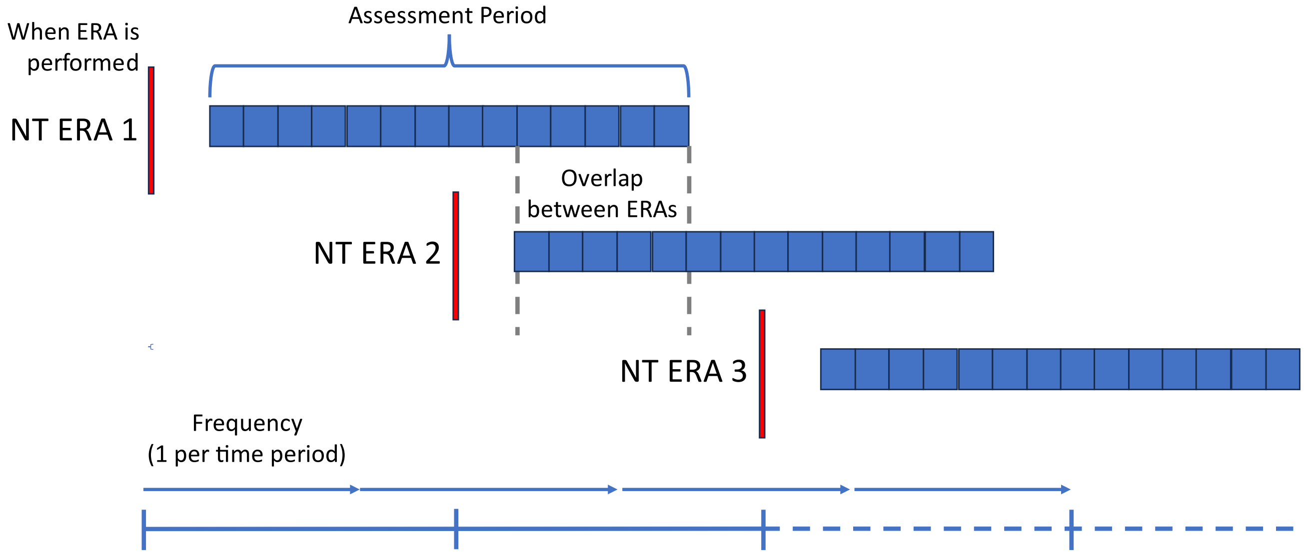

Figure 3- Timeline of performing multiple ERAs.

Requirement 1.2 sets a minimum amount of information that must be included in every ERA. This is not 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 selection.

Requirement 2

Requirement 2 outlines a minimum set of scenarios to be included in an ERA package. There are two basic sets of scenarios that form different combinations. Two load scenarios (projected and high) are expected to be similar to a 50/50, or expected load forecast and a high load forecast that would be something higher than that. High load scenarios would likely range between a 90/10 and maximum load scenario. There are then two, in effect, contingencies to be studied. The first is an energy contingency that removes the largest energy resource from the base case and runs it again. The other removes a set of resources that are supplied by the same fuel supply. This could be a natural gas pipeline but could also be a set of wind turbines that a closely situated where a storm could render them unavailable for a period of time or solar panels that could be covered by snow. Regardless of the chosen energy and fuel scenario, it is up to the BA to determine which resource or set of resources to include in the ERA and to document that decision along with a rationale per Requirement 2.2.

Requirement 3

Requirement 3 requires BAs to develop plans ahead of time to mitigate potential energy deficiencies identified through ERAs. These Operating Plans are developed so that in the event that an ERA shows that a BA will or may have insufficient energy (defined later), they will have an Operating Plan ready to implement, per Requirement 3. That Operating Plan is intended to be developed ahead of time so that it can be 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. 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 would need to be (Requirement 1.1) such that they can have time to accomplish the actions within. For example, if actions that could mitigate potential energy emergencies take two weeks to accomplish, the ERA should be looking at least two weeks into the future. Actions in an Operating Plan can be as simple as a set of prescribed notifications to a set of stakeholders that can impact the energy landscape to something as complicated as targeted load shed to save energy for when it is most needed. Ideally, actions could also include fuel replenishment, outage recall, arranging for imports from neighboring areas, and other actions that are specific to the region that would improve the supply/demand balance of energy.

As discussed in the comparison 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 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 potential energy shortfall that is identified by the ERA. Depending if the ERA is completed weeks or days prior to the energy shortfall, the BA decides on suitable plans to reduce the impact of an energy emergency. From prescribed notifications, load shed decisions, actions in an Operating Plan can be both simple and/or complex. Ideally, plans should include factors such as fuel replenishment, outage recall, importing from neighboring areas, and region-specific actions to enhance the energy supply/demand. Since the Operating Plans are being implemented based on assessments looking days to weeks ahead and the associated uncertainty of the results, BAs will likely not decide to include actions in the Operating Plans which would not need to occur until much closer to the projected event or only plan to implement those actions if the conditions projected 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 project 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.

The ERA operating plans should be designed to be adaptable to unfolding conditions and proactive enough to avoid energy shortage by preparing ahead of time. 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 where identified risk conditions could change as well as two weeks to refine action plans. For instance, if ERA results during an extreme cold period that looks out two weeks determine the energy reserve margin may not be met, the BA's Operating Plan could include the following actions:

- Survey oil inventory of oil-fired generators and request generators with low inventory order more oil;
- Notify RC and relevant entities of the projected risk (e.g., Generator Operations, relevant government authorities, other BAs with expected imports or exports);
- Increase frequency daily performance of ERAs and assessing energy reserve margins and have Operating Plan actions conditional on the risk;
- Conserve consumable fuels for period with projected energy shortfall; and
- 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 formations and cold-start issues.

Ideally, these actions will prevent an energy emergency occurring 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.

Requirement 4

Requirement 4 provides a channel of communication between a BA and their associated RC. Requirement 4 is simply a BA providing their ERA, as defined by R1, R2, and R3 to the RC. The BA and the RC shall develop a mutually agreed-upon schedule for when the BA shall submit this information to the RC. Note that the ERA has not yet been performed, but only designed. Due diligence during this design phase requires the BA to identify the risks that could lead to an energy shortfall in the near-term and/or seasonal timeframe. The design, along with the base case, scenarios, and Operating Plan(s) are all part of the package that is provided to the RC.

Requirement 5

Providing ERA information to the RC under Requirement 4 is paired with Requirement 5 for the RC to review that package within 60 days of receipt. The RC review is intended to identify risks to 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 6. For example, an assumption by two BAs sharing a common transmission interface of an import condition from the other BA 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 mitigation of discrepancies and/or opportunities for enhancements to strengthen the contents of a BA’s ERA package.

Requirement 6

Requirement 6 is the third part of the communication between the RC and BA where the BA is required to address issues identified by the RC and resubmit the ERA process, ERA scenarios, and Operating Plan(s). This requirement ensures the closing of the communication loop and documentation that review comments generated in Requirement 5 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 5 of an RC's cross-comparison of packages from multiple BAs are enshrined and potential wide area reliability risks avoided.

Requirement 7

Requirement 7 specifies that the near-term and the seasonal ERAs be performed.

Requirement 8

Requirement 8 specifies the energy reserve margin calculations for three different scenarios. The energy reserve margin is intended to be a clear threshold between whether the ERA's results identify acceptable or unacceptable levels of risk and require mitigation actions to be performed.

The calculation of the Energy Reserve Margin is a function of the largest single Contingency and load forecasts. The largest N-1 Contingency is a factor of the energy reserve margin to reflect to the need of having available energy beyond just meeting demand for services such as operating reserves and in case of further contingency events. A percentage of the load forecast is included as a component of the energy reserve margin to reflect the risk of load forecast error and the need to assess whether there is sufficient energy to meet that risk.

Requirement 8.1 applies to ERA cases with no contingencies. Requirement 8.2 applies to ERA cases with the largest energy contingency scenario. Requirement 8.3 applies to ERA cases with a fuel supply loss scenario as well as additional scenarios identified for consideration in seasonal ERA. Requirements 8.1 through 8.3 are progressively lower in the amount of energy that should be available because the scenarios associated with each section have different impacts from contingencies assessed. Since the contingencies directly model some of the potential energy reduction in an energy-constrained event, the energy reserve margin is reduced for those scenarios to avoid setting the threshold too high.

Requirement 9

Requirement 9 sets up the BA to apply Requirements 8.1, 8.2, and 8.3 by performing an ERA, then looking at the results of the ERA to determine what resources are available but not utilized in each iteration (e.g., hour) of the assessment, then compare the actual studied quantity to the requirements in R8. This concept is similar to Operating Reserve, but different in that all resources would be assumed to be available, ignoring temporal requirements to start generation. This is an energy requirement, not a real-time reserve requirement. If the energy reserve margins in R8 are not met, the BA is expected to implement an approved Operating Plan. The execution of the actions specified in this requirement provides the pathway to reduce the severity of energy emergencies or fully mitigate the need to implement EOP-011 Operating Plans before their triggering conditions are met in the shorter time horizon. Because ERA time horizons are significantly longer than Operating Planning Analysis required in TOP-002, ERAs provide BAs with several options which may be unavailable or unreasonable in a shorter time horizon; however, with this longer time horizon also come options that may not be concrete, such as advance notifications and opening lines of communication with regulators and other entities.

Requirements 10 & 11

Requirements 10 and 11 are more communication between the RC and BA, then between the RC and other BAs and RCs, after the ERA has been performed and it is known whether actions are required per the Operating Plan that was exchanged earlier. There are different requirements for near term ERAs than there are for seasonal ERAs. The purpose of these communications requirements is to provide situational awareness to the RC and other entities that may be impacted by energy risks in a BA. With this information, other BAs can better plan for their own reliability risk especially if they expected to rely on neighboring BAs for imports and exports. Additionally, the RC receiving this information from multiple BAs allows the RC to have a wide area view of the energy risk.