Standards Authorization Request
Revision to
BAL-003-1.1 Frequency Response and Frequency Bias Setting
June 28, 2017

The North American Electric Reliability Corporation (NERC*)* Standard Process Manual Version 3, Section 4.0, *Process for Developing, Modifying, Withdrawing or Retiring a Reliability Standard* requires a Standard Authorization Request (SAR) that proposes to substantially revise a Reliability Standard to be accompanied by a technical justification that includes, at a minimum, a discussion of the reliability-related benefits and costs of modifying the Reliability Standard and a technical foundation document to guide the development of the Reliability Standard. North America's only registered Frequency Response Sharing Group (FRSG), consisting of 20 Balancing Authority Areas (BAAs) within the Western Interconnection (encompassing 38 BAAs in total), submitted a SAR on February 17, 2017 requesting a revision to the existing Reliability Standard BAL-003-1.1 (BAL-003). NERC has requested additional technical justification for the SAR.

This document provides further technical justification for the previously submitted SAR, organized according to the following topics:

- Real-Time Reliability
- Event Selection
- Measurement
- Assumption behind the current standard
- Goal of a Reliability Standard

Real-Time Reliability

BAL-003 states that compliance is judged according to performance for the median event out of a larger set of historical events evaluated for a particular compliance year. This suggests it is acceptable for BAAs to provide adequate frequency response just over half the time. The standard assumes a statistical probability that if one BAA fails there will be enough excess response from other BAAs to compensate. But it also follows that all BAAs could simultaneously provide insufficient frequency response on multiple occasions without any compliance failures. This fact alone indicates BAL-003 does not adequately assure real-time reliability.

Furthermore, relying on historical event analysis to establish and evaluate frequency response does not ensure frequency response is available in real-time. Frequency response is needed 24 hours a day, 365 day a year, to manage interconnection frequency and recover from frequency events. If the Interconnection were dispatched as a single system, the operator would estimate frequency response capability needed from each resource and dispatch those resources as necessary to ensure reliability. An interconnection made up of multiple BAAs should not be treated any differently.

BAA operators must decide how to operate their systems to support reliability. BAL-003, in its current form, does not specify the amount of frequency response reserves needed in real-time for reliability—that is, capacity needed on frequency responsive resources to be prepared for the design event of an Interconnection Most Severe Single Contingency. Yet NERC's *Reliability Guideline for Operating Reserve Management* (*Guideline*) addresses this question directly. Section V.a. of the guideline states:

> *To determine an initial target (at scheduled frequency) frequency responsive reserve level (in MW) for a given responsible entity, simply multiply 10 times the responsible entity's FRO (because FRO is in MW/0.1 Hz) by the MDF for the responsible entity's Interconnection. An example to illustrate this:*
>
> *Given: ABC responsible entity is in the Eastern Interconnection (EI) and its pro-rata portion of IFRO is 1.5%.*
>
> *The key EI parameters from Table 1 are: IFRO = 1002 MW/0.1 Hz and MDF = 0.449 Hz.*
>
> *The responsible entity's FRO is {1.5% *1002 MW/0.1 Hz} or 15.2 MW/0.1 Hz.*
>
> *The responsible entity's initial frequency responsive reserve target is {10 * 15.2 * 0.449} or 67.48 MW.*
>
> *The initial target may need to be modified based on several factors, most of which are addressed later in this section. For example, if actual performance indicates additional response is needed, then the target should be increased.*

The studies performed by NERC determined the Maximum Delta Frequency A to B based on a statistical analysis of the B to C ratio. This study, in conjunction with the *Guideline*, indicates the Western Interconnection should maintain frequency responsive reserve capacity online at all times equal to approximately three times the Interconnection Frequency Response Obligation (IFRO). This amount is disputable and seems like an overestimate of reserve needed in the Western Interconnection. This is in light of The Western Interconnection's frequency response performance in recent events approximately the MW size of the double Palo-Verde design event. An overestimate or not, the current standard only obligates a BA to keep some level of this reserve available a little more than half of the year. BAL-003 must provide for this and more study needs to justify the reserves needed by BAs in real-time. Until then, the guideline provides some guidance for how much a BAA should hold in MW capacity, but the *Guideline* further states:

> *The responsible entity also may choose to perform a risk analysis in determining the level of frequency responsive reserve that assures compliance at an acceptable cost.*

This presents a problem. Reliability should not turn on economic decisions. Reliability requirements must be incorporated into standards and not just captured in guidelines that are enforced solely by peer pressure within industry. Instead of being clear, BAL-003 sends mixed messages to BAAs.

Given the current gap in BAL-003 and the "wiggle room" in the *Guideline*, BAAs could achieve compliance in many unreliable ways. For example, a BAA could only hold enough capacity to cover a 0.1 Hz deviation, because most BAL-003 measurement events in the Western Interconnection are less than 0.1 Hz (since evaluation of FRM as currently prescribed in BAL-003-1.1 began in compliance year 2015, the average frequency deviation of all NERC selected events was only -0.060 Hz/0.10 MW). Or, a BAA could plan to meet all events in two quarters of a compliance year, and then neglect the other two quarters. A pattern that could be desirable for entities that take down generation for annual maintenance, normally in the spring in the Western Interconnection. Even if BAAs operate conscientiously to protect reliability, BAL-003 creates confusion about what is needed in real-time to support reliability.

Following FERC's order approving BAL-003, markets have developed for "paper" transactions in which one BAA can agree with another to transfer "credit" for calculated frequency response (referred to as Frequency Response Transfers). While the members of FRSG generally support allowing BAAs to comply through Frequency Response Transfers, they worry that assessing compliance according to a median-based metric could degrade real-time reliability.

For example:

> Suppose a BAA cannot fully comply with BAL-003, but has existing generation equipment that does provide some frequency response. The BAA finds itself integrating substantial variable generation that does not provide automatic frequency response. The increasing variable generation displaces frequency-responsive generating units for at least half of the operating hours. The BAA weighs its options. It could pay generators to improve equipment; it could alter dispatch to increase headroom on frequency responsive units; it could install a battery capable of frequency response; and so on. After analysis, the BAA decides it is most economic to meet its Frequency Response Obligation (FRO) entirely through Frequency Response Transfers. The BAA does not seek to improve equipment capability, and it has every right to shut down frequency-responsive units to make room for the new variable generation. Available frequency response will decline compared to historic levels. The BAA now relies entirely on the transferring BAA. In this scenario, historic frequency response is lost. The transferring BAA need only respond adequately for more than half of the compliance measurement events, and the purchasing BAA is relieved of any obligation to provide frequency response in real-time. This also flies in the face of the underlying assumption of statistical probability.

BAL-003 does not require *operational* (as opposed to paper) transfers of frequency response, and therefore has not resulted in creation of real-time markets for frequency response. NERC regulations should drive market signals that reflect what is truly needed for reliability, and ensure 100% coverage through equipment, capacity, and dispatch.

Another problem with BAL-003 is that it measures the average frequency support in the 20 to 52 seconds following a frequency event, even though machine action is needed within the first 20 seconds to arrest rapid frequency decline in the Western Interconnection. The measurement lag encourages BAAs to delay response to improve compliance metrics, which subverts the primary purpose of the standard. Western Interconnection frequency could drop low enough to trigger Underfrequency Load Shedding without a single BAA failing to comply with BAL-003. This lessens, rather than enhances, Western Interconnection reliability.

The FRSG recognizes, as do NERC and FERC, that the generation fleet is changing. Frequency response will likely decline unless operators maintain frequency-responsive capability and resources are dispatched in real-time to provide adequate headroom for frequency response. The FRSG also concurs with NERC that, historically, the Western Interconnection has had sufficient frequency response. To speak plainly, the sky is not falling and risks to reliability may not be immediate. But neither NERC nor the electric utility industry should ignore this issue. Operational requirements must be clearly stated to ensure that equipment, operations, and markets develop to support real-time reliability now and in the future.

Event Selection and Measurement:

Several aspects of BAL-003's event selection and response measurement process may perversely reward poor performance and penalize proper performance. NERC's *Reliability Guideline on Primary Frequency Control* encourages Generator Operators to set governor dead bands of no more than 36 mHz (and recommends using an even smaller dead band), with a ramped (not stepped) droop of between 4% to 5%. While a smaller dead band may be feasible in the Eastern Interconnection, frequency within the smaller Western Interconnection is more variable. Here, smaller dead bands would impose undue burdens on thermal generators. Likewise, due to the size of the Western Interconnection, credible N-1 events can drop the C and B frequency points well outside the 36 mHz dead band.

In the Western Interconnection, the generation fleet provides primary frequency response for large events through governor action. Operators have gone to significant effort, in good faith, to tune governors and associated controls according to the *Guideline* to protect reliability and comply with BAL-003. Yet the current methods of event selection and response measurement do not take these settings into account.

One deficiency is that FRO and Frequency Response Measured (FRM) derive from change in frequency instead of actual frequency. Many governors have been set (as indicated by the *Guideline*) to use a dead band of 36 mHz. Therefore any changes in frequency between 59.965 and 60.035 Hertz should not trigger frequency response, but these governors with governor droop set correctly, should respond to frequencies outside the dead band. Likewise, because the governor response is ramped starting at the edge of the dead band instead of stepped, the response for a frequency that is outside but close to the dead band should be small. Therefore a change in frequency from 60.03 to 59.97 should not result in governor response, a change from 60.00 to 59.94 should result in moderate governor response, and a change from 59.97 to 59.91 should result in substantial governor response, even though all three events have the exact same frequency delta. Yet the FRM and FRO calculations treat these as equivalent events, penalizing BAAs for correctly respecting the NERC-defined dead band.

Another deficiency is the gap between 0 and 20 seconds in the measurement period. The first 8-12 seconds of an event are when frequency excursions are actually arrested. While this period is difficult to measure through Interchange metering, it is the critical period to prevent underfrequency load shedding. The measurement period lag (20-52 seconds) encourages BAAs to install controls with a 15 or 20 second delay in frequency response. Control equipment could operate less often without compromising compliance scores—certainly an unintended consequence, and one that could undermine the reliability of the Interconnection. This practice of delaying response to ensure compliance for the sake of economics at the expense of reliability is already being implemented on resources within the Western Interconnection as a direct result of the current BAL-003-1.1 measurement criteria.

Yet another issue with the FRM measure is its assumption that frequency response is linear. Although a linear assumption is reasonable for governor technology, even a governor can behave non-linearly. A step change response, capable in inverter based technology, drastically inflates the FRM measure within the first tenth of a Hertz. For example, a battery capable of injecting 10 MW upon sensing a frequency change would achieve a FRM of 10 MW/0.1 Hz for an A to B event of 0.1 Hz. That same battery would achieve a FRM of 100 MW/0.1 Hz for an A to B event of 10 mHz. The difference between FRM for the same MW injection within the first tenth of a Hertz is close to 90 MW/0.1 Hz while the difference one tenth and two tenths is only 5 MW/0.1 Hz. Because of the fraction on the denominator of the FRM equation, the equation becomes less variable for an A to B value of 0.1 Hz or greater. This needs to be accounted for in the BAL 003 standard.

There are additional problems with the number of events selected for compliance assessment and the median response requirement. By requiring selection of numerous events, regardless of how many significant frequency events occur, BAL-003 skews compliance evaluation toward events within the 36 mHz dead band. This penalizes proper performance as described above. Even if all frequency events within the dead band were excluded, the events selected to date (including previous year sample selections) have an average delta frequency of roughly 0.06 Hz. This means BAAs could remain compliant even if they carried only enough frequency responsive reserve to cover frequency changes of less than 0.1 Hz—far less than the Interconnection would need to prevent underfrequency load shedding in a major event (which is what BAL-003 is intended to prevent).

BAL-003 is intended to ensure the Western Interconnection has enough frequency responsive reserve to prevent underfrequency load shedding for a net loss of 2,440 MW, with a starting frequency of 59.976. As described above, a BAA that has installed generator controls to provide exactly that response using the NERC *Guidelines* will be penalized for not responding to small events (which is correct), whereas a BAA that carries just enough frequency responsive reserve to respond to much smaller events, or intentionally delays its response to optimize compliance over reliability, could be rewarded.

This means the Western Interconnection could experience multiple underfrequency load shedding events in a year without a single BAA failing the standard. Conversely, multiple BAAs could fail despite providing proper and reliable frequency response. Not only is this biased against BAAs that take action in good faith to follow NERC's *Guideline*, but over time, as BAAs migrate toward more cost-effective compliance methods, the Western Interconnection's initial frequency response, as well as total frequency response available, could decline.

Use of "Net Actual Interchange" to Measure Compliance with BAL-003, R1:

Net Actual Interchange (NI_A) is defined as the algebraic sum of all metered interchange over all interconnections between two physically adjacent BAAs. BAL-005-0.2b allows a scan rate of up to six seconds for both tie-line telemetry and automatic generation control (AGC) calculation. Using these values to calculate FRM has many inherent problems, and is ill suited to measure BAA response to frequency deviations caused by losses of large generating resources.

(1) The time frame for calculating a BAA's FRM is 20 to 52 seconds after a frequency deviation is identified in historical data provided by the BAA's energy management system (EMS). Many EMS/SCADA systems do not or cannot synchronize tie-line telemetry for calculation of Area Control Error (ACE) or FRM. Due to scan rates of telemetry equipment, this non-synchronization of tie-line data can dramatically skew the calculation of FRM. Although there is no intentional time delay in any of the telemetered data, permitted scan rates of up to six seconds can create lags of up to twelve seconds, depending on the timing of the event and the measurement transmitted to the host EMS for recording and calculation purposes. Measuring response beginning at 20 seconds after the frequency event is detected can skew a BAA's apparent FRM performance—whether for better or for worse, at random.

(2) Although most measurements for NI_A occur at physical meters on interties, many BAAs have pseudo-tie telemetry that does not originate from a physical meter. These pseudo-tie values are commonly associated with jointly owned generating facilities that may contribute significantly to a BAA's FRM. In addition to lag effects from scan rates of remote terminal unit (RTU) data, there are several other delays in receiving, calculating, and transmitting measurements used to calculate pseudo-tie values. Once a host BAA receives the core measurements to derive a preliminary pseudo-tie value, several additional computational and transmitting cycles must occur. At a minimum, the host BAA must run a calculation within its EMS or other control system, which may take up to six seconds. Once the value has been calculated, it is transmitted to neighboring BAAs that share the pseudo-tie value, typically through Inter-Control Center Communication Protocol (ICCP) data links. The ICCP transmittal is separate from the calculation process, with up to 12 seconds of latency between sending and receiving. As with the timing lag described in Item 1 above, the skewing effects of pseudo-tie measurements and calculation, with respect to BAL-003 compliance evaluation, are essentially random.

(3) When a frequency deviation occurs due to loss of a large generator, generator governors respond automatically to the resulting drop in frequency. If a BAA is electrically between a large resource providing frequency response and the lost generation, transmission flows can increase on the intermediary BAA's system. As transmission flows increase, transmission line losses increase as well. These losses appear as increased load on the intermediary BAA's system, which can in turn affect apparent FRM performance. In some instances, even though the BAA's generation and load response was appropriate, the losses incurred due to neighboring generator response can overwhelm the BAAs actual FRM.

(4) There is no accommodation for a BAA experiencing an intentional change to its NI_A. In previous years, scheduled interchange would be adjusted only within the 10 minutes ahead of or after the operating hour or during curtailments to manage rare unplanned transmission events. Frequency bias procedures allowed BAAs to ignore events that occurred during these intentional changes to Net Scheduled Interchange. With the advent of 15-minute scheduling, schedule changes can occur during 50 out of every 60 minutes of any operating hour. Furthermore, many BAA's representing a significant share of the WECC interconnection are currently operating in a joint 5-minute market, which results in intentional ramps at all times. This market continues to expand and other markets are developing, increasing the percentage of BAA's that experience constant intentional ramps due to NSI changes. If, by chance, a frequency deviation (selected for compliance evaluation) were to occur during this intentional re-dispatch, chances are 50%-50% that the BAA could be benefitted or harmed for BAL-003 compliance purposes. These intentional changes in Net Scheduled Interchange do not adversely affect reliability, but could harm BAA performance under BAL-003.

(5) BAAs often adjust internal generation in anticipation of daily load variations. During certain seasons, a BAA may experience relatively large changes in native load. The BAA may intentionally dispatch generation to prepare for these anticipated changes in native load and expected changes to hourly NI_A. Again, if by chance, a frequency deviation were to occur during this intentional re-dispatch, BAA compliance measurement could be improved or degraded, with no correlation to reliability.

(6) BAAs may also adjust internal generation to manage anticipated changes in output from Variable Energy Resources (VERs), primarily photovoltaic (PV) generating facilities. The California Independent System Operator (CAISO) has stated that as much as 47% if its BAA load has been served by VERs. Both increases and decreases to PV output occur on a daily basis. To manage these changes in anticipated VERs, a BAA will proactively ramp conventional generation or schedules. The result, if there is a concurrent frequency event used to measure BAL-003 compliance, is as descried above in Items 4 and 5.

Obligation for Generator Owners and Operators:

Frequency Response (FR) is a measure of an Interconnection's ability to arrest and stabilize frequency deviations following the sudden loss of generation or load, and is affected by the collective responses of generation and load throughout the Interconnection. The primary FR provided the generation fleet within an Interconnection has a significant impact on the overall FR. BAL-003 specifies the amount of frequency response (per Hertz of frequency deviation) needed from BAAs to maintain Interconnection frequency within predefined bounds and includes requirements for the measurement and provision of FR. But BAL-003 contains nothing that obligates Generator Owners/Operators (GO/GOP) to provide primary frequency response. BAAs are disadvantaged under the standard, with few options beyond expensive yearly markets for frequency responsive reserve capacity products. If BAL-003 is intended to ensure a positive frequency response to frequency excursions, then GO/GOPs must be subject to the standard.

Nothing in any other NERC standard or in the provisions of the FERC *Pro Forma* Tariff or Generation Interconnection Agreement (GIA) requires GO/GOPs to provide primary frequency response. Even a generator following the NERC Reliability Guideline – Primary Frequency Control may, in many cases, fail to respond due to the lack of headroom during an event or the blocking of the governor signal in the plant control or auxiliary systems. The BAA has no way through GIAs or tariff language to require otherwise. BAL-003 allocates a portion of the IFRO to the individual BAA, which must then attempt to allocate the obligation to all generators in the BAA. In most cases, GO/GOPs have refused to run generator units to reserve headroom for frequency response. Some GO/GOPs have asked how much they need to provide. BAAs can only explain that BAL-003 requires response expressed as a MW/0.1 Hz range. This makes it difficult to define exactly what they must provide. The retrospective nature of this standard does not enable BAAs to determine future performance and or inform GO/GOPs of their forward-looking obligation.

The ERCOT BAL-001-TRE-1, R7, "Primary Frequency Response" standard obligates the GO/GOPs to maintain functional generators and to also provide frequency response during relevant events. *"Each GO shall operate each generating unit/generating facility that is connected to the interconnected transmission system with the Governor in service and responsive to frequency when the generating unit/generating facility is online and released for dispatch, unless the GO has a valid reason for operating with the Governor not in service and the GOP has been notified that the Governor is not in service."* BAA obligations under ERCOT's standard are mostly reporting and tracking response from all generators.

FERC recognized the ERCOT standard for primary frequency response got it right and should be a pattern for future standards and revisions to current standards.[1] The ERCOT standard provides a useful model for changes needed to remedy the problems with BAL-003, or develop a Western Interconnection variance that recognizes how it differs from other regions in the NERC footprint.

NERC has pointed out that primary frequency response capability, by itself, would not require a resource to respond if called upon to help a BAA meet its FRO, and that, as a result, it is

[1] FERC has also accepted Regional Reliability Standard BAL-001-TRE-01 (Primary Frequency Response in the ERCOT Region) as mandatory and enforceable. *North American Electric Reliability Corporation*, 146 FERC ¶ 61,025 (2014).

important to have mechanisms to ensure that sufficient frequency response capability is not only available but ready to respond at all times. If NERC believes there are mechanisms available to the BAAs, then the standard should define those mechanisms. It is unclear how NERC could expect a BAA to meet its FRO without generator response provided by governor signals.

In its Notice of Proposed Rulemaking (NOPR) on Primary Frequency Response (Docket No. RM16-6-000), FERC stated that proposed modifications to GIAs for both large and small generating facilities (both synchronous and non-synchronous) would require new generators to install, maintain, and operate equipment capable of providing primary frequency response as a condition of interconnection. FERC recognized that "[w]hile NERC Reliability Standard BAL-003-1.1 establishes requirements for balancing authorities, it does not include any requirements for individual generator owners or operators," and that "[w]hen considered in aggregate, the primary frequency response provided by generators within an Interconnection has a significant impact on the overall frequency response."

The NOPR also cited a 2010 NERC survey of generator owners and operators, which found that,

> ". . . only approximately 30 percent of generators in the Eastern Interconnection provided primary frequency response, and that only approximately 10 percent of generators provided sustained primary frequency response. This suggests that many generators within the Interconnection disable or otherwise set their governors or outer-loop controls such that they provide little to no primary frequency response." (Footnotes omitted)

If FERC believes that generating facilities should be capable of providing frequency response, then the NERC standard should obligate GO/GOPs to provide it. If the generators have a significant impact on the overall frequency response, why would they be excused from BAL-003 compliance?

As noted above, NERC has approved a voluntary *Reliability Guideline on Primary Frequency Control* that encourages generators to provide a sustained and effective primary frequency response. If NERC recognized that generators were not providing primary frequency response as far back as 2010, NERC should support changes to the BAL-003 to obligate GO/GOPs to enable compliance.

There is compelling evidence and testimony from multiple sources—BAs, transmission operators, and NERC reports—to show that generators, a major source of primary frequency response, are not providing the appropriate response to frequency excursions. There is no "mechanism" available to the BAAs to compel generators to provide the necessary primary frequency response during an event. BAL-003 must be revised to address this.

Assumptions Behind the Current Standard:

BAL-003 appears to assume that all BAAs have the same composition and operate in the same manner. This may accurately describe the Eastern Interconnection. However, the Western Interconnection encompasses 38 BAAs that differ widely from one another.

Within the Western Interconnection, some BAAs are generation only, with 100% wind generation; some are generation only with 100% thermal generation; others serve load, with 100% hydro generation; and there are many other combinations.

BAL-003 rests on the assumption that as one BAA fails, the statistical probability is that other BAAs will provide sufficient excess response. But generation-only BAAs are driven by market conditions, which do not correlate to the timing of frequency events. BAL-003 allocates IFRO using a formula that has no bearing on a BAA's ability to provide frequency response. In addition, the formula uses two-year-old data to allocate IFRO. A generation-only BAA is driven by real-time conditions, not by two-year old data.

In addition, BAL-003 does a poor job of recognizing and accommodating BAA changes over time. The single largest Western Interconnection BAA (CAISO) has experienced significant changes related rooftop solar. With the installation of rooftop solar, CAISO's calculated load has decreased by over 5,000 MW, along with the reduction of the BAA calculated generation by over 5,000 MW. Under the formula to allocate IFRO, the presence of rooftop solar will reduce CAISO's FRO. At the same time, rooftop solar provides no inertia to support frequency response. Allowing large offsets from rooftop solar to reduce FRO runs counter to reliability, unfairly burdening and imposing disparate treatment on remaining BAAs. The unintended consequence is to encourage BAAs to increase the how much of their generation is behind the meter, thereby reducing their allocations of FRO. NERC's reliability standards should treat similarly situated responsible entities comparably, not create disparities among them. BAL-003 lacks flexibility to address real-time changes and real-time reliability requirements.

There is also no provision in the standard for generation that moves from one BAA to another. The BAA that lost the generation will still be held to a larger FRO than is justified by the amount of generation left in the BAA and the FRO of the attaining BAA will not change based on the increase in the amount of generation in the BAA.

Goal of a Reliability Standard

The foregoing discussion is not meant to imply that BAL-003 is completely without merit. It has brought frequency response to the forefront of many operational discussions. Some BAA operators have already taken steps to improve machine capability, change dispatch, and acquire Frequency Response Transfer from BAAs with excess. BAL-003 has moved the industry forward in its knowledge of frequency response. At the same time, it misaligns incentives for compliance and what is actually needed for reliability. This misalignment potentially drives progress in equipment, operations, and markets in the wrong direction.

To better ensure reliability, BAL-003 standard should:

- Address real-time reliability and not rely upon historical analysis and median performance. The standard needs to be flexible to address differing conditions and future changes.
- Ensure frequency response occurs to arrest rapid frequency decline and prevent underfrequency load shedding.
- Avoid unintended consequences, such as encouraging BAAs to time their response well after Point C and in the measurement period (Point B)
- Require testing of frequency responsive equipment
- Ensure comparability among all responsible entities needed for primary frequency response

SUMMARY

Real-Time Reliability

- BAL-003 as currently configured does not require response to an event. Frequency response is needed 24 hours a day, 365 day a year to manage variations in Interconnection frequency.
- Historical event-driven analysis does not ensure frequency response is available in real-time.
- Because the current standard measures historical response, and is measured by performance at the median event, the Interconnection could experience underfrequency load shedding in real-time without any compliance failures.
- The allocation of IFRO is predicated on two-year-old information, which does not reflect the Interconnection's frequency response needs in real-time.
- When a significant amount of generation trips off-line, frequency response is necessary within the first 20 seconds to arrest and stabilize rapid frequency decline. BAL-003 measures the average frequency support in the 20 to 52 second period following the event, which encourages BAAs to delay response to improve compliance. This subverts the primary purpose of the standard, and could drive less real-time reliability, not more.

Event Selection

- Current BAL-003 is driven by historical analysis of selected events and the selection criteria does not always measure frequency response. Performance metrics should reflect dead bands, beginning frequency, size and type of events, an adequate number of events, and most importantly time of measurements.
- Frequency response is mechanically driven, and can be accurately measured only during machine movement.

Measurement

- The current standard uses Net Interchange Actual (NI_A) to measure compliance. To have good measurement, one must have good statistics to support the values measured.

- NI_A is made up of several variables, changes in load, changes in generation, changes in purchases, pseudo-tie values, changes in transmission flows and losses, frequency response, and others. Statistical analysis can support measurement only when all inputs can be determined to isolate the value being measured for compliance. NI_A has far too many variables, all changing at the same time, to be treated as the sole measure of frequency response.
- Dynamic schedules are not included in the measurement, even though they may have a response component.
- Battery insertion or other responsive measures can be timed to occur in the measurement period thereby missing the arrestment period and subverting the purpose of the standard.
- Frequency response is not linear thus distorting the FRM measure, especially for events with an A to B measure less than 0.1 Hz

Assumptions Behind Current Standard

- BAL-003 appears to assume that all BAAs have the same composition and operate in the same manner. This may accurately describe the Eastern Interconnection. However, the Western Interconnection encompasses 38 BAAs that differ widely from one another.
- 100% generation only, wind only, 100% hydro base, 100% thermal base, many different mixtures
- The standard fails to recognize the changes associated with solar, and impacts associated with behind-the-meter solar. The allocation formula rewards a BAA with behind-the-meter solar and places the burden of frequency response on the remaining BAAs.