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NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Project 2017-01 – Phase II Modifications to BAL-003

Industry Webinar
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- Welcome and Agenda - **Laura Anderson**, NERC Standards Developer
- Project Background – **David Lemmons**
- Project Overview – **David Lemmons**
- Overview of Possible New/Modified Requirements – **Daniel Baker**
- Balancing Authority Requirements Options – **Tom Pruitt and Greg Park**
- Generator Owner/Generator Operator Requirements Options – **Bill Shultz, Rich Hydzik, and Danielle Croop**
 - Option 1 – Option 4
- Questions and Answers

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Background and Overview

- **Phase I**
- Revise the IFRO calculation in BAL-003-1 due to issues identified in the 2016 Frequency Response Annual Analysis (FRAA) Report, such as the Interconnection Frequency Response Obligation (IFRO) values with respect to Point C and varying Value B;
- Reevaluate the interconnections' Resource Contingency Protection Criteria;
- Reevaluate the frequency nadir point limitations (currently limited to t_0 to $t+12$);

- Review and modify as necessary Attachment A of the Reliability Standard to remove administrative tasks and provide additional clarity, e.g., related to Frequency Response Reserve Sharing Groups (FRSG) and the timeline for Frequency Response and Frequency Bias Setting activities; and
- Make enhancements to the BAL-003-1.1 FRS Forms that include, but may not be limited to, the ability to collect and submit FRSG performance data.

In addition to fixing the inconsistencies from Phase I, the SDT may separate the administrative and procedural items and propose they be reassigned to an alternative process subject to Electric Reliability Organization (ERO) and North American Electric Reliability (NERC) Operating Committee (OC) approval.

- **Phase II**

- Both the IFRO calculations and the allocation of IFROs to reliability entities are retrospective (up to 2 years). The review should determine if there are alternate methodologies which consider characteristics affecting Frequency Response (e.g., load response, mix and type of generation, BAA footprint changes) to make allocation as equitable as possible;

- Although BAs and FRSGs are responsible for coordination and/or management of Frequency Response from both resources and loads, response from resources is not addressed. The review should determine if additional reliability entities should have responsibility (e.g., GOPs) for provision of generator governor response; and
- Review the measurement methodology of Frequency Response (both System and equipment level):
 - The FRM should be reviewed to ensure that over-performance by one entity does not negatively impact the evaluation of performance by another.

- The SDT discussed several different options while trying to address the concerns raised in the SAR. These options include:
 - Potentially adding additional Balancing Authority (BA) requirements to address Real-time primary Frequency Response reserves;
 - Modification to existing BA requirements on performance measurements; and
 - Adding Generator Owner (GO) and Generator Operator (GOP) requirements for operational and responsive control.
- While these options are all viable for modifying BAL-003; there are certain items that are either mutually inclusive or mutually exclusive, so the final set of requirements proposed for BAL-003 will depend on comments received from industry so the SDT can assess next steps for Project 2017-01, Phase II.

- The SDT determined that the BA performance requirement must remain in place for multi-BA Interconnections.
- While the measurement methodology might change, a requirement on the BA will not be removed.
- The BAs (or Reserve Sharing Groups, if applicable) have ultimate responsibility for ensuring *all* reserve requirements are met at the BA level.
- There is no other NERC Registered Entity that is in the position to ensure resources are scheduled to provide the needed service.
- GOs and GOPs are not able to ensure that any single generator should be committed and dispatched in such a way to allow the generator to respond to an event.

- The SDT seeks industry feedback on the following proposed requirements:
 - New BA requirement – requires Operational Planning process to address Frequency Responsive Reserves;
 - New BA requirement – specify minimum governor settings or request governor settings from the GO;
 - If the BA specifies a governor requirement, then an additional requirement for a process to allow for exceptions would also be recommended by the SDT;
 - New GO requirement – Ensure the governor settings meet the BA specification set above; and
 - New GOP requirement – Ensure the unit is operating in a manner that will allow response to frequency events or the BA has been notified that it is not responsive.

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Overview of Possible New/Modified Requirements

- The rationale for new requirements for both BAs and GOs/GOPs is to have coordinating requirements for each:
 - One for the operational planning window;
 - One for Real-time status monitoring; and
 - One for performance.

- Existing Requirements
 - No changes to existing bias setting or measurement reporting requirements.
- New/Modified BA Requirements
 - New BA requirements **may** require a BA to explicitly address planning for Frequency Response reserves in next-day operational planning, develop methods to explicitly monitor Frequency Response reserves in Real-time, and demonstrate Frequency Response reserve maintenance after-the-fact.
- Frequency Response Reserves Operational Planning
 - Explicitly address maintaining Frequency Response reserves in operational plans/procedures.

- Real-Time Frequency Response Reserves Monitoring
 - Require BAs to explicitly monitor Frequency Response Reserves in Real-time and to have and meet Real-time targets (static or dynamic). (No formal requirement has been drafted in the white paper.)
- Real-Time Frequency Response Reserves Performance
 - Consideration of an after-the-fact metric on performance (how well did the BA follow its plan?). (No formal requirement has been drafted in the white paper.)

- **New GO/GOP Requirements**
 - New GO/GOP requirements may require a GO/GOP to explicitly document and communicate Frequency Response capability, develop methods to explicitly monitor and communicate Frequency Response capability in Real-time, and demonstrate Frequency Response performance after-the-fact.
- **Frequency Responsive Capability**
 - Simple documentation of existence of Frequency Response capability and settings (if capable).

- Communication to BA
 - What information should be reported to BA? (e.g., just settings, or additionally, actual current capability) should be reported to BA?
 - Just settings; or
 - Actual current capability?
 - What mechanism should be used for reporting?
 - In what periodicity should that information be communicated?
 - All aspects are interrelated (e.g., a one-time settings communication does not need intercontrol center communications protocol (ICCP) transfer, but Real-time ramp/headroom capability may).
- Is this/could this be covered by data collection requirements in other standards?
- Frequency Responsive Performance
 - A possible requirement to assess unit performance and meet minimal performance targets.

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Balancing Authority Requirements Options

- The current Reliability Standard BAL-003-2 requires a BA to achieve a median performance on events selected through the frequency event selection process.
- This process could be thought of as a “past” performance metric since any failure to meet the standard would not be identified until well after the compliance period has passed.
- This allows the BA to adopt a “wait and see” approach, and puts the interconnection in an assumed state of reliability without any required planning to meet those objectives.

- The SDT is proposing a BA requirement to determine a governor (or equivalent control) setting requirement for generating resources connected to the interconnected transmission system. The intent of such a requirement is to:
 - Ensure every generating resource is capable of responding to frequency deviations;
 - Ensure the BA is aware of the droop and deadband characteristics of the generating resource; and
 - Ensure the BA is aware of generating resource operating position and available frequency response.

- Operational Planning – Process
- BA-R3
 - Each Balancing Authority shall develop and implement an Operating Process, reviewed and maintained at least annually, as part of its Operating Plan to schedule frequency responsive resources sufficient to maintain interconnection frequency equal to or greater than its Frequency Responsive Reserve Obligation.
- BA-M3
 - Each Balancing Authority shall have evidence of scheduling frequency responsive resources based on their assessments of the system. For the operations planning time horizon, Balancing Authorities shall have evidence of assessments used as the basis for how resources were scheduled.

- NERC performed off-peak dynamics analyses of the recommended IFROs for the Eastern, Western, and Texas Interconnections to determine if those levels of Primary Generator Frequency Response (PGFR) are adequate to avoid tripping of the first stage of regionally approved UFLS programs in the interconnection.
 - Each of the interconnections prepared light load cases as the starting root case for each of the analyses.
 - In each case, the dynamic governor or load responses of the PGFR of the interconnection closely matched the recommended IFRO value for the prescribed resource loss.

- All three simulations did not model secondary control (i.e., AGC), which typically starts to influence PGFR in the 30-45 second timeframe.
- In all three interconnections analyzed, frequency remained above the highest UFLS set point even with each interconnection's PGFR degraded to the IFRO value for the respective interconnection.
- The FRAA report presents further analysis of each interconnection for each year.
- While the Frequency Response Measure is calculated in MW/.1Hz, the total Frequency Responsive Reserves for each BA should be based on risk associated with anticipated frequency excursions for the applicable interconnection.
- The responsible entity should have a process to determine the amount of Frequency Responsive Reserves it will plan to have available.

- Operational Planning – Settings
- BA-R4
 - Each Balancing Authority shall specify a minimum droop and deadband setting for the resources located within its boundaries and provide those minimum settings to the Generator Owner.
- R4.1
 - Each Balancing Authority shall provide a copy of the minimum droop and deadband settings to its Reliability Coordinator and adjacent Balancing Authorities within 30 calendar days of a request.

- BA-M4
 - Each Balancing Authority shall have evidence that it specified resource droop, deadband, or equivalent control settings to its resources.
 - Each Balancing Authority shall have evidence that the frequency control specifications were provided to its Reliability Coordinator and adjacent Balancing Authorities within 30 calendar days of a request.
 - Evidence may include, but is not limited to emails, website postings, and meeting minutes.

- The intent of these proposed requirements is to assist the BA in developing criteria for determining compliance with Requirement R3.
- This model is different than the other ancillary services products currently obtained and utilized by BAs to ensure reliability services are available.
 - It may negatively impact other possible sources of Frequency Response due to lack of compensation.
 - Some concern about how generators will be compensated for changes required by its BA.
 - That the process could be manipulated by a BA by assigning response to certain generators and then limiting dispatch of those generators.
 - However, this model simplifies the modeling and operational analysis and allows BAs to require specific settings.

- Operational Planning – Exemptions
- BA-R5
 - Each Balancing Authority shall specify the criteria that will exempt generators from:
 - Following the recommended governor droop and deadband settings;
 - Having its governors in service and not blocked; and
 - Having to make associated notifications on governor status changes.
 - If a Balancing Authority determines that a generator has satisfied the exemption criteria, it shall notify the associated Generator Operator.
- BA-M5
 - Each Balancing Authority shall have evidence of documenting criteria for generator exemptions and documentation of notifications to exempted resources.

- The previous Requirement R4 sets the expectations for resources.
- Requirement R5 addresses the known limitations that prevent every resource from providing Frequency Response.
- Requirements R4 and R5 support Requirement R3, which is ultimately needed to comply with Requirement R1.
- This exemption process should identify resource types that have known mechanical or safety limits to performing Frequency Response.
- This process completes the communication loop between the BA and GOP.

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Generator Owner/Generator Operator Requirements Options

- Changes in the resource mix of electric power generating facilities tend to change the grid dynamics relative to frequency control capability.
- Lower system inertia results in increased rate-of-change-of-frequency when sudden imbalances in generation and load occur.
- Each interconnection currently maintains adequate and substantial margin between automatic UFLS set-points and the lowest frequencies experienced in recent years.
- Many new resource types can be controlled such that they can provide Frequency Response.

- Many existing synchronous resource types have been modified in the past decade to provide reliable Frequency Response.
- The present and forecasted system need for Frequency Response and the response capability of resources are closely related issues.

- Options that the SDT have discussed include:
 - Copy all BAL-001-TRE performance requirements, including the requirement for the BA to calculate the response for all generators within their BA footprint. (*Option 1*)
 - Create GO/GOP performance requirements with the GO/GOP responsible for the calculation of the performance. (*Option 2*)
 - Limit the GO/GOP requirements to just “Operate with the Governor in Service” and “Notify if out of service” only. (*Option 3*)
 - Create requirements for the GO/GOP to provide the droop, deadband, and other requested data to the BA. (*Option 4*)
 - A combination of Options 3 and 4.

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Phase II
Option 1**

- **Benefits**

- The requirements are relatively clear and understood.
- Data available from TRE shows the process provides an adequate level of reliability.
- Expectation that the amount of Frequency Response seen would remain steady or increase regardless of changes in the generation mix.

- **Possible Hurdles**

- Data transfer rates between generators and BAs in many areas may not be sufficient to allow the BA to make the calculation. (ERCOT uses a 1-second data transfer rate compared to 2-to-6 seconds in other BAs).
- Calculation process may be onerous for smaller BAs.
- Generators may incur expenses to address performance requirements with no clear process for compensation.
- Interconnection size may impede the ability to identify a significant number of events that exceed the deadband.

- **Negatives**

- For BAs with large geographic areas, Frequency Deviations across the system may cause complications for the calculation process.
- Potential for penalizing GO/GOP when more than adequate response across the BA and interconnection is provided (even if the BA and GO/GOP are the same entity).
- Compliance burden may be greater than the potential reliability benefit by placing a compliance obligation on all GO/GOP when over multiple years actual response comes from 50 percent or fewer of units.
- Mandatory performance without clear compensation may negatively impact development of alternative providers of Frequency Response.

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Option 2

- **Benefits**

- Clear and relatively easy to understand.
- Data available showing experience in TRE to support adequacy of the process.
- Increased Frequency Response.
- May provide reliability value if proven to be needed.

- **Possible Hurdles**

- Calculation process may be onerous for smaller GO/GOPs.
- Generators may incur expenses to address performance requirements with no clear process for compensation.
- Data needed to make the calculation at the GO/GOP level may require significant modifications to data collection at the plant level.
- Interconnection size may impede the ability to identify a significant enough number of events that exceed the deadband.

- **Negatives**

- Large number of entities required to have the data necessary for the calculation, and maintaining trained individuals to perform the calculation may cause the process to be administratively burdensome.
- Potential for penalizing GO/GOP when more than adequate response across the BA and interconnection is provided (even if the BA and GO/GOP are the same entity).
- Compliance burden may be greater than the potential reliability benefit by placing a compliance obligation on all GO/GOPs when, over multiple years, the actual response comes from 50 percent or fewer of units.
- Mandatory performance without clear compensation may negatively impact development of alternative providers of Frequency Response.

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Option 3

- Reliability Standard VAR-002, in paraphrase, obligates the GO or GOP to:
 - Operate each generator with the automatic voltage regulator in-service and controlling voltage;
 - Maintain the voltage or reactive schedule provided by the TOP;
 - Modify voltage when instructed or provide an explanation for not being able to do so;
 - Notify the TOP of AVR, PSS, or voltage controlling device status changes;
 - Notify the TOP of reactive capability status changes;
 - Provide GSU and Aux transformer tap settings, ranges, and transformer impedance data to the TOP and TP;
 - Modify GSU transformer tap settings, if possible, at the request of the TOP; and
 - Follow alternate directions by the TOP, or be exempted due to being in startup, shutdown, or testing mode.

- Whereas the requirements of Reliability Standard VAR-002 apply to the AVR equipment located at generating facilities for the purpose of voltage control, possible requirements of a proposed BAL-003-3 could apply to the turbine/plant control systems to promote system frequency control and stability. These requirements could take the form of the following:
 - Operate each governor/speed/frequency/MW set point controller with the primary frequency regulator in-service and controlling frequency;
 - Maintain the scheduled frequency using a proportional control with percent droop and frequency deadband; settings (see the next section for a discussion of specifying and/or reporting the settings between the GO/GOP and the BA);
 - Provide an explanation to the BA for not being able to contribute to frequency control;

- Notify the BA of frequency controlling device status changes;
- Provide the in-service frequency controlling device settings to the BA;
- Modify the in-service frequency controlling device settings, if possible, at the request of the BA; and
- Follow alternate directions by the BA, or be exempted due to being in startup, shutdown, or testing modes.

FERC Order 842 requires minimum interconnection requirements for new units/facilities, including the installation, maintenance, and operation of a functioning governor.

- This requirement is one which can be "coupled" with new BA requirements for having a Frequency Response reserve plan, knowing the Frequency Response reserves available.
- Although traditional generation does not have on/off switches for governors, differing vastly from AVR control modes, improper settings can defeat an otherwise responsive governor.
- A turbine control system may not have system frequency (speed) built into the governor during on-line operation.
- Variability of the power source for these types of facilities prevents certainty of the 100% availability for Frequency Response.

- Notifications and Governor Settings
- Notifications by the GO/GOP to the BA could be provided to indicate the ability of a unit, or change in the ability of a unit, to provide Frequency Response.
- For each unit, operational experience and certain test results can provide this intelligence which can be conveyed to the BA for use in frequency response reserve planning.
- Many generating units will have known operating conditions where Frequency Response can be expected.
- Operating conditions resulting in no Frequency Response are often known.

- Real-time determination and communication of these instances would prove to be more challenging in some cases, as there may be difficulty or uncertainty in incorporating all aspects of unit operating conditions into the logic used to indicate the expected responsiveness.
- Where on/off switches are used in control systems for the frequency responsive component of the control, changes to the set points of the control can easily be communicated to the BA.

- Exceptions to any prescribed Frequency Response requirement for the GO/GOP need to be considered and permitted for certain situations. These include:
 - Unique unit attributes allowed for alternate directions by the BA, being in startup, shutdown, or testing modes, or other individual peculiarities or anomalies that exist with a generating facility.
 - These types of exceptions are analogous to voltage schedule adherence exceptions which are allowed under Reliability Standard VAR-002.
 - Communication and discussion of these exceptions should be expected between the GO/GOP and the BA.

- Consideration of Real-time Information
- Generating units providing Real-time information to BAs on the available Frequency Response capability would provide valuable transparency to the expected Frequency Response.
- The SDT has discussed a BA requirement to calculate and have available a set amount of Frequency Response reserves in Real-time.
- A requirement for the generating units to provide information to the BA on the capability would be a direct complement to this requirement.
- No BA requirement for Real-time Frequency Response reserves determination was drafted.

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Option 4

- Communication of Governor Settings
- Areas the SDT has been discussing around the topic of Real-time status, availability, and expected droop and deadband settings are:
 - Requirement to provide the data;
 - Settings to be provided, or prescribed; and
 - What parameters should be communicated.

- Requirement to provide the data – Options 4(a) and 4(b)
- Option 4(a): Add a new BA requirement in Reliability Standard BAL-003.
- Option 4(b): Provide recommendation for information to be provided under Reliability Standard TOP- 003.
- Settings to be provided, or prescribed
- Options discussed by the SDT on the droop and deadband settings information to be provided were:
 - The droop and deadband settings can be specified to the generator by the BA.
 - The GO would communicate the current droop and deadband settings of the unit to the BA.

- Discussion of options: 4(a) and 4(b)
- Under Option 4(a), a new requirement would be added to Reliability Standard BAL-003 for the BA to provide the specified Frequency Response communications to the GO.
 - The BA would be able to set the required droop and deadband for all resources.
 - BAs would need to determine if they required the “default” deadband (no greater than 36 MHz), and droop (no greater than 5%), or if there were different settings that would be appropriate.
 - It will also need to be determined if a resource type would drive the Frequency Response setting and an exception process would need to be considered for resources unable to provide Frequency Response.

- **Benefits**

- Ensures the BA knows what to expect from all generators in its footprint;
- Allows BAs to set requirements aligned with ensuring adequate Frequency Response capability is available on the system; and
- Would minimize the information that would need to be provided in Real-time from the GO to the BA.

- **Possible Hurdles**

- Requires BAs to put processes in-place to define the required droop and deadband settings;
- Could require measurable staff support to respond to generator inquiries and potential discrepancies between generator capabilities and requirements.

- **Negatives**

- Potential concerns over large discrepancies between BAs on requirements for droop and deadband settings; and
- Potential concerns over fairness between all generators in a given BA, and potentially different settings or exemptions between resource types.

- Under Option 4(b), the GO would communicate to the BA the current droop and deadband settings of the unit.
 - There would not be a set droop or deadband expectation for the resources. Rather, this would ensure the transparency of the resource capability and operations.
 - The Frequency Response communications from the GO/GOP to the BA would be managed under the existing (or modified) TOP-003 Reliability Standard.
 - A benefit to this method is that existing processes and data exchange can be used to provide the additional data.

- **Benefits**

- Would allow the BA to have situational awareness of available Frequency Response reserves; and
- Minimal cost to implement communication of the droop and deadband settings.

- **Possible Hurdles**

- This information is already being communicated to the Transmission Planner as part of the Reliability Standard MOD-027 data; and
- Determination needs to be made as to whether this data would be usable by the BA, or if this data would not be valid for Real-time awareness and reserve calculations.

- **Negatives**

- Potential to have significant data exchange requirements between the generator and BA; and
- While increasing visibility, this requirement would not necessarily increase Frequency Response.

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Standard Drafting Team Recommendations

- The SDT recommends a four-layered approach to provide for the adequacy of Frequency Response resources:
 - Require BAs to gather information on a GO's ability to provide Frequency Response, where needed, to permit improved Frequency Response reserves planning.
 - Limit the GO/GOP national standard requirement for frequency control to one that is similar to the existing GO/GOP requirement for the provision of voltage control for resources with the ability to perform the function.
 - Allow the provisions contained with the FERC Order 842, coupled with Interconnection Agreements for future connected resources, to procure and establish additional frequency responsiveness. New resources with this capability included in the functionality allow for marketplace solutions.
 - Permit the establishment of market incentives for areas/regions where additional reserve is desired.



Questions and Answers