



RPSTF: Frequency Response Narrative

Frequency response represents the actual MW contribution needed to stabilize frequency following a disturbance such as the sudden loss of a generation resource or the addition of a large non-conforming load. For some, it is difficult to distinguish between frequency response and frequency regulation. Frequency response occurs within the first few seconds following a disturbance and is the primary control needed to stabilize system frequency following the change. Additionally, frequency response is provided by a generating unit's governor action and load characteristics that consume less energy when system frequency drops. It is important to note that frequency response will not return frequency to normal, but only stabilize it at a lower value. Frequency regulation is a secondary control that includes generators on automatic generation control and it can only respond within minutes.

Overall, frequency response is declining in the Eastern Interconnection. One reason is that primary control frequency response is being withdrawn as fewer units are electing to provide governor response. Also, traditional inertial resources (steam, CTs, hydro) are being replaced by non-inertial resources (solar, wind, batteries, flywheels or demand response resources). Finally, load characteristics are changing and making load response less certain. Taken together these limitations have pushed the current frequency response trend downwards, where it should be even or upwards. Projections indicate that early as 2015 there could be only about 2000 MW/.01 Hz of frequency response left; this means that a double contingency or two large units tripping off in the Eastern Interconnection could lead to possible islanding and a system break up.

However, there are some remedies that can help arrest the decline and possibly reverse the trend. The first is changing the Generator's Governor Deadband. Currently governors are set with a deadband of ± 36 mHz. ERCOT has greatly improved frequency response by reducing governor deadband to ± 16.6 mHz. Also, some owners of resources have blocked governor response all together, this must be stopped. Additionally older boilers with sliding pressure controls should be upgraded to increase response times. Finally, replace Digital Control System operation at MW setpoints with Governor DROOP control.

The Frequency Response Initiative (FRI) was created to address this issue and the potential remedies. The FRI seeks to coordinate all NERC standards development and performance analysis activities related to frequency response and control. Also the FRI wants to identify specific frequency-related reliability factors. The FRI seeks to identify the root causes of changes in frequency response as well as practices and methods to address those root causes. Finally, the FRI considers the impacts of integration of new generation technologies (such as wind, solar, and significant nuclear expansion). The current redrafting of NERC Standard BAL-003 falls under the FRI. While not currently being reviewed BAL-001 gives NERC a methodology to evaluate Balancing Authority performance.

BAL-001 is the NERC Real Power Balancing Control Performance Standard. There are two requirements applicable to PJM as a Balancing Authority. Requirement 1 measures control performance in terms of CPS1, by comparing how well a Balancing Authority's Area Control Error (ACE) performs in conjunction with the frequency error of the Interconnection. Requirement 2 measures control performance in terms of CPS2, a Balancing Authority's ability to operate ACE within a predefined constant L_{10} . While PJM still tracks CPS2 internally, the RTO is a participant in the Balancing Authority ACE Limit (BAAL) field trial.



BAAL seeks to maintain interconnection frequency, to prevent frequency-related instability that would adversely impact the reliability of the Interconnection. BAAL theory provides that it is acceptable for a Balancing Authority to operate its ACE outside of CPS2 L₁₀ limits when it is to the benefit of Interconnection frequency. In lieu of constant L₁₀ limits, the ACE is operated within upper and lower BAAL boundaries.

BAL-003 is the NERC Frequency Response and Bias Standard. There are five requirements that are applicable to PJM as a Balancing Authority. Requirement 1 states that each Balancing Authority shall review its frequency bias setting each year by January 1st. Requirement 2 states that a Balancing Authority's frequency bias should be as close to its natural frequency response as practical and provides that said frequency bias may be either fixed or variable in nature. Requirement 3 states that each Balancing Authority shall operate its Automatic Generation Control (AGC) on Tie Line Frequency Bias, unless such operation is adverse to system or Interconnection reliability. Requirement 4 states that the respective share of jointly owned units shall be reflected in a Balancing Authority's frequency bias setting. Requirement 5 states that Balancing Authorities that serve native load shall have a monthly average Frequency Bias Setting that is at least 1% of the Balancing Authority's estimated yearly peak demand per 0.1 Hz change. Measurement is conducted on an ad hoc basis at the request of NERC.