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Background

At its September 2010 meeting, the NERC Operating Committee requested the NERC Resources Subcommittee (RS) to draft a short “position paper” on Frequency Response.

The NERC Resources Subcommittee (RS) has been concerned with the trend in Frequency Response, particularly in the Eastern Interconnection, for several years. The RS initiated the Standards Authorization Request (SAR) for BAL-003 to put a measurement process in place so engineers can objectively analyze the adequacy of Frequency Response and underlying issues to enable informed decisions.

Most in the industry agree that there is adequate Frequency Response at this point in all Interconnections. For example, it would take a contingency on the order of 10,000 MW in the Eastern Interconnection to trigger the first general step of Under Frequency Load Shedding (UFLS). The intent of the SAR for the Frequency Response Standard is to have facts and an objective process in place to adjust regionally or turn things around globally if warning signs develop or if limits are approached.

Focus of BAL-003

While it is true that generators are the primary source of Frequency Response, the focus of BAL-003 should not be generators. Assuming there is presently an acceptable amount of Frequency Response, resources would be better applied by initially evaluating performance at the Balancing Authority level and address local action in areas where Frequency Response is low.

A generator-centric standard would be costly and likely take years to implement. The *Form EIA-860 Database Annual Electric Generator Report* for 2008 lists over 7000 generators 25 MW or larger in the US. This does not include plants with small units with capacity greater than 75 MW, which would also be subject to a generator-centric standard. Monitoring and validating performance of all these generators would be difficult at best.

Target Minimum Frequency Response

The Frequency Response Standard drafting team is proposing a standard with performance goal that each Interconnection can withstand at least an N-2 event without encroaching upon the first tier of Under Frequency Load Shedding (UFLS). The Interconnection may include an additional safety margin in the standard’s contingency protection criteria.

	Eastern	Western	Texas	HQ	
Starting Frequency	59.98	59.98	59.98	59.98	Hz
Highest UFLS*	59.6	59.5	59.3	58.5	Hz
Contingency Protection Criteria	5000	2740	2500	1700	MW
Frequency Response Obligation	1316	571	368	115	MW/0.1Hz

Note: The table above is illustrative. The values have not yet been vetted in the standards process.

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The standard assumes that the given Interconnection is in a Time Error Correction at the time of the event. The target Frequency Response Obligation (FRO) is based on points A and B of the frequency excursion. The contingency protection criteria have a safety margin to address the difference between Points B and C.

*The Eastern Interconnection setpoint presented in the table is a compromise of the general first step of UFLS in the East (59.5Hz) and a special protection setting in Florida (59.7Hz). It is extremely unlikely there would be an event elsewhere in the Eastern Interconnection that would cause a “false trip” of the Florida UFLS.

It is expected the data collected in BAL-003 will be used by planners to validate models and test the adequacy of their respective Interconnection’s Contingency Protection Criterion.

Once the Frequency Response Obligations have been vetted, it would not be difficult to set Red-Yellow-Green risk levels at the Balancing Authorities (BAs) to communicate to the industry the state of Frequency Response and to better target mitigating actions.

Obtaining Frequency Response

Order No. 693 directed NERC to modify BAL-003 to identify methods of obtaining Frequency Response. A simple approach to achieve this objective is to allow BAs to obtain response by participation in a Reserve Sharing Group (RSG) similar to the acquisition of contingency reserves. Performance could be aggregated similar to the Disturbance Control Standard.

Additionally, there appears to be an existing mechanism through transmission tariffs and markets. Regulation and Frequency Response is an approved ancillary service. The FERC has also previously given the Transmission Provider authority to determine the amount and location of required ancillary services and if necessary sanction the overutilization of such services. BAL-003 could be used to objectively determine the need for additional services.

Ultimately, the bulk of Frequency Response must come from generators. This means Balancing Authorities will need a rational generator verification standard that couples to any performance obligation in BAL-003.

Field Test

Assuming BAL-003 will be a Balancing Authority-centric standard, there are several reasons why a field Test is needed, including:

- The drafting team is proposing to adjust the floor for Bias to address concerns raised in the 2003 Blackout Report. Control theory says frequency performance improves if Bias Setting and natural Frequency Response are nearly equal. Still, the interaction between Bias and the calculated performance in the other Balancing Standards could cause an unexpected interaction and could negatively impact frequency performance.

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- There has never been a single continent-wide methodology for measuring Frequency Response. There are likely factors the drafting team hasn't considered (impact of non-conforming load, seasonal impact, Frequency Response variability, etc.).
- The event selection and measurement processes have not been tested and could have flaws.
- The drafting team is evaluating other more technically-based approaches to evaluate risk and performance obligations. This evaluation will be done in parallel with the Field Test.

The Frequency Response Standard drafting Team is recommending the 2011 Bias calculation (using 2010 frequency excursions as the basis) as a field test of the standard.

Summary Points

- The Interconnections appear to have sufficient Frequency Response at this time.
- An overly stringent standard will increase customer costs for marginal increases in reliability.
- BAL-003 should also enable a process for introspection to bring more Frequency Responsive resources to bear when the Interconnection is stressed or during islanding and black start operations. Regions have the authority to develop local standards should they choose to have a more stringent standard, or if there is something unique about the Region that requires more response.
- Similar to the Control Performance Standard, BAL-003 should be "tunable" such that the Interconnection target response can be adjusted as the industry learns more.
- To expedite the standard, there should be a field trial using a defined set of 2010 frequency excursions as a basis for an objective Bias calculation for 2011 and allow analysis of data. An improved standard could be deployed in 2012.
- If Frequency Response is a priority issue, NERC and the FERC should take a leadership role to encourage Smart Grid technologies to include Frequency Response as one of the services provided.

Future Work (Generator Control)

- Generators or other sources of Frequency Response that utilize a step response once frequency crosses their governor dead-band can cause instability during island and black start operation. Black start plans should consider generator Frequency Response performance in determining black start and cranking path generators.
- Outer Loop MW control and the early withdrawal of Frequency Response is also a reliability concern. Generators that do not sustain Frequency Response during the frequency recovery period should be studied to determine the root cause of the early withdrawal. It is suspected that contributing factors are improper implementation at the generator. Market design, rules or tariffs that incent generators to remain on an exact MW schedule at all times should be changed to acknowledge the obligation to support frequency.
- Interconnections need specific guidelines for droop settings and allowable dead-bands. The droop settings should not have step changes at the dead-bands. Interconnections with low or marginal Frequency Response will need to have a closely coupled generator verification standard.