

M-4			
Interconnection Frequency Response			
Submittal Date	June 18, 2009		
Proposal Type	New <input type="checkbox"/>	Revision <input checked="" type="checkbox"/> March 16, 2022	Metric Analysis <input checked="" type="checkbox"/>
Definition	The metric will track and monitor Interconnection Frequency Response		
Rating Criteria	<ul style="list-style-type: none"> • Red (actionable): Any statistical decline in the arresting period rolling five-year time trend or any instance of Under Frequency Load Shedding (UFLS) activation due to a sudden generation loss • Yellow (monitor): Statistical decline in the stabilizing period but not the arresting period • White (stable): Improvement in the arresting period or stabilizing period and no declining trend in the other period or no trend in the arresting period or stabilizing period • Green (good/improving): Both arresting period and stabilizing period are statistically improving <p>How will it be suited to indicate performance: Primary frequency response is essential for maintaining the reliability of the Bulk Power System (BPS). When there are disturbances due to the loss of generation or load, it is critical that large rapid changes in Interconnection frequency are arrested quickly and stabilized until frequency can be restored.</p>		
Purpose	<p>The purpose of this metric is to determine frequency response trends for each Interconnection so that adequate primary frequency control is provided to arrest and stabilize frequency during frequency excursions of a predefined magnitude.</p> <p>The metric evaluates the following periods:</p> <ul style="list-style-type: none"> • Arresting period: The time from pre-disturbance frequency to the time of the frequency nadir that occurs within the first 12 seconds of the event. This interval was changed to the first 20 seconds of the event in accordance with the implementation BAL 003-2. It is during the arresting period that the combination of system inertia, load damping, and primary frequency response provided by resources 		

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	<p>act together to limit the duration and magnitude of the frequency deviation. Loss of load events are excluded from arresting period analysis.</p> <ul style="list-style-type: none"> Stabilizing period: The time after primary frequency response is deployed and the system has entered a period of relative balance and stable frequency. It is defined as the average frequency occurring between 20 and 52 seconds after the start of resource or load loss even
Formula or Type of Statistical Analysis	<p>Average and median A-B frequency response for all events selected by the NERC Frequency Working Group. This metric is based on methods defined in the ERS Framework Measure 1, 2, and 4 - Historical Frequency Analysis report used to calculate an interconnection frequency response performance measure (IFRM A-B) as the ratio of the resource or load megawatt loss that initiated the event to the difference of pre-disturbance frequency (Value A) and the stabilizing period frequency (Value B). Measurement of frequency performance in that time period is a surrogate for the lowest frequency during the event (the nadir or Point C).</p>
Time Horizon	Historic view
Metric Start Time or Baseline	2015 or when data is first available
Data Collection Interval and Roll Up	<p>Interconnection A-C Frequency Response will be calculated from the same events selected for the M-4 metric. M-4 frequency events are selected quarterly by the Frequency Working Group (FWG) utilizing event selection criteria defined in the FWG Frequency Event Selection Process Document. The M-4 frequency event Operating Year is from December 1st through November 30th.</p>
Ease of Collection	<p>Frequency data for all four Interconnections are available to NERC staff through the University of Tennessee by using the Frequency Monitoring Network (FNet). The data consists of sub-second high-speed frequency values (10 samples per second) captured by FNet's frequency disturbance recorders. Phasor Measurement Unit (PMU) may also be used, if available, for each Interconnection.</p>
Aggregation	Interconnection
Links to NERC Standard	BAL-003-2

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Data Source	Ten samples per second FNET data from the University of Tennessee Knoxville (UTK) and other NERC data sources as validated by the Frequency Working Group (FWG) via the Resources Subcommittee.					
Data Source Owner	Resource Subcommittee					
Data to be Submitted By	Balancing Authorities					
PAS and NERC Staff Use						
Need for Validation or Pilot	N/A					
SMART Rating PAS SMART rating of proposed metric, metric revision, or new metric analysis method	Total Score	Specific/Simple	Measurable	Attainable	Relevant	Tangible/ Timely
	11	2	2	2	3	2
Publications and Documentation	Style: Scatter plots and box plots of Interconnection Frequency Response trends with linear regression for a minimum five-year period. Tables with minimum Interconnection Frequency Response by year for a minimum five-year period.					