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Reliability-based Control Standard Drafting Team's Proposed Metrics

The Reliability-based Control Standard Drafting Team is developing proposed metrics and standards based on the purpose statements contained in the SAR for Project 2007-18. The team is using a comment form to gather feedback regarding the proposed metrics or solutions for the purpose statements A, B, C, and D contained within the SAR. Please review the information that follows and answer the related questions on the posted comment form.

Purpose Statement A of the approved SAR: To maintain Interconnection frequency within predefined frequency limits under all conditions (i.e., normal and abnormal), to manage frequency-related issues such as frequency oscillations, instability, and unplanned tripping of load, generation or transmission, that adversely impact the reliability of the Interconnection. (Work brought into this SAR from Draft BAL-007 though BAL-011)

Prior work on BAL-007 through BAL-011 defined a method of developing frequency and ACE limits, based on outage statistics and relay settings, and intended to limit the rate of activation of frequency sensitive relays to a targeted bound. Under the proposed standard, Reliability Coordinators (RCs) may incur violations when the frequency of their Interconnection continuously exceeds any of these frequency limits for longer than the associated time limits specified by the proposed standard. Balancing Authorities (BAs) may incur violations when their Area Control Error (ACE) exceeds a variable frequency-based ACE limit continuously for longer than T_v, a time limit specified by the standard. The Field Trial of BAL-007 in the Eastern Interconnection is currently using a time limit of 30 consecutive clock-minutes.

During the SAR drafting phase, some comments were received indicating that the current method of developing frequency and ACE limits does not fully address significant dependent events such as credible major transmission events, and coincident operation such as pumped-storage utilization and market behavior. The comments can be summarized with the following points:

- The frequency model considers independent loss of generation and does not address significant dependent events such as the loss of credible major transmission events, pump coincidence, market coincidental behavior, etc.
- The frequency model should allow for the calibration of frequency and other related limits to achieve a specified level of reliability.
- The frequency model should address the difference in Interconnection frequency response that occurs at point C versus point B. Under-frequency relays may be activated en route to point C, and generator governor response will be significantly reduced in that timeframe compared to the amount occurring at point B. (For more information see the Frequency Response Characteristic Survey Training Document.)
- The frequency model should recognize that the Interconnection frequency response is not truly a constant, but that it has a rather wide distribution and may vary significantly from year to year.

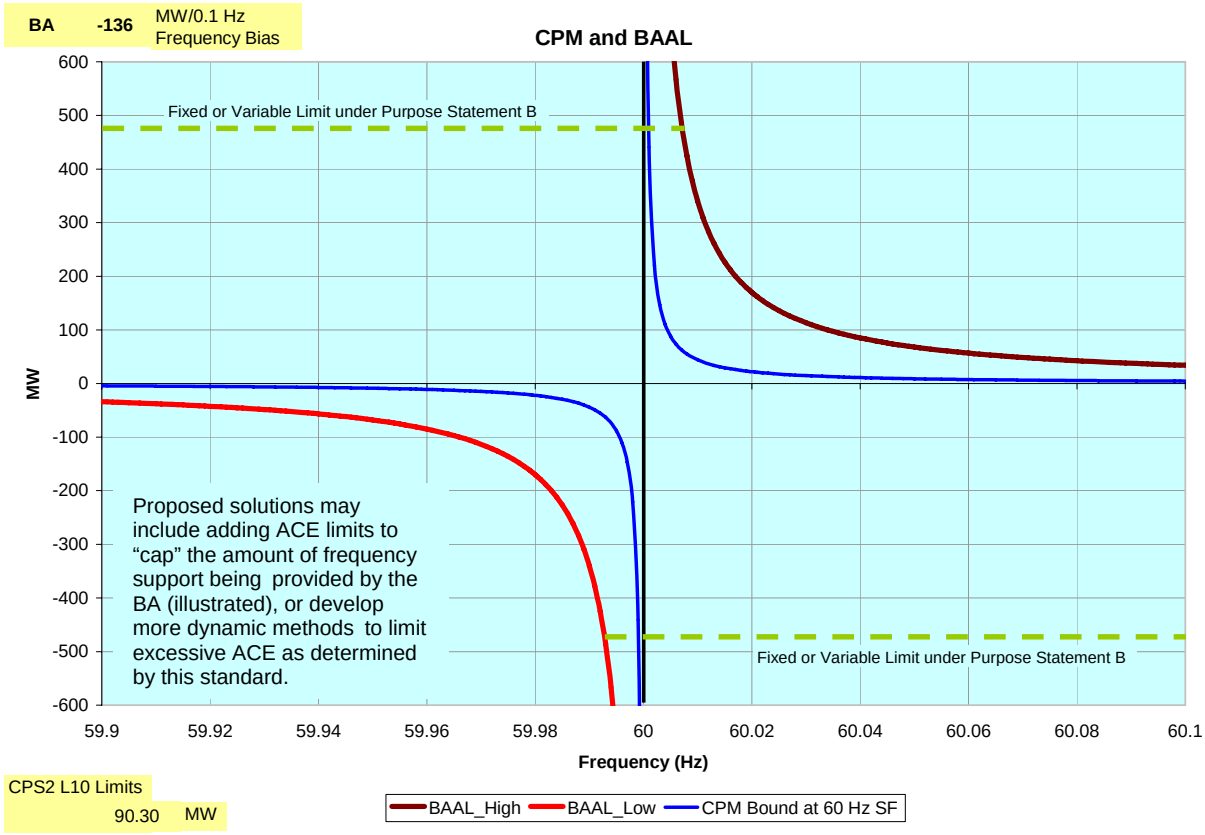
An alternative frequency model is being considered by the Reliability-Based Control Standard Drafting Team that would address these concerns to the extent practical. In the alternative frequency model being considered, low frequency values with an adverse reliability impact (typically under-frequency relay limits) would be associated with one or more large multi-contingency events that are chosen for an Interconnection based upon experience. The frequency drop associated with a large multi-contingency event would be added to the low frequency value with an adverse reliability impact in order to compute a frequency exposure limit. The goal would be to operate the Interconnection so that its frequency meets a specified level of reliability by keeping the frequency above the frequency

exposure limit sufficiently during each month. Corrections to the Interconnection frequency maintenance strategy could be made when the observed reliability either falls short of the specified level of reliability or greatly exceeds it.

Purpose Statement B of the approved SAR: To support corrective action by the BA when its excessive Area Control Error, as determined by this standard, may be contributing to or causing action to be taken to correct an SOL or IROL problem.

Purpose Statement A of the approved SAR addresses the operation of the BA when detrimental to the Interconnection Frequency, however neither the BA ACE Limit nor Control Performance Measure (CPM or CPS) places bounds on ACE when in support of Interconnection frequency. Purpose Statement B was developed to address transmission-related problems due to imbalanced operations as noted in comments received during the SAR development process. Though there are other standards in place today to address actions to be taken if imbalanced operation impacts transmission, there is not a balancing standard in place today that would require a Balancing Authority to take corrective action within a defined timeframe if excessive ACE is causing an IROL or SOL exceedance on another system that may develop into a violation.

The RBC SDT has discussed putting a limit on ACE for each BA to limit or mitigate the effect on an SOL or IROL even when the BA is supporting Interconnection frequency. The RBC SDT has discussed whether such a limit should be a static or dynamic value and what should be the basis used to determine the limits. The high and low limits could be symmetrical or asymmetrical (they do not have to be reflective). If used in conjunction with the BAAL, the graph below illustrates this concept.



The RBC SDT does not think that Purpose Statement B is applicable to single BA Interconnections (HQT and ERCOT) as they are expected to manage transmission issues within their BA Area.

Proposed Metrics

Balancing Authorities will have the option to choose one of the available metrics, provided that the specific requirements needed to support the chosen metric can be met.

- Metric Option 1 is a dynamic ACE limit (for both overgeneration and undergeneration) calculated in real time based on transmission sensitivity analysis.

- Metric Option 2 is a static ACE limit (for both overgeneration and undergeneration) based on prior transmission sensitivity analysis.

Both Metric Options would be based on an approved methodology which may be different for each Interconnection. The metric developed for this issue should be one which applies at all times similar to Tv used in the Field Trial as opposed to the 90% performance of the current CPS2 requirement. As it is unknown how much time would be needed to complete development of the limits, it may be necessary to have a transition plan. The RBC SDT has discussed a transitional means to set an initial limit, based on a fixed MW limit (similar in magnitude to L_{10}) which would be used until either Metric Option 1 or 2 is available and ready for implementation by the BA.

Example methodology for Metric Option 1: real-time dynamic excessive ACE limits would be computed periodically by the Balancing Authority (e.g., once a minute). The calculation would include the impact on constrained interfaces for which it has a distribution factor above some threshold value (e.g., 10%). For each constrained interface, an ACE value that would cause the transfer limit to be reached would be computed. This computation includes the transfer limit, actual flow, and distribution factor for the constrained interface along with the present value of ACE. From the excessive ACE values computed for the relevant constrained interfaces, the high excessive ACE limit would be set to the positive excessive ACE value nearest to 0, and the low excessive ACE limit would be set to the negative excessive ACE value nearest to 0. These limits would be presented to the operator in an appropriate format so that ACE receives correction when needed, and within the time criterion specified. Balancing Authorities would need to have their Real-time dynamic excessive ACE limit computations approved by an appropriate entity within their Interconnection, and would be required to periodically review their computations and determine if other constrained interfaces need to be added over time.

Example methodology for Metric Option 2: Static excessive ACE limits would be based on sensitivity analyses for a selected representative set of constrained interfaces within an Interconnection. These sensitivity analyses would be performed by an entity within an Interconnection composed of subject matter experts. Constrained interfaces and the impact of Balancing Authorities' overgeneration and/or undergeneration on those interfaces would be evaluated by a common methodology. For each constrained interface included in the sensitivity analyses, the transfer limit, actual flow, distribution factor and the Balancing Authority's ACE would be used to compute an excessive ACE value that would cause the constrained interface to reach its transfer limit. The subject matter experts would establish an expected level of effectiveness in protecting constrained interfaces for an Interconnection. For example, static limits that are multiples of L_{10} may be evaluated in the sensitivity analyses, and the multiple yielding 90% effectiveness (e.g.) for 90% (e.g.) of the constrained interfaces would be chosen to be used by Balancing Areas in the Interconnection.

Purpose Statement C of the approved SAR: To prevent Interconnection frequency excursions of short-duration attributed to the ramping of Interchange Transactions.

Over the course of reviewing frequency data from the Field Trial, the RBC SDT found that the predominant source of frequency excursions exceeding the Frequency Trigger Limit (FTL) of 59.95 Hz in the Eastern Interconnection was attributed to the inability of resources to adequately ramp to match the implementation of Interchange Transactions or coincident actions within the Interconnection. Such coincident actions would include implementation of pumped storage, on/off peak transition, load changes, intermittent resources and generation status changes. Imbalance across such short-duration excursions is not adequately addressed in the current CPS2 or the BAAL implemented under the Field Trial. The largest deviations have brought the Eastern Interconnection frequency to levels where the Interconnection is at greater risk of a coincident event causing under-frequency load shedding. The above factors were explained in the approved SAR, however, the purpose statement was not revised to reflect inclusion of these additional sources of short-duration frequency excursions. The RBC SDT proposes that the Purpose Statement C be revised to:

> **To prevent Interconnection frequency excursions of short-duration attributed to the ramping of Interchange Transactions or coincident actions within the Interconnection.**

Presently, the Eastern Interconnection has a recurring pattern of high then low frequency in the vicinity of 11 PM Eastern Prevailing Time. Other times of day may presently, or some time into the future, develop undesirable short-term frequency performance characteristics.

The RBC SDT proposes the development of a metric to capture data and understand performance of the interconnection and BA's as it relates to these types of frequency excursions. The intent of this prospective metric is to supplement other metrics (anticipated with the ultimate implementation of the Reliability-Based Control Standard) to mitigate undesirable short-term frequency performance characteristics. The selective use of this prospective metric during periods of poor frequency performance would allow for wider control (and its associated benefits) during the other periods of good frequency performance.

To address Purpose Statement C, the RBC SDT proposes using a short term metric such as the CPS1 One Minute Averages. This metric would not apply to an Interconnection with only one Balancing Authority Area.

Proposed Development of Short Term Metric

1. An appropriate entity responsible for the reliability of an Interconnection (e.g. – the WECC Performance Work Group) would monitor the frequency performance characteristics of the Interconnection with one minute granularity.

2. An appropriate entity responsible for the reliability of a multiple Balancing Authority Area Interconnection would identify those clock minutes within the day that chronically exhibit poor frequency performance. (e.g., 2245 through 2315 Eastern Prevailing Time for the Eastern Interconnection). These times may vary by Interconnection.

3. The Balancing Authority would compute its performance under the metric developed and provide this result to an appropriate entity responsible for the reliability of a multiple Balancing Authority Area Interconnection by the specified date after the completion of the month.

The RBC SDT has discussed alternate concepts for this metric and whether it should be based upon a fixed MW amount or based on a variable MW amount that is frequency dependent similar to CPS1. As

this metric is to address performance over a short duration, the RBC SDT has some reservations using the CPS1 One Minute Averages as there are other factors to consider such as:

- Differences between expected and actual frequency bias response
- Duration may be too short for normal CPS1 control to be practical and effective

Purpose Statement D of the approved SAR: Support timely congestion relief by requiring the Balancing Authority to employ corrective load / generation management within a defined timeframe when participating in transmission loading relief procedures.

In the issuance of curtailments, a BA could be in an imbalance situation where no transmission relief is realized unless the BA takes action as source or sink. There is not a current standard that requires the BA to balance resources and demand after a transmission loading relief (TLR) procedure has been implemented. Considerations in the proposed solutions would be the severity of the transmission issue, the firmness of the transactions, the magnitude of the imbalance, etc. The RBC SDT recognizes that Purpose Statement D is not applicable to single BA Interconnections (HQT and ERCOT). For those entities in the Eastern Interconnection or Western Interconnection, the RBC SDT discussed using a metric similar to a Disturbance Control Standard (DCS) event for a transmission loading relief procedure implementation above a defined MW threshold with time for recovery based on the severity level and directives of the RC.

The RBC SDT also discussed that, if the metrics proposed for Purpose Statement B are effective in addressing more localized constraint relief, the need for a separate metric to address transmission loading relief specifically may not be necessary.