STD Commenter Information (For Individual Commenters)	
Name	Terry Bilke
Organization	Midwest ISO
Industry Segment # 2	
Telephone	317 249 5463
E-mail	tbilke@midwestiso.org

Key to Industry Segment #'s:

1 – Trans. Owners
2 – RTO's, ISO's, RRC's
3 – LSE's
4 – TDU's
5 - Generators
6 - Brokers, Aggregators, and Marketers
7 - Large Electricity End Users
8 - Small Electricity Users
9 - Federal, State, and Provincial Regulatory or other Govt. Entities

STD Commenter Information (For Groups Submitting Group Comments)	
Name of Group:	**Group Chair:** Chair Phone: Chair Email:

List of Group Participants that Support These Comments:

Name	Company	Industry Segment #

Comments on Introduction to the Balance Resources and Demand Standard

1. Do you agree with the rationale for moving from the existing two, stand-alone periods (1-minute and 10-minutes) for CPS to an integrated 1-minute and 60-minute average-based frequency profile for CPM? (Reference the "Introduction to the Balance Resources and Demand Standard")

   ☒ Yes ☐ No

   Comments

2. This standard introduced a set of limits for the RA to use in controlling frequency and a set of limits for monitoring the BA's ACE. Do you agree with the principle of using these limits as an aid in monitoring and controlling interconnection frequency?

   Relay Limits
   ☒ Agree with using the limits in this standard
   ☐ Disagree with using the limits in this standard

   Abnormal Limits
   ☒ Agree with using the limits in this standard
   ☐ Disagree with using the limits in this standard

   Trigger Limits
   ☒ Agree with using the limits in this standard
   ☐ Disagree with using the limits in this standard

   Balancing Authority Area Control Error Limits
   ☒ Agree with using the limits in this standard
   ☐ Disagree with using the limits in this standard

   Comments about using any of these limits in this standard The concept is fine. The actual components that determine the limits should be field-tested.

3. The following terms are defined at the beginning of the draft standard. Please let us know if you agree with the proposed definitions for each of these terms:

   ACE Normal Operating Zone
   ☒ Agree ☐ Disagree

   Balancing Authority ACE Limits
   ☒ Agree ☐ Disagree

   Frequency Abnormal Limits
   ☒ Agree ☐ Disagree

   Frequency Abnormal Operating Zone
   ☒ Agree ☐ Disagree

   Frequency Deviation
   ☒ Agree ☐ Disagree

   Frequency Error
   ☒ Agree ☐ Disagree

   Frequency Event Trigger Time (t0)
   ☒ Agree ☐ Disagree

   Frequency Limit Violation Time (TV)

☒ Agree ☐ Disagree

Frequency Normal Operating Zone
☒ Agree ☐ Disagree

Frequency Relay Limits
☒ Agree ☐ Disagree

Frequency Event End Time (t1)
☒ Agree ☐ Disagree

Frequency Trigger Limit
☒ Agree ☐ Disagree

Frequency Trigger Limit Operating Zone
☒ Agree ☐ Disagree

Response Time (TR)
☒ Agree ☐ Disagree

Comments on any the definitions:

There is some cleanup needed in these definitions, but the ones checked as "Agree" are generally acceptable.

Frequency Relay Limits: If I'm not mistaken, the word "and" should be replaced with "that"

Frequency Trigger Limit: This definition isn't in the SAR. It is assumed you meant Frequency Trigger Limit (High), (Low).

Note: There should be some general wording that this standard applies to interconnected operations (not during restoration/islanded situations).

Requirement 301 – Balance Resources and Demand

4. Do you agree with the requirement?
   ☒ Yes ☐ No

5. Do you agree with the measures?
   ☒ Yes ☐ No

Comments about Requirement 301 In concept, the measures are acceptable and cover the spectrum of control needed for a standard. The metrics should be field-tested before performances values (number of allowable DEMs, etc.) are "hard coded" in the standard. Also, performance may well vary depending on BA size.

DEM - As proposed, Discrete Events Metric is intended to capture extreme events that indicate a pattern of putting the interconnection at risk and may not be captured by Abnormal Operations Metric, Control Performance Measure-1 or Control Performance Measure-60. The team was evenly divided on whether this measure is within the scope of the approved SAR.

The team developed two different versions of the DEM measure – Version A and Version B.

- Discrete Event Metric Proposal A uses a 60-minute average of performance. With this version, you collect data once every hour and calculate a monthly compliance factor by producing the average of all the hourly data points collected.
- Discrete Event Metric Proposal B uses an average of 60 calculations of one-minute average performance. With this version, you collect data every minute and calculate a monthly compliance factor by producing the average of all the one-minute data points collected.

The one-minute sample highlights the variability. The sixty-minute sample highlights the trend.

6. Which version of Requirement 301's DEM Measure do you prefer?

☐ Version A where data is collected once each hour

☒ Version B where data is collected once each minute

Comments Using the hourly measure, very large imbalances in one part of the hour can be masked by offsetting extreme imbalances near the end of the hour. However, a thoughtfully designed hourly metric would be superior to today's combination of CPS2 and DCS.

Requirement 302 – Frequency and ACE

There are two different versions of Requirement 302 – Version C and Version D.

Version C's requirement is based on the following assumption:

- The RA has ultimate responsibility for controlling frequency, and penalties should be assessed if frequency isn't controlled and the BAs within the RA area are not:
  - All supporting frequency or
  - Supporting frequency in the net

With Version C, the RA is penalized if there is a frequency violation and its BAs contribute to that violation. (With this version, the RA is penalized even if it follows procedures.)

Version D's requirement is based on the following assumption:

- The RA is responsible for following established procedures, and penalties should be assessed against the RA only if the RA doesn't follow these established procedures.

With Version D, the RA is penalized if there is a frequency violation and the RA doesn't direct its BAs to take action to control frequency within a defined time frame.

7. Which version of Requirement 302 do you prefer?

☐ Version C
☒ Version D

Comments As drafted, the policy assumes ACE is properly calculated. The RA should assess its internal status first on a frequency problem and if it's internal, direct corrective action. No matter whether internal or not, the RA should then communicate the findings with the other RAs. If the cause isn't apparent, the RAs' process should track down the problem.

Requirement 302 – Frequency and Area Control Error Version C

8. Do you agree with the requirement?

☒ Yes ☐ No

9. Do you agree with the measures?

☒ Yes ☐ No

Comments about Requirement 302 – Version C We agree with the intent. The measures appear to be a mixture of requirements, measures and reporting.

Requirement 302 – Frequency and Area Control Error Version D

10. Do you agree with the requirement?

☒ Yes ☐ No

11. Do you agree with the measures?

☒ Yes ☐ No

Comments about Requirement 302 – Version D We agree with the intent. The measures appear to be a mixture of requirements, measures and reporting.

Requirement 303 – Reliability Authority Directives

12. Do you agree with the requirement?

☒ Yes ☐ No

13. Do you agree with the measures?

☒ Yes ☐ No

Comments about Requirement 303 We assume you mean Requirement 304, not 303. The actions should also address situations where the RA directs verification/correction of ACE (when frequency is abnormal but there is not an apparent explanation).

Other Issues with Standard

There are at least two different approaches to the compliance monitoring process. One approach leaves the details of the frequency of the compliance monitoring somewhat open-ended. Another approach provides more specific limits on the frequency of compliance monitoring.

Version A

The compliance monitor may also use periodic reviews (on site, per a schedule), with spot reviews and triggered investigations to assess performance.

Version B:

The compliance monitor may also use scheduled on-site reviews every three years, and investigations upon complaint, to assess performance.

14. Which do you prefer for future versions of this standard?

☒ Version A

☐ Version B

Comments The investigations could be AIE surveys for unexplained events. Note: If ACE is misstated (metering error, schedule error, or whatever) to the degree where it contributes to an abnormal frequency event, there should be some sanctions for this. AIE is AIE, no matter the cause.

The Abnormal Operations Metric (AOM), as proposed, includes the consideration of a 'diversity factor.' A method of calculating this diversity factor is not clearly defined and needs additional research. The diversity factor tries to give each BA a wider acceptable operating margin as a benefit of interconnected operations.

15. Which do you prefer?

☒ Use a frequency-dependent equation without a diversity factor

☐ Use a diversity factor

☐ Other-please specify

Some team members think that AOM and DEM overlap or are redundant measures.

16. If you think there is sufficient redundancy, and you think one of the measures should be eliminated, which one do you think should be eliminated?

☐ No Redundancy with AOM and DEM

☒ AOM and DEM are redundant – eliminate the following:

☒ Eliminate AOM

☐ Eliminate DEM

☐ Redundant but keep both anyway

Comments

17. List any Regional or Interconnection Differences for this standard.

18. Provide any other comments on this standard.

Procedures for Developing Interconnection Frequency Limits, BAALs, and Frequency Bias

19. Do you agree with the method of calculating these limits as described in the Procedure for Determining Interconnection Frequency Limits?

    Relay Limits

    ☒Agree with the calculations for these limits

    ☐Disagree with the calculations for these limits

    Comments about the calculations for these limits The general concept is fine, but more data is needed to identify the largest credible contingency. It is probably acceptable to base two of the three events on the largest individual resources in the interconnection, but one of the contingencies should be based on events observed over X (3 to 5) years. Unit trips are not independent events. If and when these standards are deployed, there needs to be something included in the process to capture the "source data" needed to calculate limits (Interconnection frequency response, size of events, etc.)

    Abnormal Limits

    ☒Agree with the calculations for these limits

    ☐Disagree with the calculations for these limits

    Comments about the calculations for these limits

    Trigger Limits

    ☒Agree with the calculations for these limits

    ☐Disagree with the calculations for these limits

    Comments about the calculations for these limits

20. Do you agree with the method of calculating these limits as described in the Procedure for Determining Balancing Authority Area Control Error Limits?
    Balancing Authority Area Control Error Limits

    ☒Agree with the calculations for these limits

    ☐Disagree with the calculations for these limits

    Comments about the calculations for these limits

21. Do you agree with the Procedure for Determining Balancing Authority Frequency Bias?

    ☒Agree

    ☐Disagree

    Comments There is a 1% of peak demand minimum mentioned in procedure. This should be 1% of load or peak generation (whichever is greatest).

22. The Procedure for Determining Interconnection Frequency Limits used in this standard was drafted with consideration of the highest frequency operating setpoint for each interconnection as published in Operating Policy 1 Appendix 1D. The Procedure for Developing Interconnection Frequency Limits was drafted assuming that time error correction will not be included in any standard developed by NERC, but a similar frequency correction procedure will be developed by NAESB. At this point, it isn't clear if there will be a NAESB Business Practice Standard for time error correction.

    Should the team adjust the Procedure for Developing Interconnection Frequency Limits to eliminate the application of a frequency operating setpoint as published in Operating Policy 1 Appendix 1D, or should the team assume that NAESB will develop a business practice standard that will mandate time

error correction? The result of eliminating the frequency operating setpoint would be to widen the frequency normal operating zone.

☒Keep the reference to interconnection frequency operating setpoints in the Procedure for Determining Interconnection Frequency Limits

☐Eliminate the reference to interconnection frequency operating setpoints in the Procedure for Determining Interconnection Frequency Limits

Comments

Note – This form is to comment on version 1 of the Balance Resources and Demand Standard.

The latest version of this Standard (BAL_RES_&_DEMND_05_01) is posted on the Standards web site at: http://www.nerc.com/~filez/standards/Balance-Resources-Demand.html

E-mail this form between July 1– August 29, 2003, to: sarcomm@nerc.com with "Comments" in the subject line.

If you have any questions about this Standards Draft Comment Form, please contact the Director of Standards – Tim Gallagher at 609-452-8060.

Background

The Balance Resources and Demand Standards Drafting Team (team) put together a document called, "Introduction to the Balance Resources and Demand Standard" to explain the approach they took in developing the requirements and measures in the first draft of this standard. Several of the questions on this comment form ask for feedback on that rationale.

The team also drafted three technical references:

- Procedure for Developing Interconnection Frequency Limits
- Procedure for Developing Balancing Authority Area Control Error Limits
- Procedure for Developing Balancing Authority Frequency Bias

These draft procedures identify how the limits and frequency bias used in this standard could be developed. Some of the questions in this comment form ask you for feedback on the rationale for using these limits to help in real-time frequency monitoring. Other questions ask you for feedback on the methodology for the calculations.

Your feedback is very important in guiding the team's revisions to this draft standard, and to the draft procedures used to support this standard. We tried to sort the questions so that feedback on the standard is collected separately from feedback on the procedures. While we would like as many people as possible to answer all the questions on this form, we recognize that not everyone will want to analyze the details of the formulas.

The SDT is not seeking feedback on the appropriateness of the compliance monitoring process or the levels of non-compliance on the requirements in this standard during this posting period. The next posting of this standard will include specific questions asking for guidance on the appropriateness of the compliance elements of the standard.

The SDT thanks you for your active participation in this process!

STD Commenter Information (For Individual Commenters)
Name Robert Blohm
Organization Consulting Statistician
Industry Segment # 8
Telephone 609 585 5451
E-mail rb112@columbia.edu

Key to Industry Segment #'s:

1 – Trans. Owners
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Name of Group:	**Group Chair:** Chair Phone: Chair Email:

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Comments on Introduction to the Balance Resources and Demand Standard

1. Do you agree with the rationale for moving from the existing two, stand-alone periods (1-minute and 10-minutes) for CPS to an integrated 1-minute and 60-minute average-based frequency profile for CPM? (Reference the "Introduction to the Balance Resources and Demand Standard")

   ☐ Yes ☒ No

   Comments[*Note: A Summary of my answers to all the questions contained on this comment form is provided as the answer to question 18 "Provide any other comments"*.]

   The proposal is based on technical misinterpretation of the concepts of sample average, randomness, equity and frequency profile.

   - EQUITY STANDARD NOT NERC'S BUSINESS. CPM-1 alone is necessary and sufficient for reliability. Additionally imposing CPM-60 to construct and enforce a frequency profile contributes not to reliability but to achieving *equity/fairness* that is a matter not for NERC, but for FERC-overseen voluntary market competition to achieve based on existing cost and pricing incentives.

   - ONE PIVOT POINT, NOT TWO. Furthermore, controlling a frequency profile to *two "fixed points"* is mathematically impossible. A frequency profile is controlled to one "fixed point", one CPS sampling-interval-length, around which the profile may over time "pivot", but it pivots clockwise only. That single "fixed point" or "*pivot point*" may be chosen anywhere along the profile with a view to the reliability effect of the profile's eventually pivoting clockwise to it's steepest possible mathematical limit which is the target frequency profile. That pivot point was chosen by NERC to be CPS at the one-minute sampling-interval.

   The proposed CPM-1 standard is necessary and sufficient for reliability on a sound technical basis consistent with the historical record of CPS-1's development. CPS-2 should still be eliminated as proposed. Discussion:

   "FREQUENCY PROFILE" ADDRESSED A CONTEXT OF ISSUES BROADER THAN FREQUENCY CONTROL. The "frequency profile" concept was originally considered by the Performance Subcommittee in its attempt to address several issues before it that went beyond frequency control, including equity, time-error correction and Inadvertent accumulation.

   LIMITS NOT RESEARCHED. No research was ever conducted to determine whether or not the interconnection is reliable at the current one-minute CPS1 limit nor if it is reliable at that limit under the current shape of the frequency profile. The one-minute limit was chosen by extrapolating from the experienced 10-minute limit along the steepest conceivable frequency profile. Meanwhile, the 10-minute limit has been exceeded as the experienced one-minute limit drifts ever toward the CPS1 limit.

   THE LIMITING PROFILE. According to the definition I wrote on p. 2 (4^{th} definition) of the "Definitions" section of the Standard, the "target" "frequency profile" is reached when the frequency data at different points in time are completely unrelated to each other, in other words, when a Balancing Authority's control behavior is random in time and random relative any other Balancing Authority's control behavior.

   THE "ACTUAL" PROFILE MEASURES RANDOMNESS OF CONTROL BEHAVIOR. If Balancing Authorities' control behavior were random (non-coincident), CPM-60 would be lower compared to CPM-1 than CPM-60 would be when their behavior is coincident. (Their behavior is coincident, for

example, when they undergenerate together during load buildup, and overgenerate during load drop-off.) Any reliability impact of coincidence is already controlled by the limit placed on CPM-1. Removing coincidence only lowers CPM-60 and makes the frequency profile steeper, and has no effect on CPS1 which measures operating reliability based on the actual/experienced frequency profile.

PROFILE MEASURES FAIRNESS/EQUITY. In their August, 1996, research study developing CPS commissioned by NERC from EPRI (*Control Performance Standards and Procedures for Interconnected Operation*), authors Nasser Jaleeli and Louis VanSlyck of Priority Control Engineering (PCE), Inc., repeatedly state that the purpose of controlling to longer-term data samples (such as in CPM-60) in a frequency profile is to achieve, not reliability, but economic fairness in these four quotes:

- "Unfortunately, the culture of interconnected operation has failed to recognize the importance of controlling ACE averages beyond 10 minutes. The consequent inefficiencies of frequency control are not only *cost*ing many hundred millions of dollars per year but may also be allowing a very *unfair* distribution of interconnection benefits among areas.", p. 3-15
- "However, to fully *minimize costs*, the sliding averages of ΔF should be controlled on a priority basis to eliminate ΔF oscillations having periods longer than a few tens of minutes.", p. 3-15
- "Realization of the [target limit frequency profile] Curve 3, in comparison with [actual frequency profile] Curve 1, would save many hundred millions of dollars in regulating *costs* and would *fairly* disburse interconnection benefits among areas.", p. 3-17
- "Hence, a defensible set of frequency based control performance criteria should limit *short term* frequency error averages *based on reliability requirements*, and long term frequency error averages based on constraining unscheduled power flows and their resultant unscheduled energy accumulations.", p. 7-2

EQUITY IS ACHIEVED VOLUNTARILY. Indeed, when you control to CPM-60 you detect less variability using a single 60-minute average of the sampled data [just as an opinion poll varies less from true public opinion when based on a bigger single data sample] than when you control to CPM-1using 60 1-minute averages of the sampled data. Consequently you send fewer control signals and maneuver and wear out generators less; so, there is already a built-in economic incentive to control voluntarily to a chosen CPM-60, but the uneconomic culture of control operations management has deemed the personal cost of changing old customs to exceed any economic savings to shareholders from such change. Commercial AGC software is available from companies like PCE that enable a Balancing Authority to lower its control cost and indirectly control to the CPS-1 reliability limit by *voluntarily* using and controlling to a tighter CPM-60 limit. Cost-incentive alone is sufficient to prompt smart informed Balancing Authorities to indirectly meet the CPM-1 limit by voluntarily controlling to a CPM-60 limit that is self-imposed, not enforced by NERC. As the Jaleeli and VanSlyck report states:

> "Realization of the ideal target frequency requires areas to control ACE averages beyond 10 minutes for the *reward* of much larger statistical limits on peak-to-peak variation of their ACE. Since control of ACE averages beyond 10 minutes, and especially beyond one hour, does not impose much stress on generating units, such a target frequency should be very *attractive* to all areas. However, realization of such objective[sic] requires technical staff training and some modification of AGC software. Initially therefore, many areas may have some reservations about adopting such a target frequency. For areas which prefer to continue with the present culture of control, the experienced frequency characteristic [profile] is a logical target.", p. 3-18.

CPS PRECEDED MARKETS. The Jaleeli and VanSlyck study preceded the emergence of markets following FERC's 1996 open-access ruling. Before then equitable solutions were sought through regulatory design and enforcement. Since then, FERC has sought to create and enforce market conditions where self-interest achieves equitable solutions through voluntary economic decisions. Indeed, the Jaleeli and VanSlyck study almost admitted as much when it said "Minimization of interconnection regulating costs, therefore, *should not be enforced by design of performance criteria*.", p. 3-15.

MIXING UP FREQUENCY PROFILE WITH CPS2. The history of "frequency profile" in the Introduction to the Balance Resources and Demand Standard was written by one individual involved in the decision-making behind CPS1 and CPS2. However, his account is misleading, self-contradictory, and highly disputed by others deeply involved in it at the time. It begins by declaring (on p. 6) that "CPS1 and CPS2 were developed to ensure that system frequency remained within a specified frequency profile." (1st sentence, 3rd paragraph) and that "frequency profile…was used for Policy 1's CPS1 and CPS2." (2nd sentence, 1st paragraph). However the 5 other places in the same Introduction mentioning CPS2 were not written by that same individual and assert (correctly) that CPS2 was developed for other reasons, namely to place a limit on transmission loading (now supposedly addressed by DEM & AOM, but also addressed by the Operating within Transmission Limits Standard) and frequency relays (herein addressed by AOM and the real-time intervention measures):

- "the CPS2 measure is not being used as its proponents wanted it used, i.e. to *correlate ACE and transmission congestion*.", p. 7, last line.
- " The Team is proposing the replacement of the existing *tie-line flow focused CPS2* with a longer-term frequency-based measure that could be used in conjunction with CPM-1 to address the interconnection frequency profile compliance issue.", p. 9, 1st line of 3rd paragraph.
- " The new measure to replace CPS2, is called the Discrete Event Metric or DEM. DEM seeks to detect the number of short term, extreme conditions that put the interconnection at risk for frequency-induced reliability problems that adversely impact *reliability of the bulk transmission system*.", p. 10, paragraph 5.
- " BAALs are set based on the *'relay' frequency limits* developed for each interconnection. … BAAL *replaces the L_{10} of CPS2*, p.17, lines immediately above graph.
- "The proposed real-time [BAAL] measures reinforce the Reliability Authority's *responsibility for the Transmission system*", p. 18, 1st sentence, 2nd paragraph from bottom.

CPS1 AND CPS2 WERE APPLES AND ORANGES. The author of the history of "frequency profile"/CPS2 in the Introduction to the Balance Resources and Demand Standard bases it on CPS2's use of a 10-minute average of sampled ACE and magnifies this beyond all proportion to make a case for frequency profile that was not accepted at the time. Indeed, trying to combine CPS1 and CPS2 in a "frequency profile" is trying to combine apples and oranges because CPS1 and frequency-profiles measure and place a limit on an annual average of ACE "times" frequency error, while CPS2 counts the number of ten-minute intervals in a month when ACE exceeds more than 10 % of the time the 10-minute point on the frequency profile. It's no wonder that CPS2 has never served to "anchor" or "pivot" the frequency profile which has simply drifted upward beyond the originally experienced 10-minute point.

CPS2 IS A TRANSMISSION MW LIMIT REGARDLESS OF FLOW DIRECTION RELATIVE TO FREQUENCY ERROR. The public published record of the decision-making behind CPS2 is the above-mentioned 1996 Jaleeli and VanSlyck report and it clearly states reasons other than frequency profile and "coincidence" for adopting CPS2, although they point out CPS2 is consistent with frequency-profile and randomness but enforces neither:

- "CPS2 has the objective of bounding scheduled power flows.[p. E-15, p. 7-4] It is the *same as A2* but with a technically defensible methodology for setting L_d." (p. E-15), namely to offer "an incentive for areas to correct an ACE of sign *opposite* to ΔF (p. E-14).
- "Criterion A2 specifies that the average value of ACE should not exceed a certain *MW limit in any ten minute interval*.", p. 1-3
- "Larger [ACE] will cause larger unscheduled *power flows*. As suggested by Mike Potishnak of NEPEX and Wayne Smith of Ontario Hydro, it may be beneficial, therefore, to set a standard on the T clock-minute average of [ACE].", p. 6-6
- "Mike Potishnak, of NEPEX, suggested T = 10 minutes and the [NERC] Control Criteria TaskForce agreed. This recommendation had the following bases
  - Mr. Potishnak and Dr. Sutherland [U. Mass.] concluded from their data analysis that ACEs realized by many areas under present practice have small auto-coincidence for orders greater than 10 minutes. Thus they concluded that ACE10 for many areas may already be sufficiently random
  - Monitoring ACE10 conforms with the tradition of *Criterion A2*.", p. 6-7.

  Consequently selection of 10-minutes was not "arbitrary" or "a good guess at what would work", or a second point chosen "as a surrogate for the entire [frequency profile] curve", as quoted from the Introduction to the Balancing Resources and Demand Standard, p. 6, last paragraph.
- "With ΔF unpredictable, an interconnection is assured, by an area meeting condition [CPS1], that the area's *[ACE] is within the proposed statistical bound*.", p. 6-6. But an area could still get within that bound without ΔF unpredictable, by simply tightening control. Moreover the quote is even wrong in an important respect: an area can meet condition CPS1 while its ACE is outside the proposed CPS2 statistical bound, namely when its ACE has sign opposite ΔF.

CPS2 (ACE) PROVIDES CONTROL INFERIOR TO CPS1, PARTICULARLY OF PRIMARY FREQUENCY RESPONSE. This is the research finding from a simulation on the world's most robust Interconnection, in Western Japan, conducted by Tetsuo Sasaki of Kansai Electric Power Company published last year in IEEE Transactions on Power Systems, supplemented by a *Discussion* of them by me, Nasser Jaleeli and Lou VanSlyck in that publication in February 2003 (http://www.geocities.com/blohm_r/IEEE.html).

ONE CONTROL POINT TO PIVOT AROUND, NOT TWO. The author of the draft's history of "frequency profile" in the Introduction to the Balancing Standard misleads when he says "The group that developed Policy 1's CPS measures could just as easily have selected 1 minute and 20 minutes as the two surrogate points", bottom of p. 6. To the contrary, there are not two control periods, integrated or stand alone, but only one [called a "pivot point" by Jaleeli and VanSlyck]. Indeed, the Jaleeli and VanSlyck report states that one point, not two points, is sufficient for "enforcement" of a frequency profile when "experienced frequency" is the standard:

> "For those who adopt the experienced frequency as the target, one point of the characteristic [profile], anywhere from one minute to 20 minutes, is sufficient for enforcement. If this point is chosen at one minute, then $\in$ = 8.5, 6.5, and 12 mHz, for the Eastern, WSCC, and ERCOT interconnections, respectively. In this case *no other point would need to be enforced* because with these $\in$ values it is very unlikely for the tail of the characteristic [profile] to degrade!", p. 3-18.

CPS1 IS THE BEST SINGLE PIVOT POINT. Research results from a simulation on the world's most robust Interconnection, in Western Japan, by Tetsuo Sasaki of Kansai Electric Power Company published last year in *IEEE Transactions on Power Systems* and a *Discussion* of them authored by me in that publication in May 2003 (http://www.geocities.com/blohm_r/IEEE2.html)

show that a CPS60 measure adds nothing to control because it picks up less variability than CPS1.

DON'T "TARGET" BUT DON'T IGNORE FREQUENCY PROFILE. Only, the Jaleeli and VanSlyck report warns that if the single $\in$ limit is set higher than experienced, it needs to be set with an understanding of the experienced frequency profile and the effect, if any, of that profile on the maximum size tie-line flows and the effect of these on transmission because:

> "the present culture of generation control is likely to shift the experienced frequency characteristic [profile] to curve (2) [upward to cross the new single $\in$ limit]" and "Sustained scheduled flow associated with this characteristics[sic] may be higher than the secure level for the transmission system. Under this scenario, the rate of unscheduled energy accumulation may also be unacceptable", p. 3-19.

There is no discussion here of "targeting" a frequency profile. The most they say is that:

> "A secure level of long term averages of frequency error should be defined by detailed study if increased error levels are to be acceptable", p. E-15

from a transmission and relay safety point of view, which this Balancing Standard is purporting to handle by the DEM, real-time Reliability Authority limits, and AOM standards, as expressed in the last three of the first list of five quotes above from the Introduction to the Balancing Resources and Demand Standard.

TWO ASPECTS OF CPS1 CAPTURE A1 & A2. Before the single CPS1 method of bounding the average deviation of statistically measured one-minute frequency-error weighted ACEs, NERC relied on two measures:

A1, which assured that ACE errors are evenly distributed around zero, as statistical deviation is, and

A2, which limited the size of the average ACE error, as the average error of a statistical distribution does.

The two characteristics of the statistical distribution of frequency error governed by CPS1, namely equal weight either side of zero, and an average error limit, substitute for what A1 and A2 attempted to control. In other words the symmetric shape of a frequency-error distribution around 0 already incorporates the A1 and A2 characteristics. It was therefore unnecessary and inappropriate to introduce CPS2 to substitute for A2.

"OPERATING WITHIN TRANSMISSION LIMITS" STANDARD, AND REAL-TIME STANDARD TO AVERT FREQUENCY EMERGENCIES, NOT CPS2. What the CPM1 statistical distribution does not do, and what CPS2 did not do, is give guidance to the Reliability Authority in giving real-time instructions to Balancing Authorities whenever interconnection frequency is dangerously close to failure mode. That is the supposed purpose of the DEM and AOM measures, and the true innovation and insight underlying this Balancing Standard. CPS2's role of assuring operation within safe tranmission limits has been superseded by the Operating within Transmission Limits Standard.

MULTIPLE CPM STANDARDS IMPAIR THE INADVERTENT INTERCHANGE MARKET THAT WOULD ASSURE RANDOMNESS. Accordingly, CPS2 and CPM60 are both unnecessary, and interfere with CPM1. Appropriate pricing of CPM1 scores by trading an appropriately penalized CPS1 metric is indispensable to giving signals for market pricing the frequency contribution component of inadvertent interchange. Such competitive market pricing assures randomized control decisions. Adding a CPS2 standard and/or a CPM60 standard to a CPM1 standard would therefore have a detrimental effect on the competitiveness and therefore randomness of the market, and be actionable before the NAESB Standards Review Subcommittee and ultimately before FERC.

2. This standard introduced a set of limits for the RA to use in controlling frequency and a set of limits for monitoring the BA's ACE. Do you agree with the principle of using these limits as an aid in monitoring and controlling interconnection frequency?

Relay Limits

☐ Agree with using the limits in this standard
☒ Disagree with using the limits in this standard

Abnormal Limits

☐ Agree with using the limits in this standard
☒ Disagree with using the limits in this standard

Trigger Limits

☐ Agree with using the limits in this standard
☒ Disagree with using the limits in this standard

Balancing Authority Area Control Error Limits

☐ Agree with using the limits in this standard
☒ Disagree with using the limits in this standard

Comments about using any of these limits in this standard

NO SCIENTIFIC BASIS FOR RELAY LIMITS. I disagree with using these Relay Limits as a starting point to arrive at the Frequency Trigger Limit. There is no scientific basis for these relay limits. But establishing it is beyond the practical limitations of the present balancing standard. So NERC needs to develop a standard to establish a scientific basis for Relay Limits in the way FERC enjoined the industry to develop for ATC and TTC with the best methodology available.

USE STATISTICAL METHODS, NOT RELAY LIMITS, AS THE BASIS FOR AN "INTERVENTION POINT". Meanwhile statistical methods pioneered by Howard Illian/EnergyMark in his 2002 frequency report for ERCOT need to be used to derive the probability distribution of Interconnection frequency error used as a forecast. As explained in more detail in my answer to question 16, the existing Relay Limits for now can then be used to determine

- that the Interconnection is reliable if the Relay Limits lie beyond the point on the frequency-error distribution that has the same probability as one-relay-trip-in-ten-years;

- the point, called the "Intervention Point", where the Reliability Authority should intervene between the Relay Limit and the point that has the probability of one-relay-trip-in-ten-years.

NO SCIENTIFIC BASIS FOR THE OTHER FREQUENCY LIMITS. The Abnormal Limit is meaningless for being set at the purely-judgemental and *scientifically-baseless three-contingencies* Maximum Safe Megawatt Deadband within the Relay Limits. The Trigger Limit is equally seat-of-the-pants for being a "for good measure" one more standard-deviation within the Abnormal Limit. [The Definition in the standard is careless for saying one contingency below the "*Relay* Limit" instead of below the "*Abnormal* Limit"!] Both these limits should be replaced by the "Intervention Point" derived from the statistical analysis just described.

"ABNORMAL" FREQUENCY IS DETERMINED AT THE MOMENT A SECOND-STAGE VIOLATION IS TRIGGERED. The "second line of defense" attempted by the Abnormal Limit is captured by F_{T_v} as depicted in my revision to Figure 3 and in my Figure 4 in my answer to question 9. F_{T_v} always lies between the Intervention Point (Frequency Intervention (Trigger) Limit, FIL) and the Relay Limits and it equals the frequency wherever frequency happens to be when the Frequency Limit Violation Time is reached and a "second stage violation" is thereby initiated together with a tightening of AOM compliance as discussed in my answer to question 9.

MATH MISTAKE IN DEFINITION OF BALANCING-AUTHORITY ACE LIMITS. The BAALs are mathematically confused for being set at a "distribution factor" times the Balancing Authority's bias-share of the seat-of-pants three-contingencies Maximum-Safe-Megawatt-Deadband. Instead the intent was probably to set them to a distribution factor times bias times the Frequency Trigger Limit. It should be changed to bias times the Intervention point, with no distribution factor, and this would make the BAAL fully frequency-sensitive while it is applied only during a frequency violation.

DISTRIBUTION FACTOR IN BALANCING-AUTHORITY ACE LIMITS IS MISGUIDED. The distribution factor is unjustified and intended to lower or raise the BAAL depending on unspecified relationships between Balancing Authorities and the Interconnection. Accordingly the distribution factor makes the BAAL too high or too low for no good reason and is counterproductive for interfering with the frequency sensitivity of the BAAL, in contradiction to the frequency sensitivity principle underlying CPS1.

3. The following terms are defined at the beginning of the draft standard. Please let us know if you agree with the proposed definitions for each of these terms:

ACE Normal Operating Zone
☐ Agree ☒ Disagree

Balancing Authority ACE Limits
☐ Agree ☒ Disagree

Frequency Abnormal Limits
☐ Agree ☒ Disagree

Frequency Abnormal Operating Zone
☐ Agree ☒ Disagree

Frequency Deviation
☐ Agree ☒ Disagree

Frequency Error
☐ Agree ☒ Disagree

Frequency Event Trigger Time (t0)
☒ Agree ☐ Disagree

Frequency Limit Violation Time (TV)
☒ Agree ☐ Disagree

Frequency Normal Operating Zone
☐ Agree ☒ Disagree

Frequency Relay Limits
☒ Agree ☐ Disagree

Frequency Event End Time (t1)
☒ Agree ☐ Disagree

Frequency Trigger Limit
☐ Agree ☒ Disagree

Frequency Trigger Limit Operating Zone
☐ Agree ☒ Disagree

Response Time (TR)
☒ Agree ☐ Disagree

Comments on any the definitions:
NO DEFINITION OF ACE NORMAL OPERATING ZONE IS GIVEN, besides placing the term at the origin of Figure 3. I have defined it by defining ACE Abnormal Operating Zone in my correction of Figure 3 in my answer to question 9.

FREQUENCY TRIGGER LIMIT IS MISDEFINED as one contingency away from the Frequency *Relay* Limit instead of the Frequency *Abnormal* Limit.

FIRST-STAGE VIOLATION AND SECOND-STAGE VIOLATION NEED TO BE DEFINED.

THE DEFINITIONS OF THE LIMITS AND OPERATING ZONES FOR FREQUENCY AND ACEs ARE ALL SUBJECT TO THE CRITICISMS MADE IN MY ANSWER TO QUESTION 2, because they are based on arbitrary unscientific and seat-of-pants judgement about some multiple of the largest contingency. Despite the mention of one-load-shed-in-ten-years in the definitions, the definitions do not relate this term to the number of largest contingencies because there is no relation. Size/multiple of largest contingency affects, but does not need to be known to determine, the probability of one-load-shed-in-ten-years by the proven ERCOT/Illian statistical methodology. Furthermore, the Frequency Abnormal Zone may at best be defined by whatever frequency F_{T_V} is at the Frequency Limit Violation Time T_V, which is the beginning of a second-stage violation period which defines the Abnormal Zone in terms of time, not of a fixed frequency limit.

FREQUENCY ERROR AND FREQUENCY DEVIATION ARE SYNONYMS not requiring separate definitions.

FREQUENCY TIMES AND RESPONSE TIMES ARE DEFINED CORRECTLY.

THIS STANDARD MUST SET SPECIFIC VALUES, NOT JUST DEFINITIONS. Definitions do not specify, nor show how to derive, the *value* of what they define. Definitions are futile unless the Standard also specifies (how to derive) the value of what they define.

Requirement 301 – Balance Resources and Demand

4. Do you agree with the requirement?
☐ Yes ☒ No

5. Do you agree with the measures?
☐ Yes ☒ No

Comments about Requirement 301

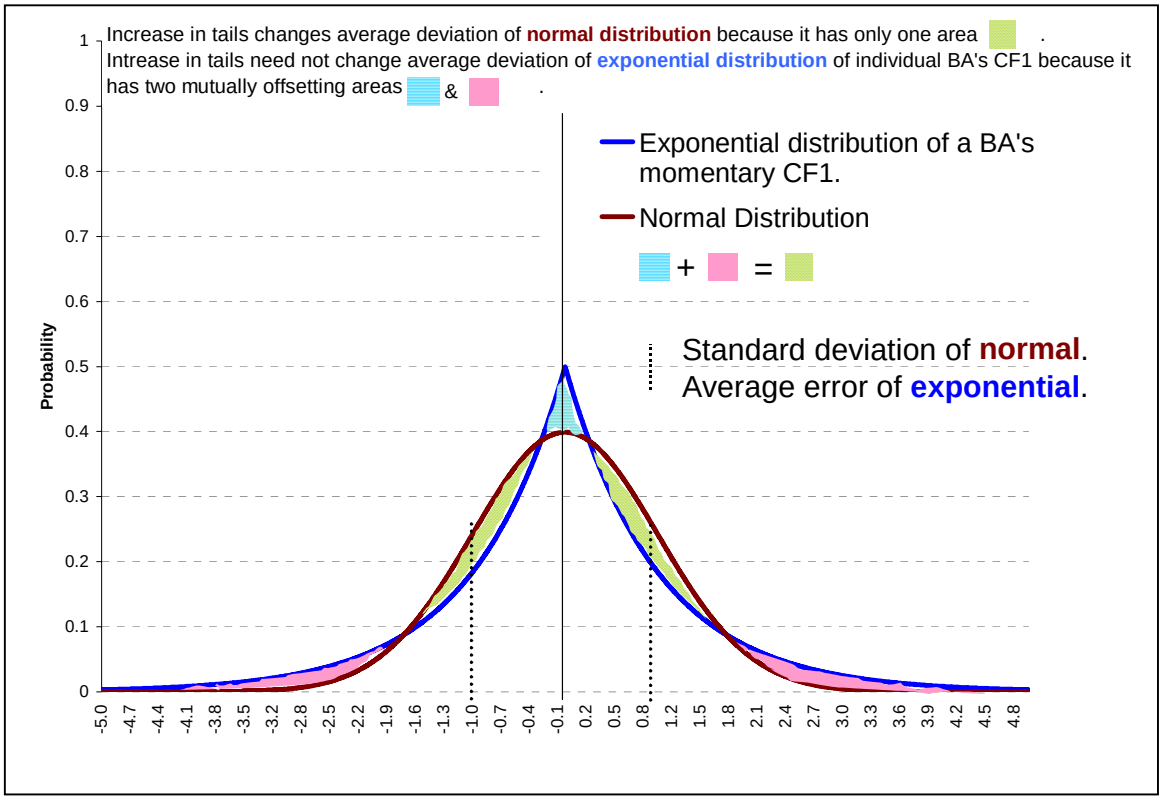
There is no sound technical basis for the DEM concept or the proposed DEM measures, but a monthly CPM1 measure, while better than the proposed DEM measures, would be technically incompatible with annual CPM-1.

NO TECHNICAL BASIS. There is no sound technical basis whatsoever for the compliance threshold value of 15, nor for any value for that matter. It is not an "event" measure at all as formulated: as formulated it detects "*usual operating*" errors. Also it assumes the wrong statistical distribution over time of momentary CPM Compliance Factor performances.

- MISTAKENLY SMALL COMPLIANCE FACTOR THRESHOLD. The DEM measure as formulated mistakenly uses the *one standard deviation* [one "standard deviation" is defined as the average magnitude of the errors regardless of direction] threshold of the distribution of momentary CPM1 Compliance Factors that applies to usual operations and flags the biggest 1/3 of measured frequency errors, instead of the *three standard deviations* intended by the concept behind the

DEM measure to flag just the biggest 2 % of the measured CF-60 or hourly-average-CF1errors which would include all the big-magnitude "events".

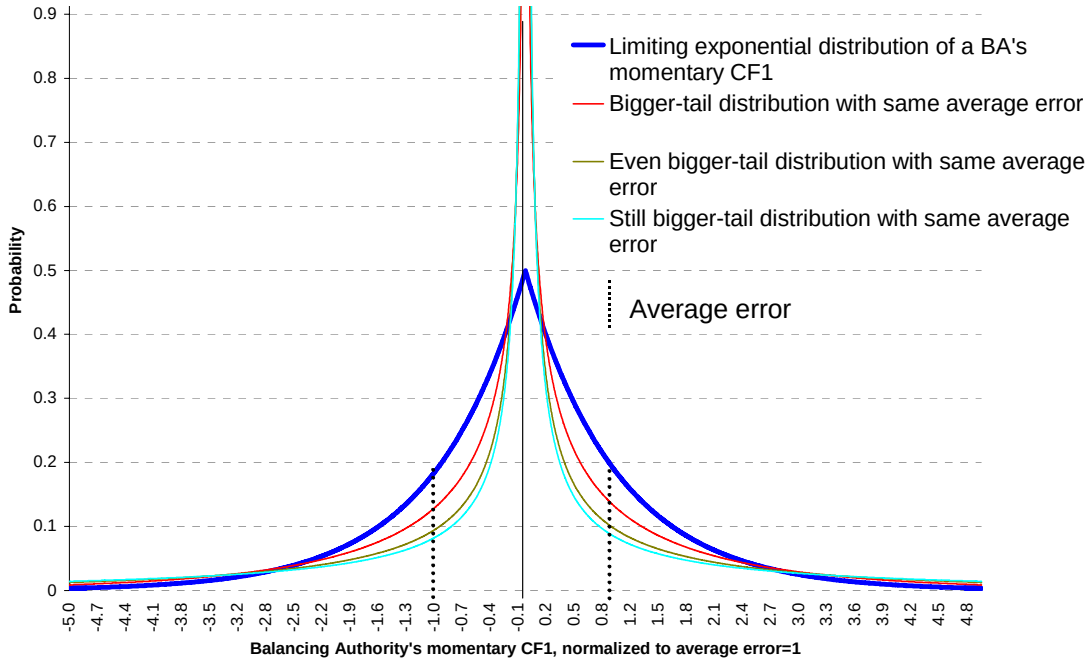
- WRONG SHAPE OF STATISTICAL DISTRIBUTION OF CPM COMPLIANCE FACTORS: EXPONENTIAL, NOT BELL. The value of 15 was chosen on the basis of using the three standard-deviation threshold, but also on the mistaken basis that the statistical distribution of a Balancing Authority's momentary CPM Compliance Factor performance over a month or over a year is a "normal distribution" "*bell curve*" such that, over a one month period of 720 CF-60s of hourly-average CF1s, 15 of the 720 hours would be the 1 % of errors inside of each tail beyond 3 standard deviations.
  - NO FIXED THRESHOLD VALUE OF LARGE ERRORS IN EXPONENTIAL DISTRIBUTION. While one-hour frequency error is distributed over a month "*normally*" in a "*bell* curve", a Balancing Authority's one-hour CPS1 performance is distributed over a month "*exponentially*" in a "*volcano*" shaped curve centered at zero error. In such a distribution, there is no longer a fixed number of errors on each side of the "standard deviation". Indeed, for a fixed standard deviation (average magnitude) of an error, the number of big errors can be greater (smaller) if the number of tiny errors is extremely greater (smaller).



- FOR CPM COMPLIANCE A HUGE NUMBER OF EXTRA TIGHT ERRORS (CF1s) CAN COMPENSATE FOR A BIG MOMENTARY ERROR (CF1). In other words,
  - A BALANCING AUTHORITY can maintain the same standard deviation of error when the relative number of his big errors increases as long as the relative number of his tiny errors increases exponentially more. He can expand the base of the volcano while keeping the mass of the volcano unchanged, as long as the funnel of the volcano narrows and spikes ever upward, making the volcano thinner and steeper. In other words, he can make up for big errors by also increasing, but by exponentially more, the proportion of tiny errors, namely by tightening his control of usual operating errors. So the number of big errors he can incur, without deteriorating the standard deviation of

error, is limited by how much he can tighten his control of usual operating errors the rest of the time.

Tails get larger/fatter while maintaining the same CF1 score (average deviation) by hollowing out mass from the sides and shifting much more mass to around the origin.



- FREQUENCY remains normally distributed at the same standard deviation of error because other Balancing Authorities' tiny errors (ever more frequent if they have had big errors) are simultaneously offsetting a Balancing Authority's big error.

- MANAGING THE "SHAPE" OF THE DISTRIBUTION IS ARBITRARY: BETTER TO USE 1-MONTH CPM-1 TO MANAGE "AVERAGE ERROR". If provision 2.2 (page 9) were to change the DEM measure to adding up the "values" of the non-compliant CPM-60 or hourly-average CPM-1 compliance factors instead of just "counting" those compliance factors, the DEM compliance threshold would need to be much greater than 15 and would serve to arbitrarily limit the "sharpness" of the exponential distribution of the compliance factors in the same way that limiting to 15 the number of events in the tails would. But such a determination would have to take into account the sharpness of the distributions of all the other Balancing Authorities' Compliance Factors, or whether other Balancing Authorities' are offsetting with tail behavior in the opposite direction; so there could be no hard-and-fast rule for a single Balancing Authority. To take this "relativity" into account, the best you can do for purposes of DEM is to manage the "average error" or "standard deviation" by a measure of CPM-1 performance over one calendar-month instead of over one year, and assess it monthly. But this would override annual CPM-1.

A MONTHY CPM-1 IS A BETTER DEM MEASURE. But it interferes with annual CPM-1:

- AVOIDS ARBITRARINESS. Using a CPM-1 measure limited to one-month performance is a preferable DEM measure because it avoids the arbitrariness of managing the shape of the exponential distribution of momentary compliance factors like CF-60 or monthly-averages of momentary CF-1.

- INTERFERES WITH ANNUAL CPM-1. But using a CPM-1 one-month performance measure for DEM interferes with the CPM-1 annual performance measure specified in this Balancing Standard. The compliance threshold for one-month CPM-1 would have to be the same as the compliance threshold for annual CPM-1 because annual CPM-1 is the annual average of seasonally-varying monthly CPM-1. Otherwise monthly CPM-1 would require a different compliance threshold for each month.
- ONE MONTH OF DATA IS NOT ENOUGH: "INTERMEDIATE-TERM" IS STATISTICALLY IRRELEVANT. In their August, 1996, research study developing CPS commissioned by NERC from EPRI (*Control Performance Standards and Procedures for Interconnected Operation*), Nasser Jaleeli and Louis VanSlyck found that only one month of data, such as would be used for a 1-month CPM-1 measure, or the proposed DEM measure, is not statistically accurate enough:

  "Also, to achieve reasonable statistical confidence, a period of 12 months seems to be necessary to provide an adequate volume of data covering most operating experiences.", page 5-16.

  So, contrary to the assumption on pages 9 & 10 of the Introduction to the Balancing Resources and Demand Standard, an "intermediate-term" performance measure is meaningless in statistics when more data over a longer time is always better. In *control performance* there is only "real-time", and "statistical" or "term"; there is no "term structure" consisting of real-time, medium-term, and long-term performance as with *financial investments*. This fact is expressed by the statistical rule that shorter-term performance measures (which are statistically inferior) *trump* longer-term performance measures. This rule is proven by the following absurd result of combining a short-term and a long-term performance measure.
- TRIGGERS ABSURD SEQUENCE OF EVER-TIGHTENING CPM-1 COMPLIANCE THRESHOLDS. But once you subject monthly CPM-1 to a compliance threshold based on an annual average of monthly CPM-1, the annual average suddenly becomes an annual maximum, and you push down the annual average of monthly CPM-1 to below the actual annual average. This is the same as reducing the compliance threshold of annual CPM-1 since it is based on the annual average of monthly CPM-1. In logical sequence, once we lower the compliance threshold of annual CPM-1, we are accordingly lowering the compliance threshold of monthly CPM-1 again and, since it becomes a maximum for monthly CPM-1, we are again lowering the annual average of monthly CPM-1 which determines the annual CPM-1 threshold, and so on in this ratcheting cycle until the compliance threshold of both annual and monthly CPM1 is zero! This logically absurd result suggests that a monthly CPM-1 measure is still not a proper measure.

DEM - As proposed, Discrete Events Metric is intended to capture extreme events that indicate a pattern of putting the interconnection at risk and may not be captured by Abnormal Operations Metric, Control Performance Measure-1 or Control Performance Measure-60. The team was evenly divided on whether this measure is within the scope of the approved SAR.

The team developed two different versions of the DEM measure – Version A and Version B.

Discrete Event Metric Proposal A uses a 60-minute average of performance. With this version, you collect data once every hour and calculate a monthly compliance factor by producing the average of all the hourly data points collected.

Discrete Event Metric Proposal B uses an average of 60 calculations of one-minute average performance. With this version, you collect data every minute and calculate a monthly compliance factor by producing the average of all the one-minute data points collected.

The one-minute sample highlights the variability. The sixty-minute sample highlights the trend.

6. Which version of Requirement 301's DEM Measure do you prefer?
   - ☒ Version A where data is collected once each hour
   - ☒ Version B where data is collected once each minute

Comments:

TWO-PART ANSWER. My two-part answer is predicated on proper reformulation of the DEM versions per the discussion below following my answers

- Politically I prefer version A insofar as I am opposed to the DEM Measure and version A is *weaker* because the longer term sample average masks short-term frequency error (in accordance with frequency profile as defined in the standard) and does not accomplish DEM's purpose as well as version B. As the Introduction to the Balancing Resources and Demand Standard very badly attempts to illustrate on pages 19 & 20, in the sections "Data Sampling and Calculation of CPM-1 and CPM-60" and "Long-term Averaging Periods", compared to version B, version A actually self-defeats the purpose of the DEM by
  - attempting to detect more variability with the shorter one-month performance measure compared to CPM-1's and CPM-60's one-year performance measure, while turning around
  - reducing the detectability of variability by lengthening the data sample-average period from one-minute to one-hour!

  [RECOMMENDED REWORDING OF THE SECTIONS OF THE INTRODUCTION TO THE BALANCING STANDARD, pages 19 & 20.

  Data SamplAverages and Calculation of CPM-1 and CPM-60
  As proposed, each data input into CPM-1 is a one-minute average of all the data samples of Area Control Error and of frequency error between the start of a clock-minute and the beginning of the next clock-minute. If a system sampled every two-seconds, a one-minute average of thirty (30) data points would be calculated for each clock minute. Area Control Error times frequency error would then be calculated for each minute of the past year and CPM1 would be the average product of Area Control Error times frequency error over that year.

  Each data input into CPM-60 is a sixty minute (clock-hour) average of all the data samples of Area Control Error and of frequency error between the start of one clock-hour and the beginning of the next clock-hour. If a system sampled every two seconds, a one-hour average of 1800 data points would be calculated for each clock hour. Area Control Error times frequency error would then be calculated for each hour of the past year and CPM-60 would be the average product of Area Control Error times frequency error over that year.

  This is a starting point for debate about the role of CPM-60. One of the prime motivations for going to a MW-Hz approach was to focus on coincident behaviors. When many entities behave in the same way (e.g. over-generating at 2200 or undergenerating at 0700) then the frequency may be high or low and by multiplying an entity's own error (ACE) with the system's error (frequency) coincident behavior can be highlighted. While the longer-term data samples of CPM-60 pick up less variability whether or not due to coincidence, CPM-60 can be tightened to force behavior to be less coincident and force the allocation of control actions to be fairer whether or not reliability improves.

  Long-term Performance-averaging periods
  The annual-average CPM-1 and CPM-60 performance is computed over a 12-month rolling period, and is assessed monthly. This annual-averaging of performance detects less variability than a monthly average of performance.would. This therefore raises the question of whether basing a DEM performance on one-month average performance to detect more variability and seasonality would be undone by using one-hour data sample averages that detect less variability than one-minute data sample-averages."]

- Technically I prefer version B insofar as it *best accomplishes* DEM's purpose because the shorter-term sample average better detects short-term frequency error (in accordance with the frequency profile as defined in the standard) and removes the longer-term sample average which defeated the shorter-term performance-assessment purpose of the DEM.

BADLY DRAFTED QUESTION AND BADLY DRAFTED DEM MEASURE. The question as written (also on p. 20 of the Introduction to the Balancing Resources and Demand Standard) is incomprehensible to me, an applied statistician, and the underlying mathematics in the standard (page 9) is ill formulated to me, an applied mathematician:

- TERMINOLOGY MIXUP. Throughout the Standard the concepts of one-minute or one-hour data *sample-average* period, one-month or one-year *average-performance* period, and one-month *assessment* period are not clearly defined and entered in the definitions. Accordingly these concepts have not been well understood by the Standard writers and have been mixed up and confused in the verbal descriptions of the standards.

  Accordingly, version B as written is not different from version A because both versions talk about "producing the average of all the [hourly or one-minute] data points collected". There is no difference in such an average if all the data points collected are one-hour or one-minute

averages. There would be a difference if the drafting team had not confused performance with data and had used the words "performance calculated" instead of "data points collected".

- CONTRADICTION. The formulas and the questions for both versions contradict this verbal description of the standard in section 2.2 (page 9):

  "The balancing authority shall maintain a monthly sum of 15 or fewer discrete event metrics."

  - VERSION A. What the formulas and the questions for version A do contrary to this is to add only and all the "values" of the CPM-60 compliance factors exceeding one (in section 2.2.1.2), instead of merely "counting" those compliance factors by setting the DEM-60 compliance factors equal to one instead of equal to the CPM-60 compliance factor;
  - VERSION B. What the formulas and the questions for version B do contrary to this and contrary to the definition of a one-hour average of one-minute CPM-1 compliance factors (CF1s) is to:
    - average hourly (in section 2.2.1.2) only the values of CF1s exceeding one instead of all of the values of CF1s during the hour, and
    - add only and all the "values" of the CF1 hourly averages exceeding one (in section 2.2.1.3), instead of merely "counting" those same CF1 hourly averages by setting the respective DEM-60 compliance factors equal to one instead of equal to the CF1 hourly average.

REWORDED QUESTION AND REWORDED DEM MEASURE. Consequently I have reworded the two parts of the question thus to conform to the verbal description of the standard in section 2.2 that is consistent with the DEM compliance section 5.2 on page 10, while the mathematics on page 9 of the standard needs to be rewritten including rewriting in standard mathematical notation the incomprehensible equations in sections 2.2.1.2 of both versions:

- Discrete Event Metric Proposal A uses a 60-minute sample-average of the data. With this version, you input a sample-average of the data once every hour and calculate an hourly compliance factor. You then calculate a monthly compliance factor by counting the number of hourly compliance factors in the month that are non-compliant
- Discrete Event Metric Proposal B uses a one-minute sample-average of the data. With this version, you input a sample-average of the data every minute and calculate a one-minute compliance factor. You then calculate an hourly compliance factor by taking the average of all the one-minute compliance factors in a clock-hour . You then calculate a monthly compliance factor by counting the number of hourly compliance factors in the month that are non-compliant.

Requirement 302 – Frequency and ACE

There are two different versions of Requirement 302 – Version C and Version D.

Version C's requirement is based on the following assumption:

The RA has ultimate responsibility for controlling frequency, and penalties should be assessed if frequency isn't controlled and the BAs within the RA area are not:

- All supporting frequency or
- Supporting frequency in the net

With Version C, the RA is penalized if there is a frequency violation and its BAs contribute to that violation. (With this version, the RA is penalized even if it follows procedures.)

Version D's requirement is based on the following assumption:

The RA is responsible for following established procedures, and penalties should be assessed against the RA only if the RA doesn't follow these established procedures.

With Version D, the RA is penalized if there is a frequency violation and the RA doesn't direct its BAs to take action to control frequency within a defined time frame.

7. Which version of Requirement 302 do you prefer?

☒ Version C

☒ Version D

Comments

Both assumptions are correct but are based on a confusion. These two versions answer the following question never asked by the drafting team: "*Who receives the penalties* levied on the BAs for AOM non-compliance?" The correct answer to that question is: "The (rest of the) *Interconnection* should receive the penalties levied on the BAs, because it is the party that is bearing the risk."

- Version C is just stating that the Reliability Authority is *not allowed to keep* the penalties levied on its Balancing Authorities, but must pass these penalties on to the Interconnection. Passing those penalties on to the Interconnection is a penalty on the 6jr Reliability Authority--a pass-through of the penalty on the Reliability Authority's Balancing Authorities.
- Version D is just stating that the Reliability Authority should be *separately penalized for not informing* the Balancing Authorities during the response time at the beginning of a violation, and this penalty is *independent and in addition to* any penalties levied on the Balancing Authorities. Warning: the draft standard is not clear whether the Reliability Authority must inform *all* its Balancing Authorities, or *just those in violation* of their BAALs. It should inform *all*.

Requirement 302 – Frequency and Area Control Error Version C

8. Do you agree with the requirement?

☐ Yes ☒ No

9. Do you agree with the measures?

☐ Yes ☒ No

Comments about Requirement 302 – Version C

Visualization of the requirement:

RA caused violation \ Event(s) caused violation	No	Yes
No	Level I Non-Compliance	Level III Non-Compliance
Yes	Level II Non-Compliance	Level IV Non-Compliance

THE REQUIREMENT AND MEASURES ARE UNNECESSARY, and would *unnecessarily complicate compliance* assessment of Balancing Authorities to a 2-dimentional matrix from the presently proposed 1-dimensional scale of %-of-instructed-ACE-reduction performed in section 5 of requirement 304. A non-compliant Balancing Authority's geographic proximity to the other non-compliant Balancing Authorities, reflected in whether the Balancing Authority's Reliability Authority is a cause of the violation, is irrelevant both to that Balancing Authority's impact on Interconnection frequency and to the Reliability Authority's performance of its task. The Reliability Authority has no control over how many of the non-performing Balancing Authorities lie in its jurisdiction. Furthermore, while several Reliability Authorities could collectively be the cause of a violation without each individually being a cause, for example if each contained just one of a number of offending Balancing

Authorities, the violation is no less serious than if one Reliability Authority is the cause. Similarly for the seriousness of a violation, whether caused by a single event, or by a combination of poor operating performances by a group of Balancing Authorities. But second-stage non-compliance is badly defined.

THE SECOND STAGE OF NON-COMPLIANCE BY BALANCING AUTHORITIES IS DISCONTIUNUOUS AND DESTABILIZING FOR REQUIRING for compliance *instantaneous* elimination of any ACE in the direction of the violation. The second stage of non-compliance occurs whenever the Frequency Abnormal Limit is breached or the recovery time exceeds the Frequency-Limit Violation Time limit. The discontinuity causes frequency instability in two ways:

- Balancing Authorities who are stage-one compliant will *over-control* so as not to risk becoming instantly stage-two non-compliant

- Instantaneous elimination of all ACEs in the direction of the violation risks causing an instantaneous *violation in the opposite direction* by forcing all ACEs in the same direction.

This situation can be remedied as follows:

STIPULATE A SECOND-STAGE ABNORMAL-LIMIT VIOLATION PERIOD AND DEFINE THE "ACE NORMAL OPERATING ZONE" RELATIVE TO FREQUENCY AND RELATIVE TO TIME. The ACE Abnormal Operating Zone over that second-stage abnormal violation period can be defined *only relative to time*, and not relative to frequency, as a diagonal line sloping downward from BAAL at the beginning T_V of the period to ACE=0 at T_Z during the period just long enough for Balancing Authorities suddenly non-compliant through no fault of their own to reasonably comply. Accordingly, Figure 3 of the definitions needs to be redrawn to display the ACE Abnormal Operating Zone, to relabel the frequency limits, and to properly depict the CPM-1 boundaries which decay to ACE=0 well before reaching the Frequency Trigger Limit (Frequency Intervention Limit, FIL), and a new Figure 4 needs to be added showing ACE relative to time, depicting the ACE Abnormal Operating Zone, and labeling the frequency limits.

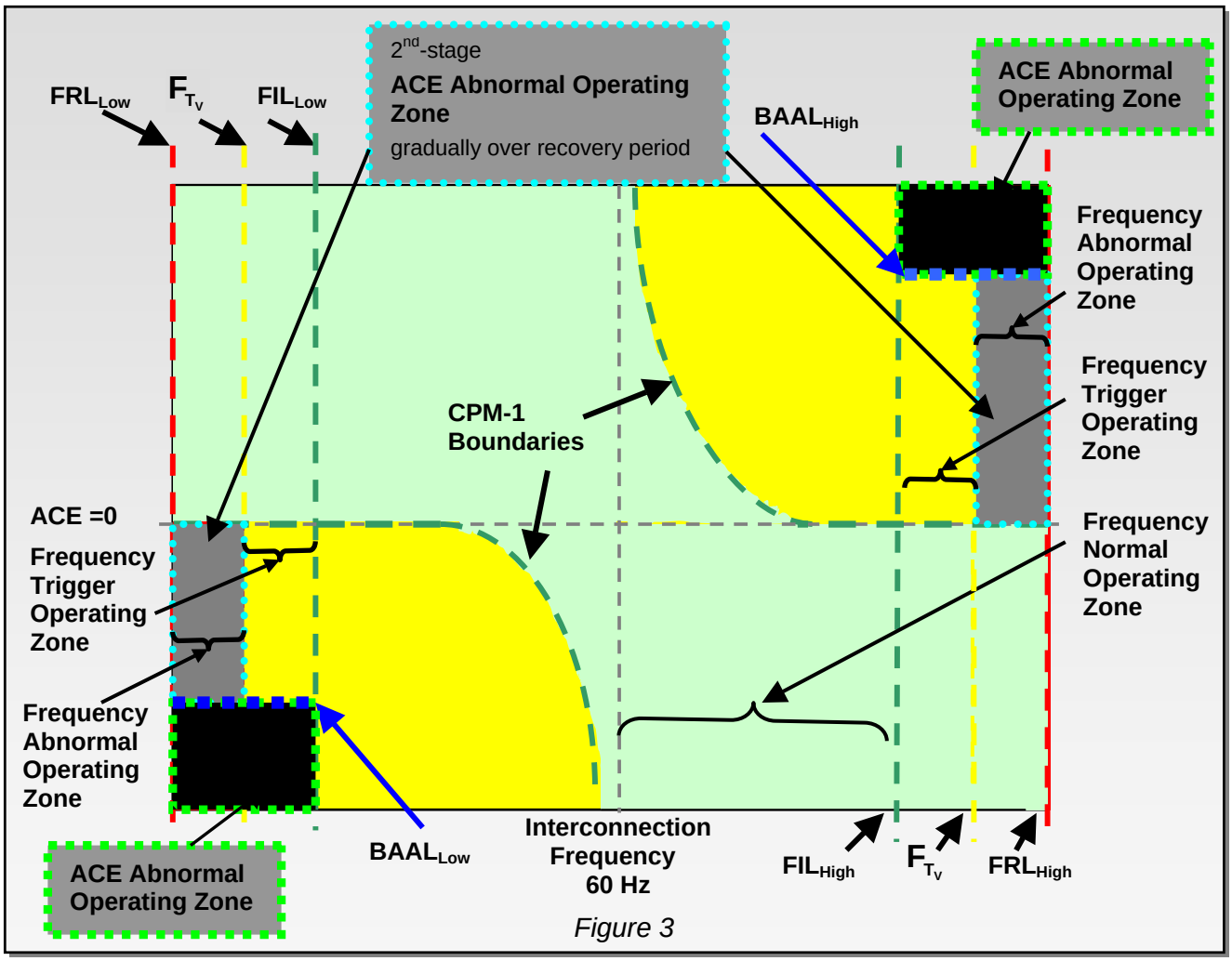

2nd-stage
ACE Abnormal Operating Zone
gradually over recovery period
ACE Abnormal Operating Zone
FRLLow
FTv
FILLow
BAALHigh
Frequency Abnormal Operating Zone
Frequency Trigger Operating Zone
CPM-1 Boundaries
ACE =0
Frequency Trigger Operating Zone
Frequency Normal Operating Zone
Frequency Abnormal Operating Zone
BAALLow
Interconnection Frequency 60 Hz
FILHigh
FTv
FRLHigh
ACE Abnormal Operating Zone

Figure 3

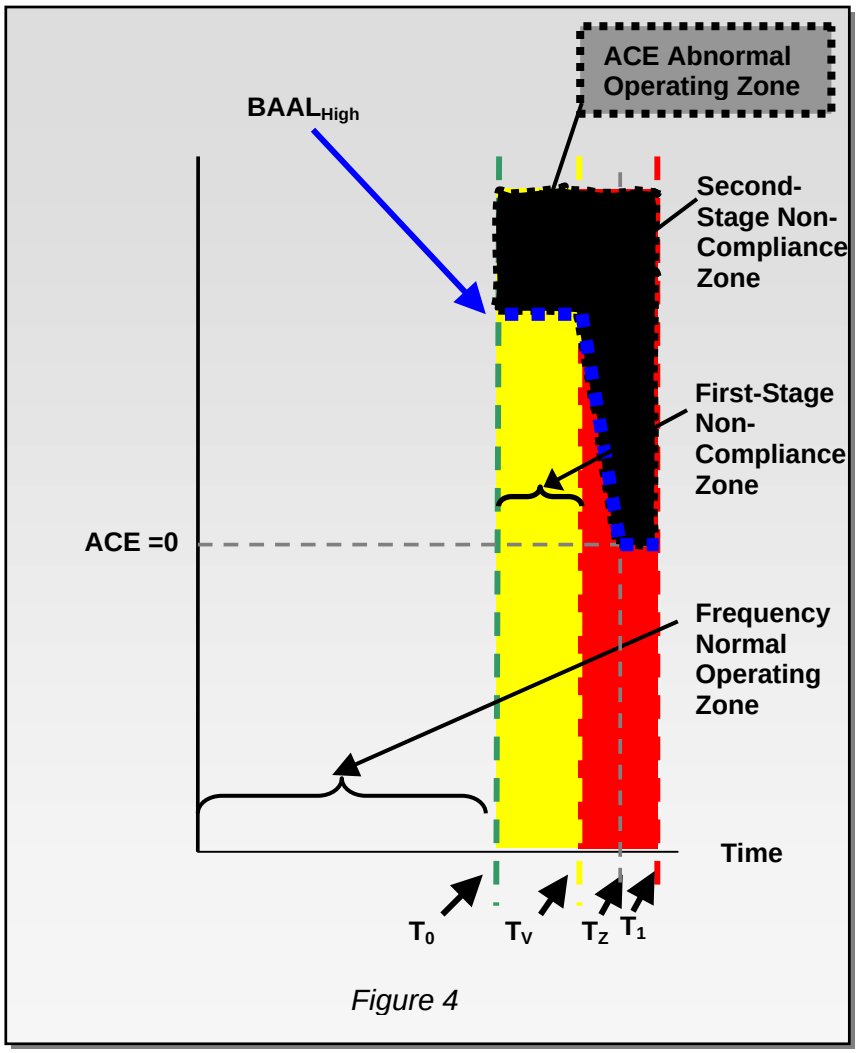


Figure 4

ADD TWO STIPULATIONS TO THE TWO STAGES OF BALANCING AUTHORITY NON-COMPLIANCE, namely that the ResponseTime allowed to the Reliability Authority:

- for first-stage compliance applies to informing *all* Balancing Authorities, not just those who exceed their BAALs, so that compliant Balancing Authorities become aware of the risk of becoming stage-two non-compliant through no fault of their own.

- for second-stage compliance refers to informing all Balancing Authorities of the *second-stage* violation, not just of the first-stage violation.

Requirement 30~~32~~ – Frequency and Area Control Error Version D

10. Do you agree with the requirement?

☒ Yes ☐ No

11. Do you agree with the measures?

☐ Yes ☒ No

Comments about Requirement 302 – Version D

VERSION D IS SIMPLER for using the second-stage of non-compliance by Balancing Authorities as a basis for *only two levels of non-compliance* by Reliability Authorities.

Requirement 3043 – Reliability Authority Directives

12. Do you agree with the requirement?
    ☒ Yes ☐ No

13. Do you agree with the measures?
    ☐ Yes ☒ No

Comments about Requirement 303
THE AOM COMPLIANCE SCALE FOR BALANCING AUTHORITIES CONTRADICTS AND COMPLICATES ANOTHER AOM COMPLIANCE SCALE PROPOSED ELSEWHERE IN THE DRAFT STANDARD. The levels of non-compliance by Balancing Authorities in section 5 of requirement 304 in terms of %-of-instructed-ACE-reduction not performed, contradict or overlay the AOL compliance scale in section 5 of requirement 301 in terms of time spent out of compliance. The use of both screens together would create an *unmanageable multidimensional compliance matrix*.

Other Issues with Standard

There are at least two different approaches to the compliance monitoring process. One approach leaves the details of the frequency of the compliance monitoring somewhat open-ended. Another approach provides more specific limits on the frequency of compliance monitoring.

Version A
The compliance monitor may also use periodic reviews (on site, per a schedule), with spot reviews and triggered investigations to assess performance.

Version B:
The compliance monitor may also use scheduled on-site reviews every three years, and investigations upon complaint, to assess performance.

14. Which do you prefer for future versions of this standard?
    ☒ Version A
    ☒ Version B
    Comments
    TECHNICALLY I PREFER VERSION A to give teeth to any technically well-founded standard.
    POLITICALLY I PREFER VERSION B to minimize the damage done by any technically unfounded standards.

The Abnormal Operations Metric (AOM), as proposed, includes the consideration of a 'diversity factor.' A method of calculating this diversity factor is not clearly defined and needs additional research. The diversity factor tries to give each BA a wider acceptable operating margin as a benefit of interconnected operations.

15. Which do you prefer?
    ☒ Use a frequency-dependent equation without a diversity factor
    ☐ Use a diversity factor
    ☐ Other-please specify
    DIVERSITY FACTOR IS MISGUIDED. MAKE THE LIMITS FREQUENCY-DEPENDENT BY USING BIAS TIMES THE FREQUENCY LIMIT. The diversity factor is intended to measure some relation of the Balancing Authority with the rest of the Interconnection by making the BAAL too high and too low to reflect that relationship. Instead of the misguided effort of using a diversity factor, we can make BAAL frequency dependent and thereby make it equal to the Balancing Authority's bias times the Frequency Trigger Limit, or bias times what I recommend to be the "Intervention Limit".

Not using a frequency-dependent measure overrides the CPS1 principle of the covariance of ACE with frequency error. Furthermore, frequency dependency preempts the possibility of false positives that would arise from applying the BAAL when there is no a frequency violation.

Some team members think that AOM and DEM overlap or are redundant measures.

16. If you think there is sufficient redundancy, and you think one of the measures should be eliminated, which one do you think should be eliminated?

☐ No Redundancy with AOM and DEM

☒ AOM and DEM are redundant – eliminate the following:

☐ Eliminate AOM

☒ Eliminate DEM

☐ Redundant but keep both anyway

Comments

The proposed DEM measure and the proposed AOM measure are both technically unfounded attempts to do one and the same thing.

AN AOM MEASURE IS THE BEST DEM MEASURE. To avoid the unscientific arbitrariness of the proposed DEM measure, and to avoid the interference with annual CPM-1 by a monthly CPM-1 measure which would be a better DEM measure than the one proposed, the best we can do is to construct as follows a technically sound AOM measure, not the proposed AOM measure:

- FIND THE ONE-EVENT-IN-TEN-YEARS FREQUENCY-ERROR POINT. This point would be where the area/probability under the probability distribution (a "forecast" of a probability distribution constructed from the historical statistical distribution) of interconnection frequency-error equals the likelihood of one event in 10 years, depending on how you define the *duration* of an "event" defined as a relay-triggering imbalance. Such a determination is consistent with the methodology used by Howard Illian/Energymark in the 2002 frequency study for the ERCOT interconnection. The benchmark of one-event-in-10-years itself needs to be researched, justified and explained. The interconnection would be deemed "reliable" if the one-event-in-ten-years frequency-error point lies within the relay limits. Otherwise, the average error $\in$ stipulated in the CPS1 standard would need to be tightened.

- SET THE REAL-TIME INTERVENTION-POINT. It should be set between the relay limit and the one-event-in-ten-years frequency-error point, and that intervention-point would delimit the "normal operating range". At that "intervention point" the Reliability Authority intervenes. The optimum point could be the point to which increasing the recovery period would move the one-in-ten-years frequency-error point closest to the relay limit before the relay limit would stop allowing that long a recovery period.

- USE "BIAS" NOT "DISTRIBUTION FACTOR" TO CONSTRUCT AN AOM "ABNORMAL OPERATIONS MEASURE" by placing on each Balancing Authority's ACE a BAAL limit (as the term is defined in the AOM in this Balancing Standard) that is the Balancing Authority's *bias-share* of the intervention-point frequency-error, but only when frequency *actually* reaches that intervention-point as is the case in the current proposed standard. In other words, the BAAL limit defined in this Balancing Standard should apply only when frequency actually reaches the intervention point. This avoids the "*false positives*" that would otherwise occur when frequency is actually within normal operating limits (vs in an "abnormal" range beyond those limits) and individual Balancing Authority behaviors are offsetting each other.

- DO LONG-TERM RESEARCH TO DETERMINE THE RELAY SET POINTS. Generators want tighter relay set points to minimize risk of damage to equipment while system operators want wider set points to maximize system integrity. A scientific basis needs to be established to inform the political process of determining the load-shed and over-frequency relay set points.

17. List any Regional or Interconnection Differences for this standard.

18. Provide any other comments on this standard.
SUMMARY OF ALL MY COMMENTS CONTAINED ON THE REST OF THIS COMMENT FORM. This draft Standard is very much a work-in-progress, the product of too little thought by too few individuals allowing no input by outside technical expertise until very late in the process to date. The standard is riddled with confusions, contradictions and mistakes that need resolution before many of the questions can even be answered clearly. My comments attempt to resolve them and to answer the questions accordingly. In summary, here are my comments:

    The draft Standard attempts to take 3 positive steps in eliminating CPS2 and DES, and in introducing the general concept of an AOM, but 4 huge negative steps in proposing CPS60 and DEM, in the measure chosen for AOM, and in not replacing the current procedure for determining frequency bias by a Frequency Response Standard. In particular:

    - The proposal to supplement CPM1 by a CPM60 and thereby enforce a "frequency profile" is wrong and misguided for being based on a misunderstanding of "sample averages" and mispreresentation of "frequency profile".

    - The proposal to eliminate CPS2 is correct.

    - The proposal to eliminate DES is correct.

    - The proposal for a "medium term" DEM measure contains a host of statistical and mathematical mistakes, confusions and contradictions. The two "alternative" DEM measures are incomprehensible as presented. Even when these shortcomings are corrected, the DEM proposal is wrong because mathematically it trumps CPM1.

    - The general concept of an AOM measure of compliance by Balancing Authorities with interventions by the Reliability Authority in the event of extreme conditions on the Interconnection is correct and is the true innovation gem in the trash of this draft Standard. But the specific measure proposed is riddled with mistakes, contradictions (including being subject to two different compliance-scale metrics for Balancing Authorities), and consistency with no known scientific basis. I provide a clean alternative measure on an established scientific basis.

    - The procedure for determining frequency bias is a perverse standard that undermines the remainder of the draft Balancing Standard, and needs to be replaced by a valid Frequency Response Standard.

Procedures for Developing Interconnection Frequency Limits, BAALs, and Frequency Bias

19. Do you agree with the method of calculating these limits as described in the Procedure for Determining Interconnection Frequency Limits?

Relay Limits

☐Agree with the calculations for these limits

☒Disagree with the calculations for these limits

Comments about the calculations for these limits

THERE IS NO "METHOD OF CALCULATION" PROVIDED HERE. Indeed, a NERC standard needs to establish a scientific basis for determining these limits. The "method" here used is a mere recipe for a research project, a mere "to do" list of "determine this" and "establish that", "calculate this" and "calculate that" that doesn't show how to calculate anything, passes the buck, and accomplishes nothing.

SEPARATE STANDARD NEEDED FOR RELAY LIMITS. That said, research on scientifically determining the relay limits is beyond the practical scope of this standard and should be the subject of a separate standard. The present draft Balancing Standard can only uncritically assume the relay limits adopted by the Interconnection, should say so explicitly without *pretending they are being calculated scientifically* , and explicitly defer to a separate standard for a calculation method. A separate standard for relay limits should be as scientifically sound as FERC required the industry to be in developing measures for TTC and ATC by the best methodology available.

Abnormal Limits

☐Agree with the calculations for these limits

☒Disagree with the calculations for these limits

Comments about the calculations for these limits

THE METHOD OF CALCULATION BY SUBTRACTING THREE-TIMES-THE-LARGEST-CONTINGENCY FROM THE UNSCIENTIFIC RELAY LIMITS IS ITSELF UNSCIENTIFIC, ARBITRARY AND "SEAT OF PANTS". While operating rules and daily decisions need to be simple, good decision-making to establish "a standard" can never be simple and snap-judgmental and must consider as scientifically as possible all the major elements. There is no race to make a decision or standard once and for all.

Trigger Limits

☐Agree with the calculations for these limits

☒Disagree with the calculations for these limits

Comments about the calculations for these limits

SEPARATE TRIGGER LIMIT AND ABNORMAL LIMIT ARE NOT NEEDED. ONE "INTERVENTION LIMIT" IS ENOUGH. There is no need to add a "for good measure" extra largest-contingency to establish a separate Trigger Limit.

ERCOT'S 2002 FREQUENCY STUDY PIONEERED A SCIENTIFIC METHOD FOR DETERMINING AN "INTERVENTION LIMIT".

- FIND THE ONE-EVENT-IN-TEN-YEARS FREQUENCY-ERROR POINT. This point would be where the area/probability under the probability distribution (a "forecast" of a statistical distribution constructed from the historical statistical distribution) of interconnection frequency-error equals the likelihood of one event in 10 years, depending on how you define the *duration* of an "event" defined as a relay-triggering imbalance. Such a determination is consistent with the methodology used by Howard Illian/Energymark in the 2002 frequency study

commissioned by the ERCOT interconnection. The benchmark of one-event-in-10-years itself needs to be researched, justified and explained. The interconnection would be deemed "reliable" if the one-event-in-ten-years frequency-error point lies within the relay limits. Otherwise, the average error ∈ stipulated in the CPS1 standard would need to be tightened.

- SET THE REAL-TIME INTERVENTION-POINT. It should be set between the relay limit and the one-event-in-ten-years frequency-error point, and that intervention-point would delimit the "normal operating range". At that "intervention point" the Reliability Authority intervenes. The optimum point could be the point to which increasing the recovery period would move the one-in-ten-years frequency-error point closest to the relay limit before the relay limit would stop allowing that long a recovery period.

20. Do you agree with the method of calculating these limits as described in the Procedure for Determining Balancing Authority Area Control Error Limits?
Balancing Authority Area Control Error Limits

☐Agree with the calculations for these limits

☒Disagree with the calculations for these limits

Comments about the calculations for these limits

"THREE TIMES THE LARGEST CONTINGENCY" IS THE SAME AS THE "MAXIMUM SAFE MEGAWATT DEADBAND" used to determine the Balancing Authority Area Control Area Limit. This age-old seat-of-pants concept from the floor of the industry is the sum-total of any scientific basis used in the draft to establish this limit and the frequency limits. It's bargain-basement back-of-envelope science and technology.

BIG MATH CONFUSION IN THE CALCULATION METHOD. The calculation method mistakes the "Maximum Safe Megawatt Deadband" (MSMD), subtracted to get the "Abnormal Limit", for the "Abnormal Limit" itself, actually for the "Trigger Limit". The calculation method makes the Balancing Authority's bias-share of the MSMD the basis for BAAL instead of bias share of the Trigger Limit or what I recommend to be the "Intervention Limit" in my answer to question 16.

DIVERSITY FACTOR IS MISGUIDED. MAKE THE LIMITS FREQUENCY DEPENDENT BY USING BIAS TIMES THE FREQUENCY LIMIT. The diversity factor is intended to measure some relation of the Balancing Authority with the rest of the Interconnection by making the BAAL too high and too low to reflect that relationship. Instead of the misguided effort of using a diversity factor, we can make BAAL frequency dependent and thereby make it equal to the Balancing Authority's bias times the Frequency Trigger Limit, or bias times what I recommend to be the "Intervention Limit". Not using a frequency-dependent measure overrides the CPS1 principle of the covariance of ACE with frequency error. Furthermore, frequency dependency preempts the possibility of false positives that would arise from applying the BAAL when there is no a frequency violation.

21. Do you agree with the Procedure for Determining Balancing Authority Frequency Bias?

☐Agree

☒Disagree

Comments

THE PROCEDURE SETS NO STANDARD. Determining frequency bias should be a NERC Standard, not a procedure, because otherwise it is merely a moral obligation not to lie, in other words it is merely an obligation to accurately estimate your responsiveness and to provide shared response to the interconnection equal to the bias estimate. The proposed procedure makes the provision of response purely discretionary and voluntary, and is therefore hardly a standard. Standards are not voluntary affairs. Even if response is "automatic", it is still set and adjustable.

THE PROCEDURE IS A PERVERSE STANDARD. Response (which is instantaneous) costs more than AGC (which is not instantaneous). This cost disincentive to provide response is accentuated by a perverse ratcheting in the proposed procedure. The more (less) response you provide and you are truthful about it, the more (less) response you are obligated to provide by your "truthful" bias estimate. In effect, you are punished for being truthful and rewarded for lying. In particular, the procedure prompts you to underprovide so that you can in turn reduce the bias estimate and accordingly reduce your cost and contribution to Interconnection shared response. Interconnection responsiveness has declined as a consequence. These facts were cited in the recent *Closure* by Tetsuo Sasaki from Japan's Kansai Electric Power Company in the May 2003 issue of *IEEE Transactions on Power Systems*, to the *Discussion* by me of a paper by him. See http://www.geocities.com/blohm_r/IEEE2.html

THE PROCEDURE HARMS THE PERFORMANCE GOVERNED BY THE REST OF THE DRAFT BALANCING STANDARD. The effect of the procedure is to shift the burden of primary control to AGC and secondary control which is governed by the rest of this proposed Balancing Standard. In other words, the procedure serves to undermine and raise the bar for performance under the rest of the draft balancing standard. Accordingly, to keep the draft Balancing Standard consistent, the procedure should be removed from the Balancing Standard.

REPLACE THE PROCEDURE BY A NEW FREQUENCY RESPONSE STANDARD INCORPORATED INTO THE CURRENT BALANCING STANDARD. The procedure should be replaced by a frequency-response standard that alleviates the burden on the AGC and secondary control performance governed by the rest of this draft Balancing Standard. A Frequency Response Standard would remove the perverse incentive, reverse the dangerous trend, and base bias-obligation (to provide frequency response) not on response provided but on contribution to interconnection Abnormal Operations. Accordingly, the worse a Balancing Authority's contribution to the very abnormal operations requiring the response, the greater would be its response obligation (bias). The better behaved and the less it causes the need for response, the lower its response bias-obligation should be, regardless of its actual response!

ADDRESSING ACE UNAVOIDABLY MEANS ADDRESSING FREQUENCY RESPONSE. ACE cannot be addressed by AGC alone. When a disturbance occurs, frequency response occurs to arrest the decline in frequency and stabilize frequency. That response "obligation" (herein called "bias-obligation") is shared per bias-share of each Balancing Authority and is the $-10B\Delta F$ term (in the direction of frequency error) in the ACE equation. That term imposes an extra hurdle on Inadvertent (really tie-line error) to keep the ACE term to within a target range determined by ΔF. In other words, a corresponding amount of additional offset in the direction opposite frequency needs to be provided in order to keep the ACE term to within that range. That "additional offset" is in fact not AGC, but "scheduled response". Response prevents ACE from getting worse than it would be without response.

RESPONSE DETERMINES INADVERTENT INTERCHANGE WHICH DETERMINES ACE. Only after response arrests frequency movement away from schedule, does AGC provide with some lag the Inadvertent needed to bring ACE back to where it was before the disturbance, to restore frequency. If each Balancing Authority's scheduling error is the same share of the Interconnection's instantaneous load-generation imbalance as that Balancing Authority's response is a share of the Interconnection's aggregate response, there is no Inadvertent and ACE exactly equals the bias obligation. Inadvertent results when those shares are different in at least one Balancing Authority. In the opposite extreme case, when only one area is responsible for the entire interconnection scheduling error, the other areas will have positive Inadvertent due to their response that their AGC would seek to counter but for the presence of the $-10B\Delta F$ term offsetting positive Inadvertent inside the ACE term, with the recovery burden left to the responsible area with the negative Inadvertent. Aggregate ACE of the Interconnection always equals the Interconnection's instantaneous load-generation imbalance. If the Interconnection's aggregate response is less (greater) than the Interconnection's aggregate bias obligation,

frequency error ΔF in the bias term -10BΔF in ACE is greater (less) than if the aggregate response equals the aggregate obligation.

PROVIDING LESS RESPONSE THAN REQUIRED BY BIAS-OBLIGATION, PROMPTS SUBSTITUTION OF MORE AGC FOR LESS RESPONSE. The bias term -10BΔF in ACE prompts an amount of AGC to offset it and (help) restore frequency, once automatic scheduled response has offset (a portion of) the instantaneous load-generation imbalance responsible for the frequency error, and has stabilized frequency. This is an "extra hurdle" that the bias obligation term represents in getting ACE to zero. Naturally, if the bias obligation term is more (less) than the frequency response, the hurdle is not enough (too much) and there is extra Inadvertent in the same (opposite) direction of frequency error, so that more (less) AGC is required than otherwise. So how different from bias-obligation the response actually is is very germane to frequency performance and AGC deployment. Yes AGC may make up for whatever the difference is in order to bring frequency back, but there is a qualitative difference and direct impact on frequency when interconnection-wide AGC is being used as a substitute for frequency response because interconnection frequency response is less than interconnection bias obligation.

LESS RESPONSE PROMPTS WIDER FREQUENCY SWINGS AND STRAIN ON AGC. An individual Balancing Authority's response inadequacy may not have an effect on frequency, but it will affect frequency performance once the other areas stop making up for that area's response inadequacy and the Interconnection response becomes inadequate relative to Interconnection bias-obligation. Once Balancing Authorities' response inadequacy (relative to bias-obligation) causes the entire Interconnection to be "response inadequate", instantaneous load-generation imbalance increases; in other words, frequency error is being allowed to increase more initially before being arrested, regardless of whether an increased amount of AGC is subsequently being used to bring frequency back. That's a direct concern to relay trip points being reached. But not only is response a reliability issue in that sense, it is also a frequency issue (for the Balancing standard) because demand for AGC increases to make up for response inadequacy. For frequency to be maintained, response inadequacy means a transfer of resources from governor response to less-expensive AGC, at the cost of ever bigger initial frequency swings.

22. The Procedure for Determining Interconnection Frequency Limits used in this standard was drafted with consideration of the highest frequency operating setpoint for each interconnection as published in Operating Policy 1 Appendix 1D. The Procedure for Developing Interconnection Frequency Limits was drafted assuming that time error correction will not be included in any standard developed by NERC, but a similar frequency correction procedure will be developed by NAESB. At this point, it isn't clear if there will be a NAESB Business Practice Standard for time error correction.

    Should the team adjust the Procedure for Developing Interconnection Frequency Limits to eliminate the application of a frequency operating setpoint as published in Operating Policy 1 Appendix 1D, or should the team assume that NAESB will develop a business practice standard that will mandate time error correction? The result of eliminating the frequency operating setpoint would be to widen the frequency normal operating zone.

    ☒Keep the reference to interconnection frequency operating setpoints in the Procedure for Determining Interconnection Frequency Limits

    ☐Eliminate the reference to interconnection frequency operating setpoints in the Procedure for Determining Interconnection Frequency Limits

    Comments
    UNTIL NERC'S RESOURCES SUBCOMMITTEE CAN FIND THE FUNDS TO COMMISSION A STUDY documenting the lack of demand for time correction in the wake of widespread *displacement of synchronous motors by DC digital devices* oblivious to frequency, time-error correction will

continue to be used by the Interconnections and should be reflected in Interconnection AOM frequency limits.

NEED FOR A NAESB STANDARD. Time-error correction is a system operation and of no interest to NAESB other than as a cost burden on the interconnection without sufficient corresponding benefit to consumers. A NAESB Business Practices Standard could provide a cost/benefit justification for not having time-error correction or show how to perform time-error correction efficiently.

NEED FOR A NERC STANDARD. As long as Interconnections continue to do time-error correction, the method used has serious frequency reliability impacts as demonstrated in a study by Howard Illian/ Energymark that was adopted by the Western Interconnection and validated by deteriorating Eastern Interconnection performance documented by me at http://www.naesb.org/pdf/weq_iiptf033103w1.pdf. Accordingly a NERC Standard consistent with this Balancing Resources and Demand Standard needs to be developed that determines how to do time-error correction in a way consistent with reliability and existing standards. Current time-error correction methodology in the Western Interconnection has overridden CPS1 by controlling frequency more tightly than CPS1 would, while in the the Eastern Interconnection it is consistent with CPS1 by using CPS1 to implement the time-error correction.