NERC

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reliability Guideline

Integrating Reporting ACE with the NERC Reliability Standards

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RELIABILITY | RESILIENCE | SECURITY

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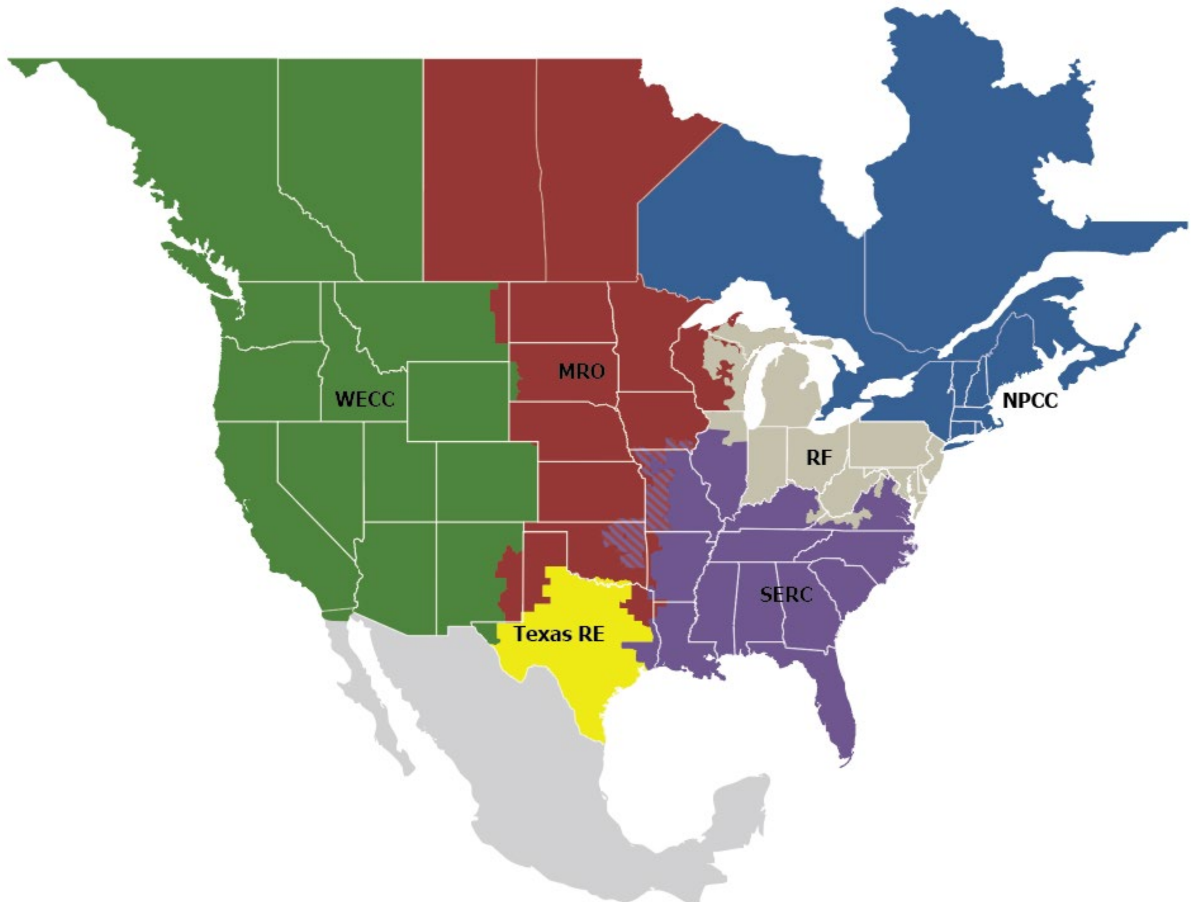
Preface

Electricity is a key component of the fabric of modern society and the Electric Reliability Organization (ERO) Enterprise serves to strengthen that fabric. The vision for the ERO Enterprise, which is comprised of the NERC and the six Regional Entities, is a highly reliable, resilient, and secure North American bulk power system (BPS). Our mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid.

Reliability | Resilience | Security
Because nearly 400 million citizens in North America are counting on us

The North American BPS is made up of six Regional Entity boundaries as shown in the map and corresponding table below. The multicolored area denotes overlap as some load-serving entities participate in one Regional Entity while associated Transmission Owners /Operators participate in another.



MRO	Midwest Reliability Organization
NPCC	Northeast Power Coordinating Council
RF	ReliabilityFirst
SERC	SERC Reliability Corporation
Texas RE	Texas Reliability Entity
WECC	WECC

Preamble

The NERC Reliability and Security Technical Committee (RSTC), through its subcommittees and working groups, develops and triennially reviews reliability guidelines in accordance with the procedures set forth in the RSTC Charter. Reliability guidelines include the collective experience, expertise, and judgment of the industry on matters that impact BPS operations, planning, and security. Reliability guidelines provide key practices, guidance, and information on specific issues critical to promote and maintain a highly reliable and secure BPS.

Each entity registered in the NERC compliance registry is responsible and accountable for maintaining reliability and compliance with applicable mandatory Reliability Standards. Reliability guidelines are not binding norms or parameters nor are they Reliability Standards; however, NERC encourages entities to review, validate, adjust, and/or develop a program with the practices set forth in this guideline. Entities should review this guideline in detail and in conjunction with evaluations of their internal processes and procedures; these reviews could highlight that appropriate changes are needed, and these changes should be done with consideration of system design, configuration, and business practices.

Executive Summary

Historically, ACE has been used to describe many terms involved in Tie Line Bias control. Within a Balancing Authority Area's (BAA's) Automatic Generation Control (AGC) algorithm there may be more than one ACE value in use. The term "Reporting ACE" was developed and is used in place of the term ACE to provide a consistent performance measurement using Reporting ACE and to remove any unnecessary restrictions on the specification of ACE within the Load-Frequency Control system.

Introduction

Purpose

This reliability guideline is intended to provide recommended practices for calculating and using Reporting Area Control Error (ACE) in a Tie Line Bias (TLB) control program integrated with the NERC Reliability Standards. The effective use of Reporting ACE within a TLB control program should address the following components:

1. Management Roles and Expectations
2. Information Technology Roles
3. Manual Source Data Entry
4. Automatically Collected Source Data
5. Uses of Reporting ACE
6. Historic Data Management
7. Special Conditions and Calculations

Each individual component should address processes and procedures, evaluation of any issues or problems along with solutions, testing, training, and communications. These provisions and activities together will be referred to as the TLB control program

Applicability

This reliability guideline is applicable to: Balancing Authorities (BAs)

Background

TLB[1] control has been used as the preferred control method in North America since the early 1950s. The term ACE was developed for the specific implementation of coordinated TLB control now in use throughout the world. This document provides responsible entities guidelines for using both required specifics and the best practices for calculating and using Reporting ACE in coordination with other measures to provide reliable frequency control. While the incorporation of these best practices is strictly voluntary, reviewing, revising, or developing a process using these practices is highly encouraged to promote and achieve reliability for the BES.

The Control Performance Standard 1 (CPS1)[2] measure was among the first of the results-based measures developed by NERC. It defined not how to perform control but rather the target control results that were to be achieved and a method to measure whether or not that defined control target had been met. As a result, when CPS1 was implemented, the ACE Equation used in that measure was also specified within that standard.

Historically, ACE has been used to describe many terms involved in TLB control. Within a Balancing Authority Area's (BAA's) Automatic Generation Control (AGC) algorithm there may be more than one ACE value in use. In some systems, the ACE is filtered prior to determining control actions in order to smooth the control signals, or there may be additional "feed- forward" terms added to ACE in anticipation of future changes (e.g. anticipated ramps, changes in ambient light at sunrise or sunset). There may be gain terms that modify certain variables such as the Frequency Bias Setting (FBS) to improve the quality of control for the specific characteristics of that particular BAA, or manual offsets.

[1] Capitalized terms hold the same definition as in the NERC glossary throughout this document.
[2] http://www.nerc.com/files/BAL-001-2.pdf

Some auditors have raised compliance issues related to the use of such modifications to the ACE used within the Load-Frequency Control (LFC) system (also referred to as AGC) and required changes in the AGC system to conform to the definition of ACE in BAL-001. The term “Reporting ACE” was developed and is used in place of the term ACE to provide a consistent performance measurement using Reporting ACE and to remove any unnecessary restrictions on the specification of ACE within the LFC system.

Chapter 1: Applicable Roles

Applicable Roles

Management, Information Technology (IT), and Balancing Authorities (BAs) should evaluate all their uses for Reporting ACE in operations and reliability measurements. Reporting ACE is one of the most important single measurements available to indicate the current state of the responsible entity's contribution to Interconnection reliability. Reporting ACE is also used as an integral part of the measurements used in BAL-001 and BAL-002. Technical requirements associated with the parameters used in the calculation of Reporting ACE are specified in BAL-003 and BAL-005.

Management Roles and Expectations

Management plays an important role in maintaining an effective TLB control program. The management role and expectations below provide a high-level overview of the core management responsibilities related to each Tie Line Bias control program. The management of each responsible entity should tailor these roles and expectations to fit within its own structure.

- Set expectations for safety, reliability, and operational performance.
- Assure that a TLB control program exists for each responsible entity and is current.
- Ensure the proper expectation of TLB control program performance.
- Share insights and good practices with other BAs.

Information Technology (IT) Roles

- Participate in appropriate TLB control related training.
- Ensure the Reporting ACE and source information are always current and correct.
- Implement the TLB control program in Real-time.
- Ensure that the Energy Management System (EMS) supports the manual data entry of all source data required to be entered by IT staff, system operations staff, and System Operators and properly manages that data once entered.
- Ensure that the EMS supports and manages the automatic collection of all source data that is required to be measured in real-time through telemetry and data exchange including data quality information to indicate data validity.
- Ensure that the programs that manage data used to calculate components of Reporting ACE, Reporting ACE itself, and subsequent measures based on Reporting ACE are up to date and correct as identified by, but not limited to the calculations and equations in section 7:

Balancing Authorities (BAs)

The role of the Balancing Authority is to monitor ACE with respect to the Control Performance Standard and Disturbance Control Standard. The BA evaluates dispatch options and coordinates their actions with other BAs, Marketing Entities, Transmission Operators, and the Reliability Coordinator.

Chapter 2: Data Collection

The Area Control Area (ACE) uses two sources of data when calculating a value. Manual source data that can be entered real time or after the fact by BA or IT personal and automatically collected source data that is pulled from equipment in the field.

Manual Source Data Entry

Reporting ACE is calculated in Real-time, at least every six seconds[3], by the responsible entity's Energy Management System (EMS), and may be partially based on source data manually entered into that system. The following source data may be manually entered:

NI_S (Scheduled Net Interchange): The power transfer schedules, including Dynamic Schedules and the schedule ramps where applicable, are processed by the EMS. Dynamic Schedules are estimated before the delivery period, and corrected in real-time. If telemetry failures occur during such delivery periods, they are manually corrected after the delivery. If scheduled flow estimates are equal and have opposite signs for the Adjacent BAAs, the effect of any errors will be confined to the two Adjacent BAAs responsible for the manual entries. Failure to match scheduled flow estimates will result in errors that affect other BAAs.

NI_A (Actual Net Interchange): The telemetry values of actual tie flows, including pseudo-ties, between Adjacent BAAs may not be available from an automatic collection source due to telemetry failures, requiring manual entry of estimated flows. These manual entries should be performed in a manner that reasonably assures equal magnitude and opposite sign values are used by the Adjacent BAAs entering the manual data. If the actual flow estimates are the same for the Adjacent BAAs, the effect of any errors will be confined to the two Adjacent BAAs responsible for the manual entries. Failure to match actual flow estimates will result in errors that affect other BAAs on the Interconnection.

B (Frequency Bias Setting): The FBS, or minimum required value, for the BAA is specified by calculations performed as part of compliance with BAL-003-1.1 - Frequency Response and FBS;

"R2. Each Balancing Authority Area that is a member of a multiple Balancing Authority Area Interconnection and is not receiving Overlap Regulation Service and uses a fixed Frequency Bias Setting shall implement the Frequency Bias Setting determined in accordance with Attachment A, as validated by the ERO, into its Area Control Error (ACE) calculation during the implementation period specified by the ERO and shall use this Frequency Bias Setting until directed to change by the ERO."[4]

10 is the factor (10 0.1Hz/Hz) that converts the FBS units to MW/Hz.

F_S (Scheduled Frequency): Scheduled Frequency, normally 60 Hz, is manually adjusted on a coordinated basis when directed to do so by the Interconnection Time Monitor as specified in BAL-004-0.[5] It is

[3] BAL-005-1 Balancing Authority Control – "R2. The Balancing Authority Area shall use no greater than a six-second scan rate in acquiring data necessary to calculate Reporting ACE."

[4] As a note of interest, the new procedures put forth with BAL-003-1.1 will result in the reduction of minimum FBS values on the multiple BA Interconnections to bring them closer to the natural measured Frequency Response of the Interconnection. The rule requiring a minimum FBS of 0.9% of peak load in the NERC standards dates back to 1962 when NAPSIC, the precursor to the NERC Operating Committee, codified the recommendations of the Interconnected Systems Group made in 1956 to set a minimum of 50% of the natural measured response, which was 2% of peak load at that time. The 1% figure was more than 200% of the natural measured response for the Eastern Interconnection and in some cases is approaching a value that could result in instability by being too high. The logic justifying a minimum of the natural response is still valid. When configured with a FBS equal to the actual Frequency Response of the BAA, Reporting ACE will reflect the BAA's obligation to match its actual interchange, less the impact from its current Frequency Response offset, to its scheduled interchange.

[5] This is consistent with condition 3 in the Reporting ACE Definition: "The use of a common Scheduled Frequency F_S for all areas at all times."

important for all BAAs on an interconnection to make these adjustments on a coordinated basis so that all BAAs are controlling to the same Scheduled Frequency at all times.

I_{ME} (Interchange Meter Error): This term, normally zero, is available for use by the System Operator or operations staff to add a correction term in the Reporting ACE calculation to compensate for data or equipment errors affecting any other components identified by analysis of historic data demonstrating the existence of errors, usually errors between integrated hourly scan-rate data and hourly agreed to accumulated meter data. (See the Special Conditions and Calculations section of this document for additional information)

L_{max} is the maximum value allowed for I_{ATEC} set by each BA between $0.2*|B|$ and L_{10}, $0.2*|B| \leq L_{max} \leq L_{10}$.

Y is normally calculated by the ATEC program in the EMS for BAAs on the Western Interconnection.

H is set to 3 and used by the ATEC program in the EMS for BAs on the Western Interconnection. It represents the number of hours over which the primary inadvertent interchange is paid back.

B_S is used by the ATEC program in the EMS for BAAs on the Western Interconnection. It represents the sum of the minimum FBSs for all BAAs on the Interconnection.

ΔTE is used by the ATEC program in the EMS for BAAs on the Western Interconnection. In some cases, it may be calculated by the EMS based on the factors in the ΔTE equation. ΔTE is the hourly change in system Time Error as distributed by the Interconnection time monitor.

TD_{adj} is an adjustment for the differences between the local clock in the local time standard and the Interconnection time monitor control center clocks so that the local EMS can calculate the correct ΔTE for the BAAs and used by the ATEC program in the EMS for BAAs on the Western Interconnection.

TE_{offset} is entered as instructed by the Interconnection time monitor.

ε_1 is the RMS Limit for the 1-minute average frequency error for the Interconnection.

Automatically Collected Source Data

Reporting ACE is calculated in Real-time, at least as frequently as every six seconds, by the responsible entity's Energy Management System (EMS) predominantly based on source data automatically collected by that system. Also, the data must be updated at least every six seconds for continuous scan telemetry and updated as needed for report-by-exception telemetry.

In addition, data quality information (usually in the form of data quality flags associated with each data value) must be retained and presented in real-time to the System Operators. This data quality information is presented to the System Operator to have situational awareness with respect to the quality of the data inputs and final calculated result. It is later used to determine which data is valid for use in performance calculations such as CPS1, BAAL, DCS, and frequency response obligation (FRM).

NI_S (Scheduled Net Interchange): Most interchange schedules and some Dynamic Schedules are entered into the EMS in a summary format either as individual schedules, schedule nets with each Adjacent BAA, or a final Scheduled Net Interchange. These schedules are converted into scan-rate schedules by the EMS. The EMS calculates the Scheduled Net Interchange, where applicable, by summing all individual schedule values or nets with each Adjacent BAA for all regular and Dynamic Schedules and includes the result as NIS in the ACE equation. Ramping is not accounted for, these schedules represent the contracted transactions or the expected transactions (for dynamic schedules).

NI_A (Actual Net Interchange): The tie-line value representing each tie-line flow and pseudo-tie quantity is collected at the required scan rate of six seconds or less.[6] [7] [8] [9] Data that is of questionable accuracy or timeliness is flagged with an appropriate data quality flag. This information is presented to the System Operator to support situational awareness.[10] The EMS sums the individual flow values on all tie lines and pseudo ties with all adjacent BAAs at the scan rate and includes this value as NI_A in the Reporting ACE equation calculation. The result is a series of NI_A values at the EMS scan rate and associated data quality flags. The associated data quality of the telemetry is also assigned to the result of appropriate calculations.

F_A (Actual Frequency): Actual frequency is provided by a frequency measuring device at the accuracy specified in BAL-005[11] at the EMS scan rate. If a frequency value is not available, the value for that scan is marked invalid.

II_{actual} (Inadvertent Interchange): This term is only used in the Western Interconnection ACE calculation. Inadvertent Interchange "Actual" for the previous hour is calculated by the EMS from the previous hour's data as the difference between the integrated hourly average Scheduled Net Interchange and the integrated hourly average Actual Net Interchange.

t (Manual Time Error correction minutes in the hour): The number of minutes of manual Time Error correction in the hour.

[6] Data transmitted at a rate slower than the scan rate of the remote sensing equipment may require the inclusion of anti-aliasing filtering at the source of the measurement to eliminate the risk of aliasing in the data transmitted to the EMS.

[7] It is acceptable to collect tie-line flow data from RTUs that use report by exception as long as those RTUs can support the scan rate of six seconds or less when data is changing rapidly and both adjacent BAAs are receiving comparable data to keep the measured flows equivalent.

[8] The six-second scan rate not only assures that data collected is close to Real-time, it also limits the latency (time skew) associated with the data collection.

[9] The accuracy of the flow data is set by those using the flow data for transmission flow management. As with all ACE data, as long as both adjoining BAAs are using the same values for tie-line flow, the effects of any error in flow measurement will be confined to the two adjacent BAAs.

[10] Indications of suspect data are usually indicated with color changes and/or alarms

[11] BAL-005 – Automatic Generation Control specifies an accuracy of ≤0.001 Hz (equivalent to ≤ +/- 0.0005 Hz) for the Digital Frequency Transducer.

Chapter 3: ACE Management

Uses of Reporting ACE

Reporting ACE is currently used to measure balancing performance within TLB control on all of the Interconnections.[12] Consequently, Reporting ACE is one of the primary measurement parameters in many of the NERC Balancing Standards. The following standards require the use of Reporting ACE as part of the performance metrics or set requirements associated with the calculation of Reporting ACE.

- BAL-001-2 – Real Power Balancing Control Performance.
- BAL-002-2 – Disturbance Control Standard – Contingency Reserve from a Balancing Contingency Event (when approved by FERC).
- BAL-005-0.2b – Automatic Generation Control and BAL-005-1 – Balancing Authority Control (when approved by FERC).

Historic Data Management

The industry currently requires the retention of data supporting the calculation of Reporting ACE and compliance measurements based in part on Reporting ACE to support the NERC compliance audit process. This data retention must be considered as an integral part of the Reporting ACE and "TLB control program".

Special Conditions and Calculations

I_{ME} (Interchange Meter Error): This term, normally zero, is available for use by the System Operator or operations staff to add a correction term in Reporting ACE. It compensates for data or equipment errors affecting any other components of Reporting ACE identified by analysis of historic data. These errors are usually between integrated hourly scan-rate data and hourly agreed to accumulated meter data. The process used for including adjustments in the I_{ME} term should be based on good quality control methods.[13]

These error correction adjustments can be used to correct errors in NI_A, NI_S,[14] Reporting ACE, and other measurements that depend upon an accurate Actual Net Interchange and/or an accurate Scheduled Net Interchange. The same logic and evaluation processes that are valid for inclusion in the I_{ME} term of the Reporting ACE equation should also be valid as adjustments to the scan rate tie-line flows used for the measurement of Frequency Response as part of the BAL- 003-1.

ACE Diversity Interchange: This is a frequency neutral form of ACE exchange that uses real-time, sub-minute adjustments to the unadjusted ACE values of participating BAs that always net to zero and are non-zero individually only when at least one participating BAs unadjusted ACE value differs in algebraic sign from at least one other participating BAs unadjusted ACE. Participating BAs achieve reductions in their generation control and reporting ACE values by incorporating the ADI adjustments computed by an ACE Diversity Interchange algorithm. A participating BA's ADI adjustment term for each calculating cycle allows a flow that has already occurred on the participating BA's tie-lines to be maintained.

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[12] On single BAA Interconnections, the ACE equation reduces to a single term, **$-10B\,(F_A - F_S)$**, because there are no tie lines or schedules to include in the first term, **$(NI_A - NI_S)$**, and there is no **I_{ME}** term to correct for tie line or dynamic schedule measurement errors in the first term.

[13] Adjustments to the **I_{ME}** term should follow good quality control methods and exclude tampering as demonstrated by the Deming's Funnel Experiment.

[14] As long as the actual tie line flows and scheduled flows match for adjacent Balancing Authority Areas, any problems with the measurement of balancing on the Interconnection will be confined to within the boundaries of those adjacent Balancing Authority Areas. Errors in the **NI_S** would only occur and only support correction in cases where there is a measurement error associated with a dynamic schedule.

Imbalance Market Transactions: The Energy Transfer System Resources (ETSRs) are defined as aggregate resources at the IM BAA Default Generation Aggregation Point (DGAP), which is an aggregation of all supply resources in the BAA. Each ETSR is defined as either an import or an export resource, and it is associated with an EIM intertie with another EIM BAA.

Use of Source-Sink Pairs for Asynchronous DC Tie Lines to Another Interconnection: One of the primary rules for insuring the validity of the Reporting ACE equation is, "All portions of the Interconnection are included in exactly one BAA so that the sum of all BAAs generation, load, and loss is the same as total Interconnection generation, load, and loss." This is accomplished by requiring the inclusion in Reporting ACE of all tie lines, pseudo ties, interchange schedules and Dynamic Schedules to Adjacent BAAs and only Adjacent BAAs on the same Interconnection, and requiring the exclusion of all asynchronous DC tie lines and associated scheduled interchange with BAAs on a different Interconnection from Reporting ACE. Following this simple rule insures that all loads, losses and generation are properly included with each Interconnection.

Instead of including the power transfers from an asynchronous DC tie line between two Interconnections as a normal interchange transfer between two BAAs, this form of power transfer should be included as though it is a linked source-sink pair for the purposes of managing frequency control within a tie line bias control program. One terminal of an asynchronous DC tie line will appear to the receiving Interconnection and receiving BAA as an energy resource similar to a generator. This is the source end of the source-sink pair. The other terminal of the same asynchronous DC tie line will appear to the supplying Interconnection and supplying BAA as an energy sink similar to a load. This is the sink end of the source-sink pair.

Interchange transactions linked to either the source or sink from other BAAs on the same Interconnection as the source or sink will schedule those transactions, include those transactions in Reporting ACE, and manage those transactions in a similar manner to any other energy transaction. Only the BAA acting as the source or the sink for the DC tie line will exclude the asynchronous tie line from its Reporting ACE while including all transactions with Adjacent BAAs on the same Interconnection associated with that source or sink power transfer in their Reporting ACE.

ACE Component and CPS1 Calculations:

- Actual Net Interchange[15] (NI_A):
  - All BAAs involved account for the power exchange and associated transmission losses as actual Interchange between the BAAs, both in their ACE and Reporting ACE equations and throughout all of their energy accounting processes.
    - Calculate for each scan[16].
    - Integrated hourly average calculated for each hour as an integration of the scan rate values.
      - Scheduled Net Interchange[17] (NI_S):
    - Calculate for each scan.

[15] By definition "Actual megawatt transfers on asynchronous DC tie lines directly connected to another Interconnection are excluded from Actual Net Interchange." Additional information on asynchronously connected DC tie lines connected to another interconnection is provided in "Special Conditions and Calculations" section of this document.

[16] Actual Net Interchange scan-rate values are also used as one of the primary inputs to the calculation of Frequency Response Measure (FRM) on FRS Form 1 and FRS Form 2.

[17] By definition "Scheduled megawatt transfers on asynchronous DC tie lines directly connected to another interconnection are excluded from Scheduled Net Interchange." Additional information on asynchronously connected DC tie lines connected to another interconnection is provided in the "Special Conditions and Calculations" section of this document.

- Integrated hourly average calculated for each hour as an integration of the scan rate values. (This value differs from the block accounting value.)
- Note: Dynamic Schedules are to be accounted for as Interchange Schedules by the source, sink, and contract intermediary BAA(s), both in their respective ACE and Reporting ACE equations, and throughout all of their energy accounting processes.
  - Frequency Error ($\Delta F = (F_A - F_S)$):
- Calculate for each scan.
- Calculate clock-minute average from valid samples available within each clock-minute[18] where at least half of the scan-rate samples are valid.

- Frequency Trigger Limit – Low (FTL_{Low}):
  - Calculate the Frequency Trigger Limit – Low for each clock-minute where at least half of the scan rate samples are valid by subtracting three times Epsilon1 from the Scheduled Frequency (F_S).
    - Frequency Trigger Limit – High (FTL_{High}):
      - Calculate the Frequency Trigger Limit – High for each clock-minute where at least half of the scan rate samples are valid by adding three times Epsilon1 to the Scheduled Frequency (F_S).
    - Accumulated Primary Inadvertent Interchange (PII):
      - Calculated each hour for WECC BAAs only.

$$\mathbf{PII}_{\mathbf{accum}}^{\mathbf{on/off}\text{peak}} = \text{last period's } \mathbf{PII}_{\mathbf{accum}}^{\mathbf{on/offpeak}} + \mathbf{PII}_{\mathbf{hourly}}$$

    - Automatic Time Error Correction ($\mathbf{I}_{\text{ATEC}}$):
      - Calculate for each hour for WECC BAAs only for inclusion in the ACE and Reporting ACE Equation for the next hour.

$$\mathbf{I}_{\mathbf{ATEC}} = \frac{\mathbf{PII}_{\mathbf{accum}}^{\mathbf{on/off\ peak}}}{(\mathbf{1-Y})*\mathbf{H}}$$ when operating in ATEC mode.

The absolute value of $\mathbf{I}_{\text{ATEC}}$ shall not exceed L_{max}.

$\mathbf{I}_{\text{ATEC}}$ shall be zero when operating in any other AGC mode.

$\mathbf{PII}_{\mathbf{hourly}}$ = (1-Y) * (IIactual –B delta TE/6)

- Reporting ACE:
  - Calculate for each scan.
  - Calculated average for each clock-minute for BAAs using a fixed FBS when at least half of the values are valid.[19]
    - Compliance Factor:[20]

[18] Clock-minute averages are used for the calculation of ACE and Frequency Error in CPS1 and BAAL to eliminate the transient variations of tie-line flows and frequency error used in the calculation of performance measures. The one-minute period was chosen because it is evenly divisible by all whole-second scan rates less than the maximum specified scan rate of six seconds. This assures greater comparability of performance data among BAs with different scan rates.

[19] The average of the value of the ratio of the scan rate value of Reporting ACE divided by the scan rate value of -10 times the FBS times the Actual Frequency for those BAs using a variable FBS, where at least half of the ratio values are valid.

[20] Used for CPS1.

- Calculate for each scan where both Reporting ACE and Frequency Error are valid.
- Calculate for each clock-minute where both the average clock-minute Frequency Error and the average clock-minute Reporting ACE are valid.[21]
    - Clock-hour compliance factor:[21]
    - Calculate for each hour by summing the valid clock-minute compliance factors for the hour and dividing by the number of valid clock-minute compliance factors in the hour.
- Month compliance factor:[21]
    - Calculate by summing the valid clock-minute compliance factors in the month and dividing by the number of valid compliance factors in the month.
    - 12-month compliance factor:[21]
    - Calculate by summing the valid clock-minute compliance factors in the 12-month period and dividing by the number of valid clock-minute compliance factors in the 12-month period.
        - CPS1 compliance factor.
    - Calculate the CPS1 compliance factor by dividing the 12-month compliance factor by the square of the Epsilon1 value for the Interconnection.
- CPS1:
    - Calculate the CPS1 scan rate performance by dividing the scan rate compliance factor by the square of the Epsilon1 value for the interconnection and subtracting that value from 2 and multiplying the result by 100 to convert to a percentage performance for each scan with a valid compliance factor.
    - Calculate the CPS1 clock-minute performance by dividing the clock-minute compliance factor by the square of the Epsilon 1 value for the interconnection and subtracting that value from 2 and multiplying the result by 100 to convert to a percentage performance for each clock-minute with a valid compliance factor.
    - Calculate the CPS1 clock-hour performance by dividing the clock-hour compliance factor by the square of the Epsilon1 value for the interconnection and subtracting that value from 2 and multiplying the result by 100 to convert to a percentage performance for each clock-minute with a valid compliance factor.
    - Calculate the CPS1 monthly performance by dividing the month compliance factor by the square of the Epsilon 1 value for the interconnection and subtracting that value from 2 and multiplying the result by 100 to convert to a percentage performance for each clock-minute with a valid compliance factor.
    - Calculate the CPS1 12-month performance by dividing the 12-month compliance factor by the square of the Epsilon 1 value for the interconnection and subtracting that value from 2 and multiplying the result by 100 to convert to a percentage performance for each clock-minute with a valid compliance factor.

[21] The compliance factor is calculated when the average of the value of the ratio of the scan rate value of Reporting ACE divided by the scan rate value of -10 times the FBS for those BAs using a variable FBS, where at least half of the ratio values are valid and the average clock-minute Frequency Error is valid.

Contributors

NERC gratefully acknowledges the contributions and assistance of the following industry experts in the preparation of this guideline.

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Greg Park	Western Power Pool
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Joseph Marcrum	Southern Company
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Guideline Information and Revision History

Guideline Information	
Category/Topic: [NERC use only]	**Reliability Guideline/Security Guideline/Hybrid:** Reliability Guideline
Identification Number: [NERC use only]	**Subgroup:** [NERC use only]

Revision History		
Version	**Comments**	**Approval Date**
0	Initial Version – Calculating and Using Reporting ACE in TLB Control Program	5/18/2015
1	Resources Subcommittee Review	11/4/2019
2	Resources Subcommittee Review; reformat and addition of metrics	2/6/2023

Metrics

Pursuant to the Commission's Order on January 19, 2021, *North American Electric Reliability Corporation*, 174 FERC ¶ 61,030 (2021), reliability guidelines shall now include metrics to support evaluation during triennial review consistent with the RSTC Charter.

Baseline Metrics

All NERC reliability guidelines include the following baseline metrics:

- BPS performance prior to and after a reliability guideline as reflected in NERC's State of Reliability Report and Long Term Reliability Assessments (e.g., Long Term Reliability Assessment and seasonal assessments)
- Use and effectiveness of a reliability guideline as reported by industry via survey
- Industry assessment of the extent to which a reliability guideline is addressing risk as reported via survey

Specific Metrics

The RSTC or any of its subcommittees can modify and propose metrics specific to the guideline in order to measure and evaluate its effectiveness, listed as follows:

Compare monthly or quarterly CPS1 and BAAL exceedance values submitted in the voluntary quarterly data filing submitted by each BA to the NERC BASS website to CPS1 and BAAL exceedance values calculated from raw RACE data submitted to NERC for the M6 metric.

- Using Reporting ACE (RACE) from the M6 data historian, calculate Compliance Factor clock minute averages: (*CF*clock-minute). *CF*clock-minute= [(RACE/-10*B*) * 10 dFclock-minute]
- Calculate Clock-Minute CPS1 values: CPS1= (2 – *CF*) * 100%
  - Develop counters to compile exceedances of CCPS1 clock-minute <= -700%
- Compare the monthly CPS1 and BAAL exceedance minutes submitted by the BA to the CPS1 and BAAL (RACE derived) exceedances from M6 historian data.

Observations:

- The CPS1 and BAAL Exceedance values submitted by the BA should be approximately the same as those calculated from the M6 raw RACE data. While the performance scores will not match exactly BAs who differences materially exceed those of those of the majority of BAs could potentially have an error in their RACE, CPS1, or BAAL calculations.
- The BAs reported CPS1 <= -700% exceedance minutes should exactly match the BAs reported BAAL exceedance minutes. If those numbers are different it could indicated and error in the RACE, CPS1 or BAAL calculations.