NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

BAL-002-2 – Disturbance Control Performance - Contingency Reserve for Recovery from a Balancing Contingency Event Standard Background Document

RELIABILITY | ACCOUNTABILITY




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Introduction

The revision to NERC Policy Standards in 1996 created a Disturbance Control Standard (DCS). It replaced B1 (Area Control Error (ACE) return to zero within 10 minutes following a disturbance) and B2 (ACE must start to return to zero in 1 minute following a disturbance) with a standard that states: ACE must return to either zero or a pre-disturbance value of ACE within 15 minutes following a reportable disturbance. Balancing Authorities are required to report all disturbances equal to or greater than 80% of the Balancing Authority's most severe single contingency.

BAL-002 was created to replace portions of Policy 1. It measures the ability of an applicable entity to recover from a reportable event with the deployment of reserve. The reliable operation of the interconnected power system requires that adequate generating capacity be available at all times to maintain scheduled frequency and avoid loss of firm load following loss of transmission or generation contingencies. This generating capacity is necessary to replace generating capacity and energy lost due to forced outages of generation or transmission equipment.

This document provides background on the development and implementation of BAL-002-2 - Contingency Reserve for Recovery from a Balancing Contingency Event. This document explains the rationale and considerations for the requirements and their associated compliance information. BAL-002-2 was developed to fulfill the NERC Balancing Authority Controls (Project 2007-05) Standard Authorization Request (SAR), which includes the incorporation of the FERC Order 693 directives. The original SAR, approved by the industry, presumes there is presently sufficient contingency reserve in all the North American Interconnections. The underlying goal of the SAR was to update the standard to make the measurement process more objective and to provide information to the Balancing Authority or Reserve Sharing Group, such that the parties would better understand the use of Contingency Reserve to balance resources and demand following a Reportable Contingency Event. Currently, the existing BAL-002-1 standard contains Requirements specific to a Reserve Sharing Group which the drafting team believes are commercial in nature and is a contractual arrangement between the reserve sharing group parties. BAL-002-2 is intended to measure the successful deployment of contingency reserve by responsible entities. Relationships between the entities should not be part of the performance requirements, but left up to a commercial transaction.

Clarity and specifics are provided with several new definitions. Additionally, the BAL-002-2 eliminates any question on who is the applicable entity and assures the applicable entity is held responsible for the performance requirement. The drafting team's goal was to have BAL-002-2 solely a performance standard. The primary objective of BAL-002-2 is to assure the applicable

entity balances resources and demand and returns its Area Control Error to defined values (subject to applicable limits) following a Reportable Balancing Contingency Event.

As proposed, this standard is not intended to address events greater than a Responsible Entity's Most Severe Single Contingency. These large multi-unit events, although unlikely, do occur. Many interactions occur during these events and Balancing Authorities and Reserve Sharing Groups must react to these events. However, requiring a recovery of ACE within a specific time period is much too simple of a methodology to adequately address all of these interactions. Rather, the combination of the recently passed BAL-001-2 standard, in which R2 requires operation within an ACE bandwidth based on interconnection frequency, TOP-007 and EOP-002, are much better at addressing issues when large events occur. The Balancing Authority ACE Limit (BAAL) in R2 of BAL-001-2 looks at interconnection frequency to provide the BA a range in which the BA should strive to operate as well as a 30-minute period to address instances when the BA is outside of that range. If an event larger than the BA's MSSC occurs, the BAAL will likely change to a much tighter control limit based on the change in interconnection frequency. The 30-minute limit under the BAAL will allow the BA time to quickly evaluate the best course of action and then react in a reasonable manner. The TOP-007 standard addresses transmission line loading. Members of the BAL-002-2 drafting team are aware of instances that could cause transmission overloads if certain units (typically N-1-1 or greater) where lost and reserves responded. In addition, under EOP-002, if the BA does not believe that it can meet certain parameters, different rules are implemented. Because of the potential for significant unintended consequences that could occur under a requirement to activate all reserves, the drafting team recommends to the industry that the revised BAL-002-2 only address events which are planned for and not any loss of resource that would exceed MSSC. Therefore, the definitions and requirements under BAL-002-2 exclude events greater than the MSSC. This will help ensure reliable operation, clarity of requirements and supports reliable operation of the Bulk Electric System and allows other standards to address events of greater magnitude.

Background

This section discusses the new definitions associated with BAL-002-2.

Balancing Contingency Event

The purpose of BAL-002-2 is to ensure the Balancing Authority or Reserve Sharing Group balance resources and demand by returning its Area Control Error to defined values following a Reportable Balancing Contingency Event.

The drafting team included a specific definition for a Balancing Contingency Event to eliminate any confusion and ambiguity. The prior version of BAL-002 was broad and could be interpreted in various manners leaving the ability to measure compliance up to the eye of the beholder. By

including the specific definition, it allows the Responsible Entity to fully understand how to perform and meet compliance. Also, FERC Order 693 (at P355) directed entities to include a Requirement that measures response for any event or contingency that causes a frequency deviation. By developing a specific definition that depicts the events causing an unexpected change to the Responsible Entity's ACE, the necessary requirements assures FERC's requirement is met.

Most Severe Single Contingency

The Most Severe Single Contingency (MSSC) term has been widely used within the industry; however, it has never been defined. In order to eliminate a wide range of definitions, the drafting team has included a specific definition designed to fulfill the needs of the standard. In addition, in order to meet FERC Order No. 693 (at P356), to develop a continent-wide contingency reserve policy, it was necessary to establish a definition for MSSC.

Contingency Reserve

Most system operators generally have a good understanding of the need to balance resources and demand and return their Area Control Error to defined values following a Reportable Balancing Contingency Event. However, the existing contingency reserve definitions primarily focused on generation and not Demand Side Management (DSM). In order to meet FERC Order No. 693 (at P 356) to include a Requirement that explicitly allows DSM to be used as a resource for contingency reserve, the drafting team elected to expand the definition of Contingency Reserve to explicitly include capacity associated with DSM.

Additionally, conflict existed between BAL-002 and EOP-002 as to when an entity could deploy its contingency reserve. To eliminate the possible conflict and to assure BAL-002 and EOP-002 work together and complimented each other, the drafting team clarified the existing definition of Contingency Reserve. The conflict arises since the actions required by Energy Deficient Entities before declaring either an Energy Emergency Alert 2 or an Energy Emergency Alert 3 requires deployment of all Operating reserve which includes Contingency Reserve. An Energy Deficient Entity may need to declare either an Energy Emergency Alert 2 or an Energy Emergency Alert 3, without incurring a Balancing Contingency Event, and without a Balancing Contingency Event, a Responsible Entity cannot utilize its Contingency Reserve without violating the NERC Standard BAL-002-2. To resolve this conflict, the drafting team elected to allow the Responsible Entity to use its Contingency Reserve while in a declared Energy Emergency Alert 2 or Energy Emergency Alert 3.

Reserve Sharing Group Reporting ACE

The drafting team elected to include this definition to provide clarity for measurement of compliance for the appropriate Responsible Entity. Additionally, this definition is necessary since the drafting team has eliminated R5.1 and R5.2 from the existing standard. R5.1 and R5.2 are definitions mixed with performance. The drafting team has included all the performance requirements in the proposed standards R1 and R2, and therefore must add the definition of the Reserve Sharing Group Reporting ACE.

Other Definitions

Other definitions have been added or modified to assure clarification within the standard and requirements.

Rationale by Requirement

Requirement 1

The Responsible Entity experiencing a Reportable Balancing Contingency Event shall, within the Contingency Event Recovery Period, return its Reporting ACE to at least:

- Zero (if its Pre-Reporting Contingency Event ACE Value was positive or equal to zero):
  - less the sum of the magnitudes of all subsequent Balancing Contingency Events that have already occurred during the Contingency Event Recovery Period, and
  - further reduced by the magnitude of the difference between (i) the Responsible Entity's Most Severe Single Contingency (MSSC) and (ii) the sum of the magnitudes of the Reportable Balancing Contingency Event and all previous Balancing Contingency Events that have not completed their Contingency Reserve Restoration Period when the sum referenced in section (ii) of this bullet is greater than MSSC,

  , Or
- Its Pre-Reporting Contingency Event ACE Value, (if its Pre-Reporting Contingency Event ACE was negative):
  - less the sum of the magnitudes of all subsequent Balancing Contingency Events that have already occurred during the Contingency Event Recovery Period, and
  - Further reduced by the magnitude of the difference between (i) the Responsible Entity's Most Severe Single Contingency (MSSC) and (ii) the sum of the magnitudes of the Reportable Balancing Contingency Event and all previous Balancing Contingency Events that have not completed their Contingency Reserve Restoration Period when the sum referenced in section (ii) of this bullet is greater than MSSC

1.1 All Reportable Balancing Contingency Events will be documented using CR Form 1.

1.2. Requirement R1 (in its entirety) does not apply when the Responsible Entity experiencing a Reportable Balancing Contingency Event is experiencing an Energy Emergency Alert Level 2 or Level 3.

1.3 Requirement R1 (in its entirety) does not apply when the Responsible Entity experiencing an Balancing Contingency Event exceeding its Most Severe Single Contingency or multiple Balancing Contingency Events whose sum exceeds its Most Severe Single Contingency within a 15 minute period for those events that occur within that 15 minute period. Requirement R1 also shall not apply to subsequent events beyond the 15 minute period but within 105 minutes of the first Balancing Contingency Event if the sum of the events exceeds the Responsible Entity's Most Severe Single Contingency.

Background and Rationale

Requirement R1 reflects the operating principles first established by NERC Policy 1. Its objective is to assure the Responsible Entity balances resources and demand and returns its Area Control Error (ACE) to defined values (subject to applicable limits) following a Reportable Balancing Contingency Event. It requires the Responsible Entity to recover from events that would be less than or equal to the Responsible Entity's MSSC. It establishes a ceiling for the amount of Contingency Reserve and timeframe the Responsible Entity must demonstrate in a compliance evaluation. It is intended to eliminate the ambiguities and questions associated with the existing standard. In addition, it allows Responsible Entities to have a clear way to demonstrate compliance and support the Interconnection to the full extent of MSSC.

By including new definitions, and modifying existing definitions, and the above R1, the drafting team believes it has successfully fulfilled the requirements of FERC Order No. 693 (at P 356) to include a Requirement that explicitly allows DSM to be used as a resource for Contingency Reserve. It also recognizes that the loss of transmission as well as generation may require the deployment of contingency reserve.

Additionally, R 1 is designed to assure the applicable entity must use reserve to cover a Reportable Balancing Contingency Event or the combination of any previous Balancing Contingency Events that have occurred within the specified period, to address the Order's concern that the applicable entity is responding to events and performance is measured. The Reportable Balancing Contingency Event definition, along with R1 allows for measurement of performance.

The drafting team used data supplied by Consortium for Electric Reliability Technology Solutions (CERTS) to help determine all events that have an impact on frequency. Data that was compiled by CERTS to provide information on measured frequency events is presented in Attachment 1. Analyzing the data, one could demonstrate events of 100 MW or greater would capture all frequency events for all interconnections. However, at a 100 MW reporting

threshold, the number of events reported would significantly increase with no reliability gain since 100 MW is more reflective of the outlying events, especially on larger interconnections.

The goal of the drafting team was to design a continent-wide standard to capture the majority of the events that impact frequency. After reviewing the data and industry comments, the drafting team elected to establish reporting threshold minimums for each respective Interconnection. This assures the requirements of the FERC Order No. 693 are met. The reportable threshold was selected as the lesser of 80% of the applicable entity(s) Most Severe Single Contingency or the following values for each respective Interconnection:

- Eastern Interconnection – 900 MW
- Western Interconnection – 500 MW
- ERCOT – 800 MW
- Quebec – 500 MW

Additionally, the drafting team only used the positive events for purposes of determining the above thresholds.

Violation Severity Levels

In the Violation Severity Levels for Requirement R1, the impact of the Responsible Entity recovering from a Reportable Balancing Contingency Event depends on the amount of its Contingency Reserve available and does it have sufficient response. The VSL takes these factors into account.

Compliance Calculation

To determine compliance with R1, the required contingency reserve response and measured contingency reserve response are computed and compared as follows (assuming all resource loss values, i.e. Balancing Contingency Events, are positive):

- The required contingency reserve response equals the lesser of the megawatt loss of the Reportable Balancing Contingency Event, and, the Most Severe Single Contingency minus the sum of the megawatt losses of any previous Balancing Contingency Events whose start preceded the start of the Reportable Balancing Contingency Event by less than the sum of the Contingency Event Recovery Period and Contingency Reserve Restoration Period.
- The measured contingency reserve response is equal to one of the following:
  - If the Pre-Reportable Contingency Event ACE Value is greater than or equal to zero, then the measured contingency reserve response equals (a) the megawatt value of the Reportable Balancing Contingency Event plus (b) the most positive ACE value within its Contingency Event Recovery Period (and following the occurrence of the last subsequent event, if any) plus (c) the sum of the megawatt losses of subsequent Balancing Contingency Events occurring within the Contingency Event Recovery Period of the Reportable Balancing Contingency Event.

- If the Pre-Reportable Contingency Event ACE Value is less than zero, then the measured contingency reserve response equals (a) the megawatt value of the Reportable Balancing Contingency Event plus (b) the most positive ACE value within its Contingency Event Recovery Period (and following the occurrence of the last subsequent event, if any) plus (c) the sum of the megawatt losses of subsequent Balancing Contingency Events occurring within the Contingency Event Recovery Period of the Reportable Balancing Contingency Event, minus (d) the Pre-Reportable Contingency Event ACE Value.

• Compliance is computed as follows on CR Form 1 in order to document all Balancing Contingency Events used in compliance determination:

- If the required contingency reserve response is less than or equal to zero, then the Reportable Balancing Contingency Event Compliance equals 100 percent.
- If the required contingency reserve response is greater than zero,
  - And the measured contingency reserve response is greater than or equal to the required contingency reserve response, then the Reportable Balancing Contingency Event Compliance equals 100 percent.
  - And the measured contingency reserve response is less than or equal to zero, then the Reportable Balancing Contingency Event Compliance equals 0 percent.
  - And the measured contingency reserve response is less than the required contingency reserve response but greater than zero, then the Reportable Balancing Contingency Event Compliance equals 100% * (1 – ((required contingency reserve response – measured contingency reserve response) / required contingency reserve response)).

The above computations can be expressed mathematically in the following 7 sequential steps, labeled as [1-7], where:

ACE_BEST – most positive ACE during the Contingency Event Recovery Period occurring after the last subsequent event, if any (MW)

ACE_PRE - Pre-Reportable Contingency Event ACE Value (MW)

COMPLIANCE - Reportable Balancing Contingency Event Compliance percentage (0 - 100%)

MEAS_CR_RESP - measured contingency reserve response for the Reportable Balancing Contingency Event (MW)

MSSC – Most Severe Single Contingency (MW)

MW_LOST - megawatt loss of the Reportable Balancing Contingency Event (MW)

REQ_CR_RESP – required contingency reserve response for the Reportable Balancing Contingency Event (MW)

SUM_PREV - sum of the megawatt losses of any previous Balancing Contingency Events whose start precedes the start of the Reportable Balancing Contingency Event by less than the sum of the Contingency Event Recovery Period and Contingency Reserve Restoration Period (MW)

SUM_SUBSQ - sum of the megawatt losses of subsequent Balancing Contingency Events occurring within the Contingency Event Recovery Period of the Reportable Balancing Contingency Event (MW)

REQ_CR_RESP = minimum of MW_LOST, and, (MSSC – SUM_PREV) **[1]**

If ACE_PRE is greater than or equal to 0, then

MEAS_CR_RESP = MW_LOST +ACE_BEST + SUM_SUBSQ **[2]**

If ACE_PRE is less than 0, then

MEAS_CR_RESP = MW_LOST +ACE_BEST + SUM_SUBSQ – ACE_PRE **[3]**

If REQ_CR_RESP is less than or equal to 0, then COMPLIANCE = 100 **[4]**

If REQ_CR_RESP is greater than 0, and,

MEAS_CR_RESP is greater than or equal to REQ_CR_RESP, then

COMPLIANCE = 100 **[5]**

If REQ_CR_RESP is greater than 0, and, MEAS_CR_RESP is less than or equal to 0, then

COMPLIANCE = 0 **[6]**

If REQ_CR_RESP is greater than 0, and, MEAS_CR_RESP is greater than 0, and,

MEAS_CR_RESP is less than REQ_CR_RESP, then

COMPLIANCE = 100 * (1 – ((REQ_CR_RESP – MEAS_CR_RESP)/ REQ_CR_RESP)) **[7]**

Requirement 2

R2. Except during the Responsible Entity's Contingency Event Recovery Period and the Responsible Entity's Contingency Reserve Restoration Period, or during an Energy Emergency Alert Level 2 or 3 for the Responsible Entity, the Responsible Entity shall maintain an amount of Contingency Reserve, averaged over each Clock Hour, at least equal to its Most Severe Single Contingency.

Background and Rationale

R2 establishes a uniform continent-wide contingency reserve requirement. R2 establishes a requirement that contingency reserve be at least equal to its Most Severe Single Contingency. By including a definition of Most Severe Single Contingency and R2, a consistent uniform continent-wide contingency reserve requirement has been established. Its goal is to assure that the Responsible Entity will have sufficient contingency reserve that can be deployed to meet R1.

FERC Order 693 (at P356) directed BAL-002 be developed as a continent-wide contingency reserve policy. R2 fulfills the requirement associated with the required amount of contingency reserve a Responsible Entity must have available to respond to a Reportable Balancing Contingency Event. Within FERC Order 693 (at P336) the Commission noted that the appropriate mix of operating reserve, spinning reserve and non-spinning reserve should be addressed. However, the Order predated the approval of the new BAL-003, which addresses frequency responsive reserve and the amount of frequency response obligation. With the development of BAL-003, and the associated reliability performance requirement, the drafting team believes that, with R2 of BAL-002 and the approval of BAL-003, the Commission's goals of a continent-wide contingency reserves policy is met. The suites of BAL standards (BAL-001, BAL-002, and BAL-003) are all performance-based. With the suite of standards and the specific requirements within each respective standard, a continent-wide contingency policy is established.

In the Violation Severity Levels for Requirement R1, the impact of the Responsible Entity recovering from a Reportable Balancing Contingency Event depends on the amount of its Contingency Reserve available and does it have sufficient response. Additionally, the drafting team understands that Responsible Entities available Contingency Reserve may vary slightly from MSSC at any time. This variability is recognized in Requirement R2 through averaging the available Contingency Reserve over each Clock Hour.

The ideal goal of maintaining an amount of Contingency Reserve to cover the Most Severe Single Contingency at all times is not necessarily in the best interest of reliability. It may have the unintended result of tying the operators' hands by removing the use of their available contingency reserve from their toolbox for other reliability issues. By allowing for the occasional use of this minimal amount of Contingency Reserve at the operators' discretion, reliability is enhanced. The SDT crafted the proposed standard to encourage the operators to use, at their discretion and within the limits set forth in the standard, their available contingency reserve to best serve reliability in real-time.

Attachment 1

NERC Interconnections 2009-2013

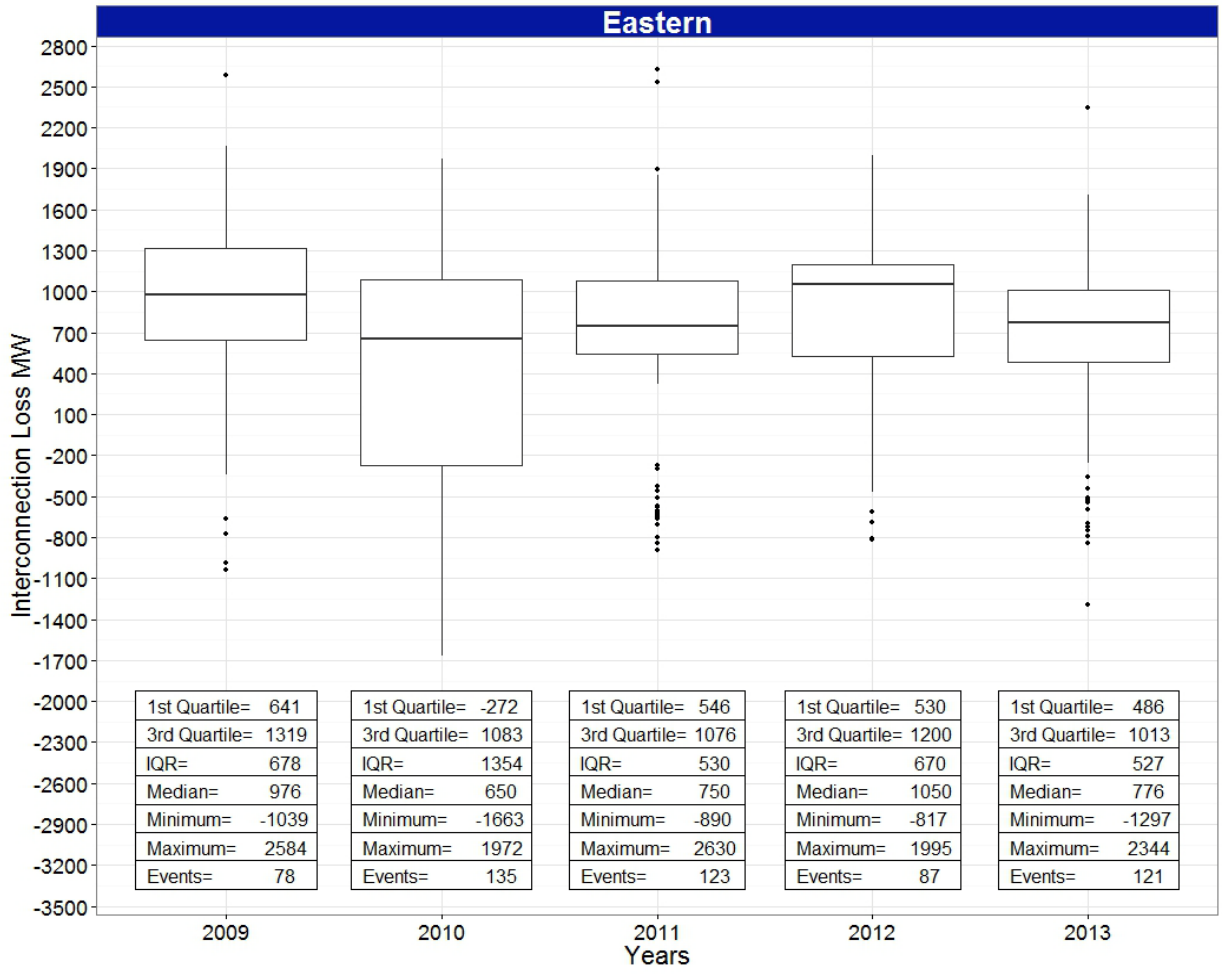
Frequency Events Loss MW Statistics

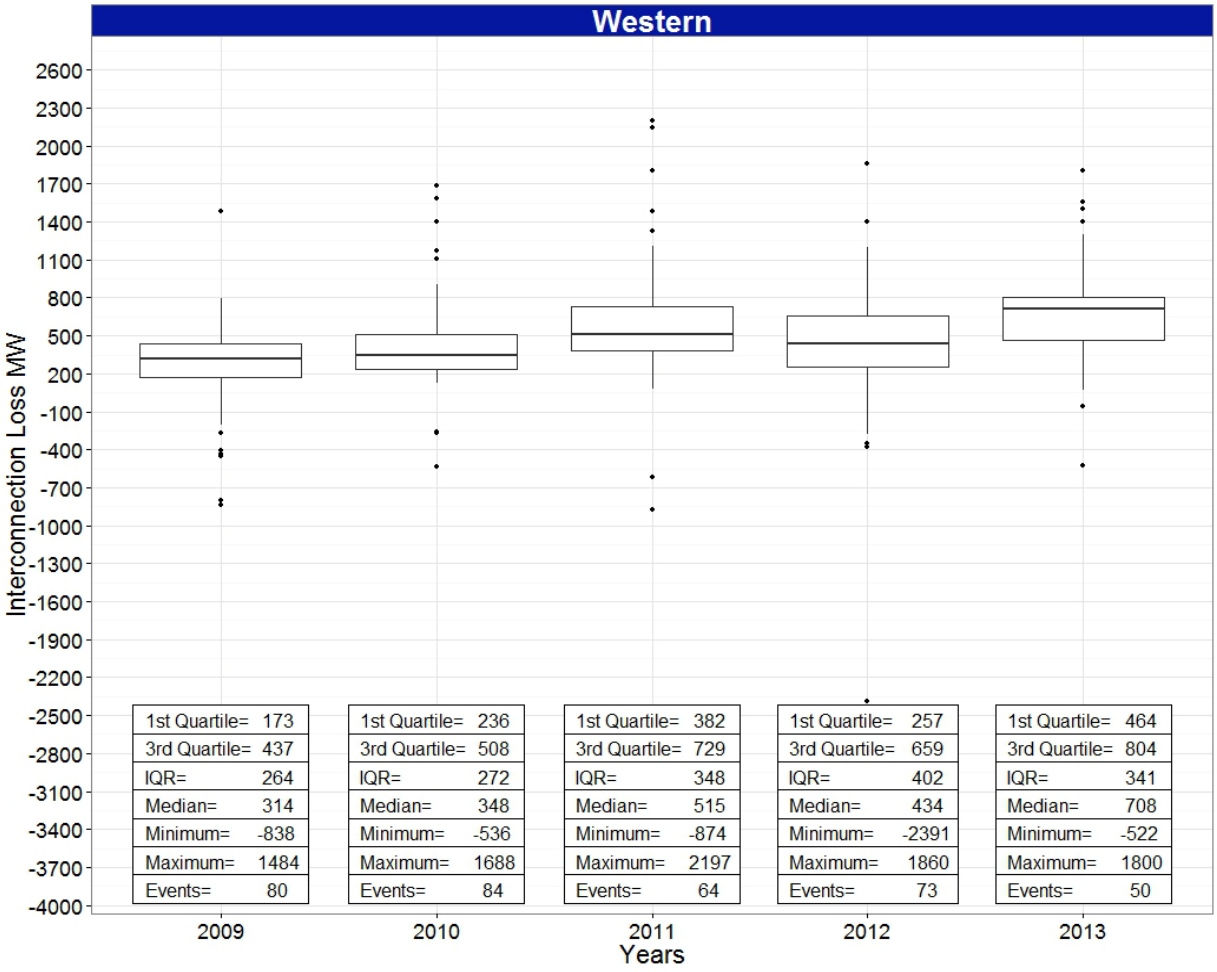
For: NERC BARC Standard Drafting Team

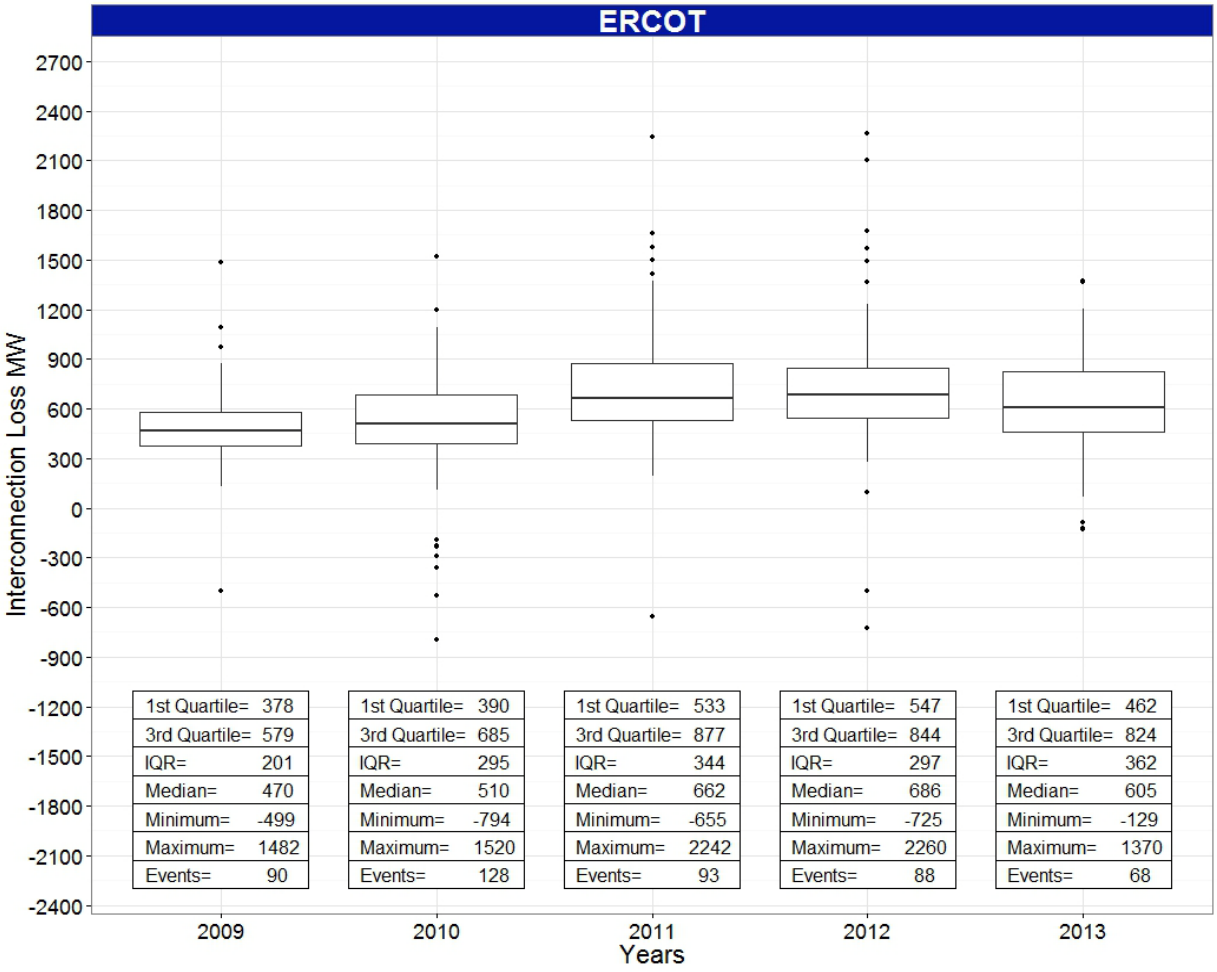
Prepared by: CERTS

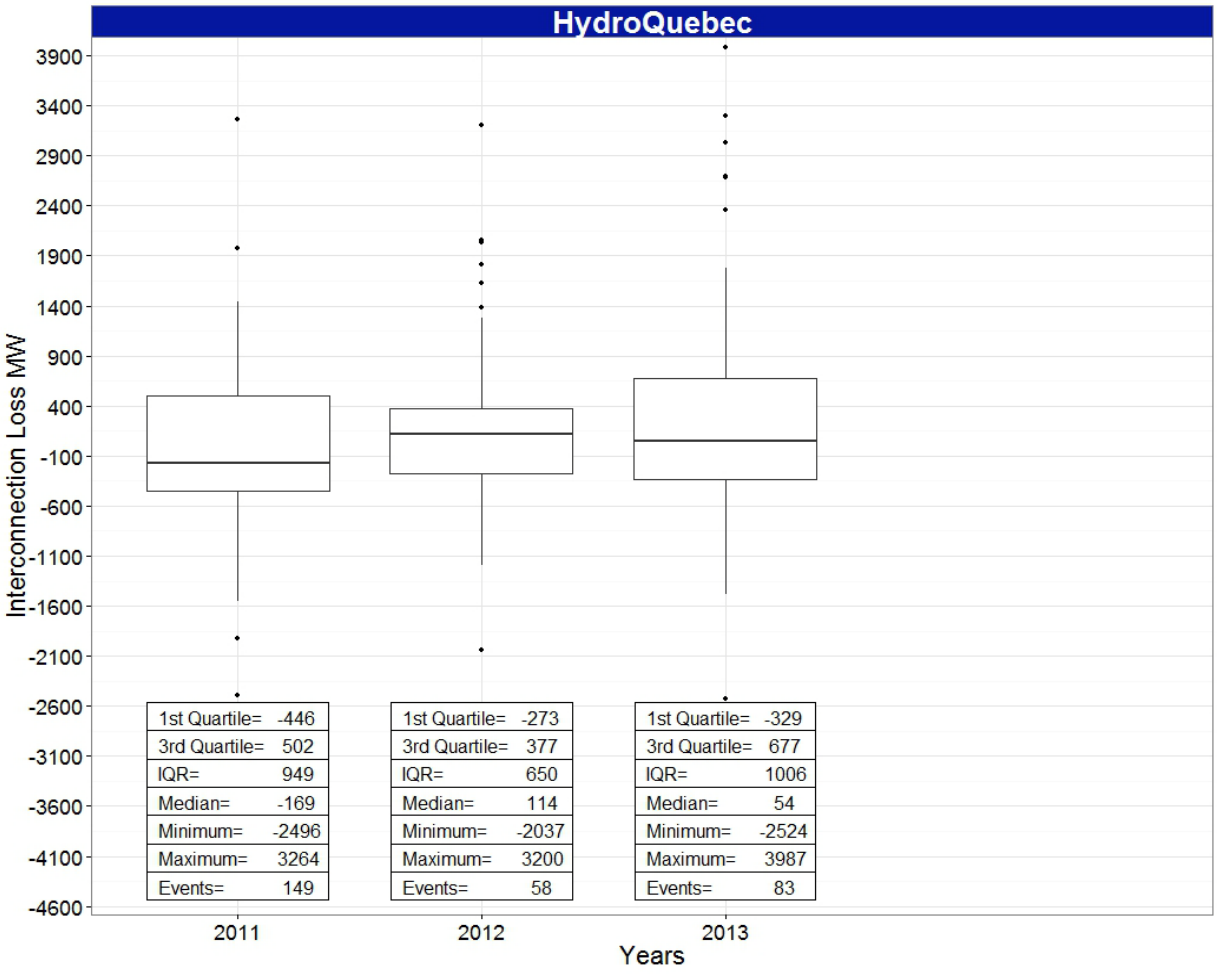
Date: October 15, 2013

CERTS
Consortium for Electric Reliability Technology Solutions


Eastern
Interconnection Loss MW
2800
2500
2200
1900
1600
1300
1000
700
400
100
-200
-500
-800
-1100
-1400
-1700
-2000
-2300
-2600
-2900
-3200
-3500
2009
2010
2011
2012
2013
Years
1st Quartile= 641
3rd Quartile= 1319
IQR= 678
Median= 976
Minimum= -1039
Maximum= 2584
Events= 78
1st Quartile= -272
3rd Quartile= 1083
IQR= 1354
Median= 650
Minimum= -1663
Maximum= 1972
Events= 135
1st Quartile= 546
3rd Quartile= 1076
IQR= 530
Median= 750
Minimum= -890
Maximum= 2630
Events= 123
1st Quartile= 530
3rd Quartile= 1200
IQR= 670
Median= 1050
Minimum= -817
Maximum= 1995
Events= 87
1st Quartile= 486
3rd Quartile= 1013
IQR= 527
Median= 776
Minimum= -1297
Maximum= 2344
Events= 121


Western
Interconnection Loss MW
2600
2300
2000
1700
1400
1100
800
500
200
-100
-400
-700
-1000
-1300
-1600
-1900
-2200
-2500
-2800
-3100
-3400
-3700
-4000
2009
2010
2011
2012
2013
Years
1st Quartile= 173
3rd Quartile= 437
IQR= 264
Median= 314
Minimum= -838
Maximum= 1484
Events= 80
1st Quartile= 236
3rd Quartile= 508
IQR= 272
Median= 348
Minimum= -536
Maximum= 1688
Events= 84
1st Quartile= 382
3rd Quartile= 729
IQR= 348
Median= 515
Minimum= -874
Maximum= 2197
Events= 64
1st Quartile= 257
3rd Quartile= 659
IQR= 402
Median= 434
Minimum= -2391
Maximum= 1860
Events= 73
1st Quartile= 464
3rd Quartile= 804
IQR= 341
Median= 708
Minimum= -522
Maximum= 1800
Events= 50


ERCOT
Interconnection Loss MW
2700
2400
2100
1800
1500
1200
900
600
300
0
-300
-600
-900
-1200
-1500
-1800
-2100
-2400
2009
2010
2011
2012
2013
Years
1st Quartile= 378
3rd Quartile= 579
IQR= 201
Median= 470
Minimum= -499
Maximum= 1482
Events= 90
1st Quartile= 390
3rd Quartile= 685
IQR= 295
Median= 510
Minimum= -794
Maximum= 1520
Events= 128
1st Quartile= 533
3rd Quartile= 877
IQR= 344
Median= 662
Minimum= -655
Maximum= 2242
Events= 93
1st Quartile= 547
3rd Quartile= 844
IQR= 297
Median= 686
Minimum= -725
Maximum= 2260
Events= 88
1st Quartile= 462
3rd Quartile= 824
IQR= 362
Median= 605
Minimum= -129
Maximum= 1370
Events= 68



No Data Available for 2009 and 2010