Policy 1 – Generation Control and Performance

Version 2

Policy Subsections

A. Control Performance Standard
B. Disturbance Control Standard
C. Frequency Response and Bias
D. Time Control Standard
E. Automatic Generation Control Standard
F. Inadvertent Interchange Standard
G. Surveys Standard

Introduction

Each CONTROL AREA shall have access to and/or operate resources to provide for a level of OPERATING RESERVE sufficient to account for frequency support, errors in load forecasting, generation loss, transmission unavailability, and regulating requirements. Sufficient OPERATING RESERVES is defined as the capacity required to meet the Control Performance Standard (Section A), Disturbance Control Standard (Section B), and Frequency Response Standard (Section C) of this Policy.

A. Control Performance Standard

[Appendix 1A, "Area Control Error (ACE) Equation"]
["Performance Standard Training Document"]

Introduction

The CONTROL AREA balance between demand and supply (generation plus INTERCHANGE) is measured by its AREA CONTROL ERROR (ACE). Because supply and demand change unpredictably, there will often be a mismatch between them, resulting in non-zero ACE.

The Control Performance Standard (CPS) establishes the statistical boundaries for ACE magnitudes, ensuring that steady-state frequency is statistically bounded around its scheduled value. Each CONTROL AREA must achieve at least the minimum performance required by the CPS. CPS1 defines the permissible distribution of all CONTROL AREAS' ACEs in an INTERCONNECTION and is based on expected frequency performance within that individual INTERCONNECTION. CPS2 limits the magnitude of the impact that a CONTROL AREA places on its respective INTERCONNECTION. Values controlling the effects of CPS are set by the Resources Subcommittee.

1. Monitoring. Each CONTROL AREA shall monitor its control performance against two Standards: CPS1 and CPS2.

1.1. Control Performance Standard (CPS1). On a rolling 12-month basis, the average of the clock-minute averages of a CONTROL AREA'S ACE divided by 10B (B is the clock-minute average of the CONTROL AREA'S frequency bias) times the corresponding clock-minute averages of the INTERCONNECTION'S FREQUENCY ERROR shall be less than a

$$AVG_{Period}\left[\left(\frac{ACE_i}{-10B_i}\right)_1 * \Delta F_1\right] \le \in_1^2 \; or \; \frac{AVG_{Period}\left[\left(\frac{ACE_i}{-10B_i}\right)_1 * \Delta F_1\right]}{\in_1^2} \le 1$$

specific limit. This limit $\in_1^2$ is a constant derived from a targeted frequency bound (separately calculated for each INTERCONNECTION) reviewed and set as necessary by the NERC Resources Subcommittee. [See the "**Performance Standard Training Document"** for application for variable frequency bias.]

1.2. Control Performance Standard (CPS2). The average ACE for at least 90% of clock-ten-minute periods (6 non-overlapping periods per hour) during a calendar month must be within a specific limit, referred to as L_{10}. [See the "**Performance Standard Training Document**," for the methods for calculating L_{10}.]

$$AVG_{10-\text{minute}}(ACE_i) \le L_{10}$$

where:

$$L_{10} = 1.65 \in_{10} \sqrt{(-10B_i)(-10B_s)}$$

$\in_{10}$ is a constant derived from the targeted frequency bound. It is the targeted RMS of ten-minute average frequency error from schedule based on frequency performance over a given year. The bound, $\in_{10}$, is the same for every control area within an Interconnection,

2. Control Performance Standard (CPS) Compliance. Each CONTROL AREA shall achieve, as a minimum, CPS1 compliance of 100% and CPS2 compliance of 90% [See the "**Performance Standard Training Document," Section C**].

2.1. CONTROL AREAS Participating in SUPPLEMENTAL REGULATION SERVICE**.** A CONTROL AREA providing or receiving SUPPLEMENTAL REGULATION SERVICE through DYNAMIC TRANSFER shall continue to be evaluated on the characteristics of its own ACE with the SUPPLEMENTAL REGULATION SERVICE included.

2.2. CONTROL AREAS Providing OVERLAP REGULATION SERVICE. A CONTROL AREA providing OVERLAP REGULATION SERVICE shall evaluate CPS1 and CPS2 using the characteristics of the combined CONTROL AREAS' ACE and combined FREQUENCY BIAS SETTINGS.

2.3. CONTROL AREAS Receiving OVERLAP REGULATION SERVICE. A CONTROL AREA receiving OVERLAP REGULATION SERVICE shall not have its control performance evaluated (i.e. from a control performance perspective, the CONTROL AREA has shifted all control requirements to the CONTROL AREA providing overlap regulation).

B. Disturbance Control Standard

[Appendix 1A – Area Control Error Equation]
[Performance Standard Training Document]

Introduction

The CONTROL AREA demand-supply balance will quickly change following the sudden loss of load or generation failure. This results in a sudden change in the CONTROL AREA'S ACE, and also a change in INTERCONNECTION frequency. The Disturbance Control Standard measures the CONTROL AREA'S ability to utilize its CONTINGENCY RESERVES following a REPORTABLE DISTURBANCE. Because generator failures are far more common than significant losses of load and because CONTINGENCY RESERVE activation does not typically apply to the loss of load, the application of the Disturbance Control Standard is limited to the loss of supply and does not apply to the loss of load.

Each CONTROL AREA shall have access to and/or operate resources to provide for a level of CONTINGENCY RESERVE sufficient to meet the DCS performance standards.

RESERVE SHARING GROUPS shall have the same responsibilities and meet the same obligations as individual CONTROL AREAS with regards to monitoring and meeting the Disturbance Control Standard.

Standards

1. **CONTINGENCY RESERVES**. Each CONTROL AREA shall have access to and/or operate CONTINGENCY RESERVES to respond to DISTURBANCES. This CONTINGENCY RESERVE is that part of the OPERATING RESERVES that is available, following loss of resources by the CONTROL AREA, to meet the Disturbance Control Standard (DCS). CONTINGENCY RESERVE may be supplied from generation, controllable load resources, or coordinated adjustments to INTERCHANGE SCHEDULES.

1.1. **CONTINGENCY RESERVE Accounting.** The same portion of RESOURCE CAPACITY shall not be counted by more than one entity (e.g. reserves from jointly owned generation) as part of its CONTINGENCY RESERVES.

1.2. **REGIONAL CONTINGENCY RESERVE Policies.** Each Region, subregion or RESERVE SHARING GROUP shall specify its CONTINGENCY RESERVE policies, including the minimum reserve requirement for the group, its allocation among members, the permissible mix of OPERATING RESERVE – SPINNING and OPERATING RESERVE – SUPPLEMENTAL that may be included in CONTINGENCY RESERVE, and the procedure for applying CONTINGENCY RESERVE in practice, and the limitations, if any, upon the amount of interruptible load that may be included.

2. **CONTINGENCY RESERVE to meet Disturbance Control Standard**. Each CONTROL AREA or RESERVE SHARING GROUP shall activate sufficient CONTINGENCY RESERVE to comply with the NERC Disturbance Control Standard. As a minimum the CONTROL AREA, or RESERVE SHARING GROUP, shall carry at least enough CONTINGENCY RESERVES to cover the MOST SEVERE SINGLE CONTINGENCY.

2.1. **Contingency review.** All RESERVE SHARING GROUPS and CONTROL AREAS shall at least annually review their probable contingencies to determine their prospective MOST SEVERE SINGLE CONTINGENCIES.

2.2. **Disturbance Control Standard Compliance.** When a CONTROL AREA or RESERVE SHARING GROUP experiences a REPORTABLE DISTURBANCE (SEE 2.4), it is compliant

with the Disturbance Control Standard when the DISTURBANCE RECOVERY CRITERION is met within the DISTURBANCE RECOVERY PERIOD. Each CONTROL AREA or RESERVE SHARING GROUP shall meet the Disturbance Control Standard (DCS) 100% of the time for REPORTABLE DISTURBANCES.

2.2.1. DISTURBANCE RECOVERY CRITERION. The CONTROL AREA shall return its ACE to zero if its ACE just prior to the DISTURBANCE was positive or equal to zero. For negative initial ACE values just prior to the DISTURBANCE, the ACE must return to its pre-disturbance value. The default performance criterion described above may be adjusted to better suit the needs of an INTERCONNECTION based on analysis approved by the NERC Resources Subcommittee and the NERC Operating Committee.

2.2.2. DISTURBANCE RECOVERY PERIOD. The default DISTURBANCE RECOVERY PERIOD is 15 minutes after the start of a REPORTABLE DISTURBANCE. This period may be adjusted to better suit the needs of an INTERCONNECTION based on analysis approved by the NERC Resources Subcommittee and the NERC Operating Committee.

2.3. RESERVE SHARING GROUP. Each RESERVE SHARING GROUP shall comply with the Disturbance Control Standard. A RESERVE SHARING GROUP shall be considered in a DISTURBANCE condition whenever a group member has experienced a REPORTABLE DISTURBANCE and calls for the activation of CONTINGENCY RESERVES from one or more other group members. (If a group member has experienced a REPORTABLE DISTURBANCE condition but does not call for reserve activation from other members of the RESERVE SHARING GROUP, then that member shall report as a single CONTROL AREA.) Compliance may be demonstrated by either of the following two methods:

2.3.1. Group compliance to Disturbance Control Standard. The RESERVE SHARING GROUP reviews group ACE (or equivalent) and demonstrates compliance to the DCS. To be in compliance, the group ACE (or its equivalent) must meet the DISTURBANCE RECOVERY CRITERION after the schedule change(s) related to reserve sharing have been fully implemented, and within the DISTURBANCE RECOVERY PERIOD.

2.3.2. Group member compliance to Disturbance Control Standard. The RESERVE SHARING GROUP reviews each member's ACE in response to the activation of reserves. To be in compliance, a member's ACE (or its equivalent) must meet the DISTURBANCE RECOVERY CRITERION after the schedule change(s) related to reserve sharing have been fully implemented, and within the DISTURBANCE RECOVERY PERIOD. [See Requirement 2.2.2 above.]

2.4. Reportable Disturbances. REPORTABLE DISTURBANCES are contingencies that are greater than or equal to 80% of the MOST SEVERE SINGLE CONTINGENCY loss. Regions may optionally reduce the 80% threshold, provided that normal operating characteristics are not being considered or misrepresented as contingencies. Normal operating characteristics are excluded because DCS only measures the recovery from sudden, unanticipated losses of supply-side resources.

2.5. Treatment of Multiple Contingencies.

2.5.1. Simultaneous Contingencies. Multiple contingencies occurring within one minute or less of each other shall be treated as a single contingency. If the combined magnitude of the multiple contingencies exceeds the MOST SEVERE

SINGLE CONTINGENCY, the loss shall be reported, but excluded from compliance evaluation.

2.5.2. Multiple Contingencies within the REPORTABLE DISTURBANCE period. Additional contingencies that occur after one minute of the start of a Reportable Disturbance but before the end of the DISTURBANCE RECOVERY PERIOD can be excluded from evaluation. The CONTROL AREA or RESERVE SHARING GROUP shall determine the DCS compliance of the initial REPORTABLE DISTURBANCE by performing a reasonable estimation of the response that would have occurred had the second and subsequent contingencies not occurred.

2.5.3. Multiple Contingencies within the CONTINGENCY RESERVE RESTORATION PERIOD. Additional Reportable Disturbances that occur after the end of the DISTURBANCE RECOVERY PERIOD but before the end of the CONTINGENCY RESERVE RESTORATION Period shall be reported and included in the compliance evaluation. However, the CONTROL AREA or RESERVE SHARING GROUP can request a waiver from the Resources Subcommittee for the event if the contingency reserves were rendered inadequate by prior contingencies and a good faith effort to replace contingency reserve can be shown.

3. Restoration of Reserves. Each Control Area must fully restore its CONTINGENCY RESERVES within the CONTINGENCY RESERVE RESTORATION PERIOD for its INTERCONNECTION.

3.1. Start of CONTINGENCY RESERVE RESTORATION PERIOD. The CONTINGENCY RESERVE RESTORATION PERIOD begins at the end of the DISTURBANCE RECOVERY PERIOD.

3.2. CONTINGENCY RESERVE RESTORATION PERIOD. The CONTROL AREA or RESERVE SHARING GROUP shall restore its CONTINGENCY RESERVES within 90 minutes. This period may be adjusted to better suit the reliability targets of the INTERCONNECTION based on analysis approved by the NERC Resources Subcommittee.

4. Disturbance Control Performance Adjustment. Each CONTROL AREA or RESERVE SHARING GROUP *not meeting the Disturbance Control Standard* during a given calendar quarter shall increase its CONTINGENCY RESERVE obligation for the calendar quarter (offset by one month) following the evaluation by the Region and/or the NERC Resources Subcommittee. [e.g. For the first calendar quarter of the year, the penalty is applied for May, June, and July.] The increase shall be directly proportional to the non-compliance with the Disturbance Control Standard in the preceding quarter. This adjustment is not compounded across quarters, and is an additional percentage of reserve needed beyond the MOST SEVERE SINGLE CONTINGENCY. A RESERVE SHARING GROUP may choose an allocation method for increasing its CONTINGENCY RESERVE for the RESERVE SHARING GROUP provided that this increase is fully allocated. [See the "**Performance Standard Training Document**," Section C.]

5. Reserve Policy Compliance Documentation. A representative from each CONTROL AREA or RESERVE SHARING GROUP that was non-compliant in the calendar quarter most recently completed shall provide written documentation verifying that the CONTROL AREA or RESERVE SHARING GROUP will apply the appropriate Disturbance Control Performance Adjustment beginning the first day of the succeeding month, and will continue to apply it for three months. The written documentation shall accompany the quarterly Disturbance Control Standard Report when a CONTROL AREA or RESERVE SHARING GROUP is non-compliant.

C. Frequency Response and Bias

[Appendix 1A – The Area Control Error (ACE) Equation]
[Frequency Response Characteristic Survey Training Document]

Requirements

1. Bias setting review. Each CONTROL AREA shall review its FREQUENCY BIAS SETTINGS by January 1 of each year and recalculate its setting to reflect any change in area frequency response characteristic.

1.1. Bias setting method. The FREQUENCY BIAS SETTING, and the method used to determine the setting, may be changed whenever any of the factors used to determine the current bias value change.

1.2. Bias setting reporting. Each CONTROL AREA shall report its FREQUENCY BIAS SETTING, and method for determining that setting, to the Performance Subcommittee.

1.3. Bias setting verification. Each CONTROL AREA must be able to demonstrate and verify to the Performance Subcommittee that its FREQUENCY BIAS SETTING closely matches or is greater than its system response.

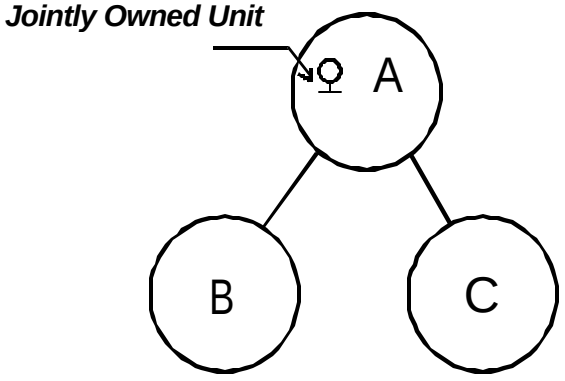
Standards

1. Tie-line bias. Each CONTROL AREA shall operate its AGC on tie-line frequency bias, unless such operation is adverse to system or INTERCONNECTION reliability. The Standards for tie-line bias control follow:

1.1. Bias setting to match frequency response. The CONTROL AREA shall set its frequency bias (expressed in MW/0.1 Hz) as close as practical to the CONTROL AREA's frequency response characteristic. Frequency bias may be calculated several ways:

1.1.1. Fixed bias setting. A fixed frequency bias value may be used which is based on a fixed, straight-line function of tie-line deviation versus frequency deviation. The fixed value shall be determined by observing and averaging the frequency response characteristic for several DISTURBANCES during on-peak hours.

1.1.2. Variable bias setting. A variable (linear or non-linear) bias value may be used which is based on a variable function of tie-line deviation to frequency deviation. The variable frequency bias value shall be determined by analyzing frequency response as it varies with factors such as LOAD, generation, governor characteristics, and frequency.



1.1.3. Bias and jointly owned generation. CONTROL AREAs that use DYNAMIC SCHEDULING or PSEUDO-TIES for jointly owned units must reflect their respective share of the unit governor droop response into their respective FREQUENCY BIAS SETTING. Fixed schedules for JOINTLY OWNED UNITS mandate that the CONTROL AREA (A) that contains the JOINTLY OWNED UNIT must incorporate the respective share of the unit governor droop response for any CONTROL AREAs that have fixed schedules (B and C). The CONTROL AREAs that have a fixed schedule (B and C) but do not contain the JOINTLY

OWNED UNIT should *not* include their share of the governor droop response in their FREQUENCY BIAS SETTING.

1.1.4. Minimum bias setting for CONTROL AREAS that serve native LOAD. The CONTROL AREA'S monthly average FREQUENCY BIAS SETTING must be at least 1% of the CONTROL AREA'S estimated yearly peak demand per 0.1 Hz change as described in the Frequency Response Characteristic Survey Training Document.

1.1.5. Minimum bias setting for CONTROL AREAS that do not serve native LOAD. The CONTROL AREA'S monthly average FREQUENCY BIAS SETTING must be at least 1% of its estimated maximum generation level in the coming year per 0.1 Hz change as described in the Frequency Response Characteristic Survey Training Document.

1.1.6. Bias and overlap regulation. A CONTROL AREA that is performing OVERLAP REGULATION SERVICE will increase its FREQUENCY BIAS SETTING to match the frequency response of the entire area being controlled. A CONTROL AREA that is performing SUPPLEMENTAL REGULATION SERVICE shall not change its FREQUENCY BIAS SETTING.

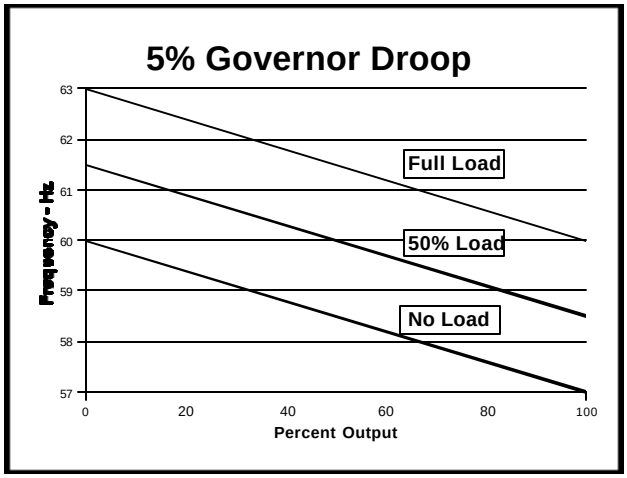
Guides

1. **Governor installation.** Generating units with nameplate ratings of 10 MW or greater should be equipped with governors operational for frequency response unless restricted by regulatory mandates

2. **Governors free to respond.** Turbine governors and HVDC controls, where applicable, should be allowed to respond to system frequency deviation, unless there is a temporary operating problem.

3. **Governor droop.** All turbine generators equipped with governors should be capable of providing immediate and sustained response to abnormal frequency excursions. Governors should provide a 5% droop characteristic. Governors should, as a minimum, be fully responsive to frequency deviations exceeding ± 0.036 Hz (± 36 mHZ).

4. **Governor limits.** Turbine control systems that provide adjustable limits to governor valve movement (valve position limit or equivalent) should not restrict travel more than necessary to coordinate boiler and turbine response characteristics



Graph showing relation between generator output and Interconnection frequency at 0, 50%, and 100% LOAD for a 5% governor droop characteristic.

D. Time Control Standard

[Appendix 1A — The Area Control Error Equation]
[Appendix 1D — Time Error Correction Procedures]

Introduction

INTERCONNECTION frequency is normally scheduled at 60.00 Hz and controlled to that value. The control is imperfect and over time the frequency will average slightly above or below 60.00 Hz resulting in electric clocks developing an error relative to true time. When the error exceeds pre-set limits, corrective action is taken by adjusting the scheduled frequency, a practice termed Time Error Correction. Each CONTROL AREA shall participate in Interconnection Time Error Correction procedures unless it is operating asynchronously to its INTERCONNECTION.

CONTROL AREA s operating asynchronously may establish their own time error control bands, but must notify the NERC Resources Subcommittee of the bands being utilized, and also provide notification if they are changed.

The Operating Reliability Subcommittee shall designate, on February 1st of each year, a RELIABILITY COORDINATOR to act as the Interconnection Time Monitor to monitor time error for each of the INTERCONNECTIONS and to issue time error correction orders.

Standard

1. **Time error correction notice and commencement.** Time error corrections shall be conducted in accordance with Appendix 1D, "Time Error Correction Procedure."

2. **Time Error Initiation.** Time error corrections will start and end on the hour or half-hour, and notice shall be given at least one hour before the time error correction is to start or stop. All CONTROL AREAS within an INTERCONNECTION shall make all Time Error corrections directed by the Interconnection Time Monitor for its INTERCONNECTION. All CONTROL AREAS within an INTERCONNECTION shall make Time Error Corrections at the same rate.

Requirements

1. **Interconnection Time Monitor.** Each Interconnection Time Monitor shall monitor time error and shall initiate or terminate corrective action orders according to the procedure specified in Appendix 1D, "Time Error Correction Procedure."

2. **Time Error Correction labeling.** Time error correction notifications shall be labeled alphabetically on a monthly basis (A-Z, AA-AZ, BA-BZ,…).

3. **Time correction offset.** The CONTROL AREA may participate in a Time Error Correction by either of the following two methods:

    1.1. **Frequency offset.** The Control Area may offset its frequency schedule by 0.02 Hz, leaving the FREQUENCY BIAS SETTING normal, or

    1.2. **Schedule offset.** If the frequency schedule cannot be offset, the CONTROL AREA may offset its net INTERCHANGE schedule (MW) by an amount equal to the computed bias contribution during a 0.02 Hz frequency deviation (i.e., 20% of the FREQUENCY BIAS SETTING).

4. Request for Termination or Halt of Scheduled Time Error Correction. Any RELIABILITY COORDINATOR in an INTERCONNECTION may request the termination of a time error correction in progress. Any RELIABILITY COORDINATOR may request the halt of a scheduled time error correction that has not begun. CONTROL AREAs that have reliability concerns with the execution of a time error correction shall notify their RELIABILITY COORDINATOR and request the termination of a time error correction in progress. To enable NERC to track the results of the application of procedures relating to Time Control Standards, a RELIABILITY COORDINATOR requesting a termination or halt of a Time Error Correction shall forward an explanation for requesting the termination to the chairman of the Resources Subcommittee within 5 business days.

5. INTERCONNECTION time error notification. The INTERCONNECTION Time Monitor shall on the first day of each month issue a notification of time error, accurate to within 0.01 second, to the other RELIABILITY COORDINATORS within the INTERCONNECTION to assure uniform calibration of time standards.

5.1. Western INTERCONNECTION time error notification. Within the Western INTERCONNECTION, the RELIABILITY COORDINATOR designated as the Interconnection Time Monitor shall provide the accumulated time error (accurate to within 0.001 second) to all CONTROL AREAS on a daily basis at 1400 PDT/PST using the WSCCNet. The alphabetic designator shall accompany time error notification if a time error correction is in progress.

6. Time correction on reconnection. When one or more CONTROL AREAs have been separated from the INTERCONNECTION, upon reconnection, they shall adjust their time error devices to coincide with the time error of the INTERCONNECTION. A notification of the adjustment to time error shall be passed through Time Notification Channels as soon as possible after reconnection.

7. Leap seconds. CONTROL AREAS using time error devices that are not capable of automatically adjusting for leap seconds shall arrange to receive advance notice of the leap second and make the necessary manual adjustment in a manner that will not introduce an improper INTERCHANGE SCHEDULE into their control system.

E. Automatic Generation Control Standard

[Appendix 1A – The Area Control Error (ACE) Equation]
[Performance Standard Training Document]

Introduction

CONTROL AREAS utilize AUTOMATIC GENERATION CONTROL (AGC) to automatically direct the loading of REGULATING RESERVE. AGC is used to limit the magnitude of AREA CONTROL ERROR (ACE) variations to the CPS bounds. This section contains Standards that apply to the CONTROL AREA AGC needed to calculate ACE and to routinely deploy the REGULATING RESERVE.

1. CONTROL AREA components. All load, generation, and transmission operating in an INTERCONNECTION must be included within the metered boundaries of a CONTROL AREA.

2. Resource Requirements

2.1. Regulating capability. Each CONTROL AREA shall maintain REGULATING RESERVES that can be controlled by AGC to meet the Control Performance Standard (CPS).

2.2. Regulation Service.

2.2.1. Equipment Requirements. A CONTROL AREA providing REGULATION SERVICE shall ensure that adequate metering, communications and control equipment is employed to prevent such service from becoming a burden on the INTERCONNECTION or other CONTROL AREAS.

2.2.2. Failure Notification. A CONTROL AREA providing REGULATION SERVICE shall notify the host CONTROL AREA for whom it is controlling if it is unable to provide the service, as well as any INTERMEDIARY CONTROL AREAS.

2.2.3. Backup. A CONTROL AREA receiving REGULATION SERVICE shall ensure that backup plans are in place to provide replacement REGULATION SERVICE should the supplying CONTROL AREA no longer be able to provide this service.

3. AUTOMATIC GENERATION CONTROL (AGC).

3.1. AGC calculation. The CONTROL AREA'S AUTOMATIC GENERATION CONTROL (AGC) shall compare total NET ACTUAL INTERCHANGE to total NET SCHEDULED INTERCHANGE plus frequency bias obligation to determine the CONTROL AREA'S AREA CONTROL ERROR (ACE). Single CONTROL AREAS operating asynchronously may employ alternative ACE calculations such as (but not limited to) flat frequency control. If a CONTROL AREA is unable to calculate ACE for more than 30 minutes it shall notify its RELIABILITY COORDINATOR.

3.2. AGC operation. CONTROL AREA AGC shall remain in operation unless such operation adversely impacts the reliability of the INTERCONNECTION.

3.3. Manual control. If AGC has become inoperative, the CONTROL AREA shall use manual control to adjust generation to maintain scheduled INTERCHANGE.

4. Data Requirements.

4.1. Data scan rates for ACE. The Control Area shall ensure that data-acquisition for and calculation of ACE occur at least every six seconds.

4.2. Frequency. Each CONTROL AREA shall provide redundant and independent frequency metering equipment that shall automatically activate upon detection of failure of the primary source. This overall installation shall provide a minimum availability of 99.95%.

4.3. NET SCHEDULED INTERCHANGE.[1]

4.3.1. Inclusion of Schedules. The CONTROL AREA shall include all INTERCHANGE SCHEDULES with ADJACENT CONTROL AREAS in the calculation of NET SCHEDULED INTERCHANGE for the AREA CONTROL ERROR (ACE) equation.

4.3.1.1. CONTROL AREAS with an HVDC link to another CONTROL AREA connected asynchronously to their INTERCONNECTION may choose to omit the INTERCHANGE SCHEDULE related to the HVDC link from the ACE equation if it is modeled as internal generation or load.

4.3.1.2. This standard may not apply to CONTROL AREAS operating asynchronously from their INTERCONNECTION.

4.3.2. Dynamic Schedules. The CONTROL AREA shall include all Dynamic Schedules in the calculation of NET SCHEDULED INTERCHANGE for the ACE equation. (See **Appendix 1A, "Area Control Error (ACE) Equation").**

4.3.3. Interchange Ramps. SCHEDULED INTERCHANGE values used in ACE shall include the effect of ramp rates, which are identical and agreed to between affected CONTROL AREA s. All such calculations shall conform to specifications in **Policy 3, "Interchange", Section C, "Interchange Schedule Standards."**

4.4. Actual Net Interchange.[2]

4.4.1. Tie flows. All tie-line flows between ADJACENT CONTROL AREAS shall be included in each CONTROL AREA 's ACE calculation.

4.4.2. Tie-line metering. CONTROL AREA tie-line MW metering shall be telemetered to both control centers, and shall emanate from a common, agreed-upon source using common primary metering equipment. MWh data shall be telemetered or reported at the end of each hour.

4.4.3. Data filtering. The power flow and ACE signals that are utilized for calculation of CONTROL AREA performance or that are transmitted for REGULATION SERVICE shall not be filtered prior to transmission except for anti-aliasing filtering of tie lines.

4.4.4. Metering for jointly owned generation. Common metering equipment shall be installed where DYNAMIC SCHEDULES or PSEUDO-TIES are implemented between two or more CONTROL AREAS to deliver the output of JOINTLY OWNED UNITS or to serve remote LOAD.

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[1] Interchange is *scheduled* between ADJACENT CONTROL AREAS as explained in the "Interchange Reference Document." ADJACENT CONTROL AREAS may or may not be *physically* adjacent.

[2] Actual Interchange is always measured between PHYSICALLY ADJACENT CONTROL AREAS as explained in the "Interchange Reference Document."

4.5. Verification of Tie Flows

4.5.1. Hourly verification of tie flows. Each CONTROL AREA shall perform hourly error checks using tie-line MWh meters with common time synchronization to determine the accuracy of its control equipment.

4.5.2. Adjustments for equipment error. The CONTROL AREA shall adjust the component (e.g., tie line meter) of ACE that is in error (if known) or use the interchange meter error (I_{ME}) term of the ACE equation to compensate for any equipment error until repairs can be made.

4.6. Data Recording and Display.

4.6.1. Minimum data recording. The CONTROL AREA shall provide its SYSTEM OPERATORS with sufficient instrumentation and data recording equipment to facilitate monitoring of control performance, generation response, and after-the-fact analysis of area performance. As a minimum, the CONTROL AREA must provide its SYSTEM OPERATORS with real-time values for AREA CONTROL ERROR (ACE), INTERCONNECTION frequency and NET ACTUAL INTERCHANGE with each ADJACENT CONTROL AREA.

4.6.2. Backup power for data recording. The CONTROL AREA shall provide adequate and reliable backup power supplies and shall periodically test these supplies at the CONTROL AREA'S control center and other critical locations to ensure continuous operation of AGC and vital data recording equipment during loss of the normal power supply.

4.7. Data Quality. The CONTROL AREA shall ensure data quality:

4.7.1. Data Integrity. Data shall be sampled at least at the same periodicity with which ACE is calculated.

4.7.2. Missing or bad data. Missing or bad data shall be flagged for operator display and archival purposes.

4.7.3. Coincident Data Sampling. Collected data shall be coincident to the greatest practical extent; i.e., ACE, INTERCONNECTION frequency, net interchange, and other data (see section 4.8.1) shall all be sampled at the same time.

4.7.4. Data Accuracy. Control performance and reliable operation is affected by the accuracy of the measuring devices. The required minimum values for measuring devices are listed below:

Device	*Accuracy*	*Units*
Digital frequency transducer	≤ 0.001	Hz
MW, MVAR, and voltage transducer	≤ 0.25	% of full scale
Remote terminal unit	≤ 0.25	
Potential transformer	≤ 0.30	
Current transformer	≤ 0.50	

4.8. Data Retention.

4.8.1. Performance Standard Data. Each CONTROL AREA shall retain its ACE, actual frequency, SCHEDULED FREQUENCY, NET ACTUAL INTERCHANGE, NET SCHEDULED INTERCHANGE, tie-line meter error correction and FREQUENCY BIAS SETTING data in digital format at the same scan rate at which the data is collected for at least one year.

4.8.2. Disturbance Control Performance Data. Each CONTROL AREA or RESERVE SHARING GROUP shall retain documentation of the magnitude of each REPORTABLE DISTURBANCE as well as the ACE charts and/or samples used to calculate the CONTROL AREA'S or RESERVE SHARING GROUP'S disturbance recovery values. The data shall be retained for one year following the reporting quarter for which the data was recorded.

4.8.3. Data Format. CONTROL AREAs shall be prepared to supply data to NERC in the industry standard format (defined below):

4.8.3.1. CPS source data in daily CSV files with time stamped one minute averages of: 1) ACE and 2) Frequency Deviation from Schedule, will be provided to NERC or the Regions within one week upon request.

4.8.3.2. DCS source data will be supplied in CSV files with time stamped scan rate values for: 1) ACE and 2) Frequency Deviation from Schedule for a time period, from two minute prior to thirty minutes after the identified disturbance, will be provided to NERC or the Regions within one week upon request.

4.8.3.3. Other data (as defined in **Requirement 4.8.1, "Performance Standard Data"**) may be requested on an ad hoc basis by NERC and the Regions.

4.8.3.4. A sample of the specific file format and naming convention required can be found on the NERC Resources Subcommittee web page.

5. Calibration of measurement devices. Each CONTROL AREA shall at least annually check and calibrate its time error and frequency devices against a common reference.

F. Inadvertent Interchange Standard

[Appendix 1F, "Inadvertent Interchange Dispute Resolution Process and Error Adjustment Procedures"]
["Inadvertent Interchange Accounting Training Document"]
[Policy 3, "Introduction"]

Introduction

INADVERTENT INTERCHANGE provides a measure of non-scheduled INTERCHANGE and bilaterally scheduled inadvertent payback. These transfers are caused by such factors as CONTROL AREA regulation and frequency response, metering errors in frequency and/or interchange measurements (either scheduled or actual), unilateral INADVERTENT INTERCHANGE payback and human errors.

The INADVERTENT INTERCHANGE Standard defines a process for monitoring CONTROL AREAS to help ensure that, over the long term, the CONTROL AREAS do not excessively depend on other CONTROL AREAS in the INTERCONNECTION for meeting their demand or INTERCHANGE obligations.

Each CONTROL AREA shall, through daily INTERCHANGE SCHEDULE verification and the use of reliable metering equipment, accurately account for INADVERTENT INTERCHANGE. Each CONTROL AREA shall actively prevent unintentional INADVERTENT INTERCHANGE accumulation due to poor control. Each CONTROL AREA shall also be diligent in reducing accumulated inadvertent balances in accordance with Operating Policies.

Standards

1. **INADVERTENT INTERCHANGE calculation.** INADVERTENT INTERCHANGE shall be calculated and recorded hourly. INADVERTENT INTERCHANGE may accumulate as energy into or out of the CONTROL AREA.

2. **Including all interconnections.** Each CONTROL AREA shall include all AC tie lines that connect to its physically ADJACENT CONTROL AREAS in its INADVERTENT INTERCHANGE account. Interchange served through jointly owned facilities must be properly taken into account.

3. **Metering requirements.** All CONTROL AREA INTERCONNECTION points shall be equipped with common MWh meters, with readings provided hourly to the control centers of both ADJACENT CONTROL AREAS.

4. **INADVERTENT INTERCHANGE Accounting.** ADJACENT CONTROL AREAS shall operate to a common NET INTERCHANGE SCHEDULE and ACTUAL NET INTERCHANGE value and shall record these hourly quantities, with like values but opposite sign. Each CONTROL AREA shall compute its INADVERTENT INTERCHANGE based on the following:

4.1. **Daily accounting**. Each CONTROL AREA, by the end of the next business day, shall agree with its adjacent CONTROL AREAS to:

4.1.1. The hourly values of NET INTERCHANGE SCHEDULE.

4.1.2. The hourly integrated MWh values of NET ACTUAL INTERCHANGE

4.2. **Monthly accounting**. Each CONTROL AREA shall use the agreed-to Daily and Monthly accounting data to compile its monthly accumulated INADVERTENT INTERCHANGE for the On-Peak and Off-Peak hours of the month. **[Refer to "Inadvertent Interchange Accounting Training Document"]**

4.3. After-the-Fact Corrections. After-the-fact corrections to the agreed-to Daily and Monthly accounting data shall only be made to reflect actual operating conditions (e.g. a meter being used for control was sending bad data). Changes or corrections based on non-reliability considerations shall not be reflected in the CONTROL AREA's INADVERTENT INTERCHANGE. After-the-fact corrections to scheduled or actual values will not be accepted without agreement of the ADJACENT CONTROL AREA(s).

5. INADVERTENT INTERCHANGE payback. Each CONTROL AREA shall be diligent in reducing accumulated inadvertent balances. INADVERTENT INTERCHANGE accumulations shall be paid back by either of the following methods:

5.1. Energy "in-kind" payback. INADVERTENT INTERCHANGE accumulated during "on-peak" hours shall only be paid back during "on-peak" hours. INADVERTENT INTERCHANGE accumulated during "off-peak" hours shall only be paid back during "off-peak" hours. [**See Appendix 1F, "On-Peak and Off-Peak Periods."**]

5.1.1. Bilateral payback. INADVERTENT INTERCHANGE accumulations may be paid back via an INTERCHANGE SCHEDULE with another CONTROL AREA. **[Refer to Policy 3, "Interchange" for Interchange Scheduling Requirements.]**

5.1.1.1. Opposite balances. The SOURCE CONTROL AREA and SINK CONTROL AREA must have inadvertent accumulations in the opposite direction.

5.1.1.2. Agreement on schedule. The terms of the inadvertent payback INTERCHANGE SCHEDULE shall be agreed upon by all involved CONTROL AREAS and TRANSMISSION PROVIDERS in accordance with NERC operating **Policy 3, "Interchange."**

5.1.2. Unilateral payback. INADVERTENT INTERCHANGE accumulations may be paid back unilaterally controlling to a target of non-zero ACE. Controlling to a non-zero ACE ensures that the unilateral payback is accounted for in the CPS calculations. The unilateral payback control offset is limited to the CONTROL AREA's L_{10} limit and shall not burden the INTERCONNECTION.

5.2. Other payback methods. Upon agreement by all REGIONS within an INTERCONNECTION, other methods of INADVERTENT INTERCHANGE payback may be utilized.

6. INADVERTENT INTERCHANGE summary. Each CONTROL AREA shall submit a monthly summary of INADVERTENT INTERCHANGE as detailed in **Appendix 1F,** "Inadvertent Interchange **Energy Accounting Practices and Dispute Resolution Process."** These summaries shall not include any after-the-fact changes that were not agreed to by the SOURCE CONTROL AREA, SINK CONTROL AREA and all INTERMEDIARY CONTROL AREA(s).

6.1. Summary balances. INADVERTENT INTERCHANGE summaries shall include at least the previous accumulation, net accumulation for the month, and final net accumulation, for both the "on-peak" and "off-peak" periods.

6.2. Summary submission. Each CONTROL AREA shall submit its monthly summary report to its Resources Subcommittee Survey Contact by the 15th calendar day of the following month. The Resources Subcommittee Survey Contact will prepare a composite tabulation and submit that tabulation to the NERC staff by the 22nd calendar day of the month.

6.2.1. Failure to Report. A CONTROL AREA that neither submits a report nor supplies a reason for not submitting the required data by the 20th calendar day of the following month shall be considered non-compliant.

6.2.2. Dispute Resolution. Adjacent CONTROL AREAS that cannot mutually agree upon their respective NET ACTUAL INTERCHANGE or NET SCHEDULED INTERCHANGE quantities by the 15th calendar day of the following month shall, for the purposes of dispute resolution, submit a report to their respective Resources Subcommittee Survey Contact. The report shall describe the nature and the cause of the dispute as well as a process for correcting the discrepancy. The Dispute Resolution Process is described in **Appendix 1F, "Inadvertent Interchange Dispute Resolution Process and Error Adjustment Procedures."**

G. Surveys Standard

[Area Interchange Error Survey Training Document]
[Frequency Response Characteristic Survey Training Document]
[Performance Standard Training Document]

Introduction

Periodic surveys of the control performance of the CONTROL AREAs are conducted to reveal control equipment malfunctions, telemetering errors, improper frequency bias settings, scheduling errors, inadequate generation under automatic control, general control performance deficiencies, or other factors contributing to inadequate control performance.

Requirements

1. **On-request Surveys.** Each CONTROL AREA shall perform each of the following surveys, as described in the Performance Standard Training Document, when called for by the Resources Subcommittee:

1.1. **AIE survey.** Area Interchange Error survey to determine the CONTROL AREAS' INTERCHANGE error(s) due to equipment failures or improper SCHEDULING operations, or improper AGC performance.

1.2. **FRC survey.** Frequency Response Characteristic survey to determine the CONTROL AREAS' response to INTERCONNECTION FREQUENCY DEVIATIONS.

2. **Ongoing Surveys.** Each CONTROL AREA shall submit the following surveys on a regular basis as specified below:

2.1. **CPS, DCS, and FRS Surveys.** Performance Standard surveys to monitor the CONTROL AREAS' control performance during normal and DISTURBANCE situations.

2.1.1. **CPS Surveys.** Each CONTROL AREA shall submit a CPS Survey to its Resources Subcommittee Survey Contact no later than the 10th day following the end of the month. The Resources Subcommittee Survey Contact shall submit the CPS survey to NERC no later than the 20th day following the end of the month.

2.1.2. **DCS Surveys.** Each CONTROL AREA or RESERVE SHARING GROUP shall submit one completed copy of DCS Form, "NERC Control Performance Standard Survey – All Interconnections" to its Resources Subcommittee Survey Contact no later than the 10th day following the end of the calendar quarter (i.e. April 10th, July 10th, October 10th, January 10th). The Resources Subcommittee Survey Contact shall submit the CPS survey to NERC no later than the 20th day following the end of the calendar quarter.

2.1.3. **FRS Surveys.** Each CONTROL AREA or RESERVE SHARING GROUP shall submit one completed copy of FRS Form, "NERC Frequency Response Standard Survey – All Interconnections" to its Resources Subcommittee Survey Contact no later than the 10th day following the end of the calendar month in which the survey was called. The Resources Subcommittee Survey Contact shall submit the FRS survey to NERC no later than the 20th day of that same month.

Section 2.1.3 is contingent upon approval of Section C, Version 2.

2.2. Inadvertent Interchange Summaries (surveys). Each Region shall prepare an Inadvertent Interchange summary monthly to monitor the CONTROL AREAs' monthly Inadvertent Interchange and all-time accumulated Inadvertent Interchange. Each Region shall submit a monthly accounting to NERC by the 22nd day following the end of the month being summarized.