

A. Introduction

1. **Title: Automatic Underfrequency Load Shedding Requirements**
2. **Number: PRC-006-SERC-01**
3. **Purpose: To establish consistent and coordinated requirements for automatic underfrequency load shedding (UFLS) programs among all SERC applicable entities. This standard implements the requirements assigned to the “group of Planning Coordinators in the region” in the NERC Automatic Underfrequency Load Shedding standard PRC-006-01.**
4. **Applicability:**
 - 4.1 **Distribution Provider that does not have an agreement with a Transmission owner to provide UFLS (referred to hereafter as a Participating Distribution Provider)**
 - 4.2 **Transmission Owner that has an agreement to provide UFLS for a Distribution Provider (referred to hereafter as a Participating Transmission Owner)**
 - 4.3 **Generator Owner**
 - 4.4 **Transmission Planner**
5. **(Proposed) Effective Date: Requirements R1, R2, and R3 shall become effective 12 months after the first day of the first quarter following regulatory approval. This 12 month period is needed to allow time for entities to perform the studies necessary to assess the effectiveness of the UFLS schemes.**

The remaining requirements shall become effective 30 months after the first day of the first quarter following regulatory approval. This additional 18 months is needed to allow time for any necessary changes to be made to the existing UFLS schemes in the SERC Region.

B. Requirements

- R1. Each Transmission Planner in the SERC Region shall develop and document criteria to select portions of the Bulk Electric System (BES), including portions of adjacent interconnected regions that may form islands. This criteria shall include consideration of historical events, system studies and portions of the BES that are designed to be detached from the interconnection (planned islands) as a result of the operation of a relay scheme or special protection system. Each Transmission Planner in the SERC Region shall use this criteria to determine appropriate islands to study as a design basis for UFLS. Islands identified to form a design basis for UFLS shall include at least the following: [*Violation Risk Factor: Medium*] [*Time Horizon: Long-term Planning*]
 - 1.1. A single island that includes all of the SERC Region to verify that all SERC UFLS schemes meet the performance requirements when acting together.
 - 1.2. A single island for each SERC Sub-region to verify that all UFLS schemes within the SERC Sub-region meet the performance requirements when acting together.

- R2.** Each Transmission Planner in the SERC Region shall design an automatic UFLS scheme (percent of load to be shed, frequency set points, and time delays) that meets the following minimum requirements: [*Violation Risk Factor: High*] [*Time Horizon: Long-term Planning*]
- 2.1.** Have the capability of shedding at least 30 percent of the Peak Demand (MW) physically located within its transmission planning area.
 - 2.2.** Shed load with a minimum of three frequency set points.
 - 2.3.** The highest frequency set point with time delay of less than one second shall be no lower than 59.3 Hz and not higher than 59.5 Hz.
 - 2.4.** The lowest frequency set point shall be no lower than 58.4 Hz
 - 2.5.** The difference between frequency set points shall be at least 0.2 Hz but no greater than 0.5 Hz.
 - 2.6.** Time delay (from frequency reaching the set point to the trip signal) shall be at least 6 cycles
- R3.** Each Transmission Planner in the SERC Region shall design its UFLS scheme to meet performance requirements 3.1.1 through 3.1.2 for each identified island (if any) in its footprint. The Transmission Planner shall design its UFLS scheme such that when combined with all of the other UFLS schemes in the SERC Region, the composite will meet performance requirements 3.1.1 through 3.1.2 for the SERC Region considered as an island. The Transmission Planner shall design its UFLS scheme such that when combined with all of the other UFLS schemes in its SERC Sub-region, the composite will meet performance requirements 3.1.1 through 3.1.2 for the SERC Sub-region considered as an island. [*Violation Risk Factor: High*] [*Time Horizon: Long-term Planning*]
- 3.1.** These performance requirements shall be satisfied for underfrequency conditions resulting from an imbalance between load and generation of 15%, 20%, and 25% for all design basis islands where imbalance equals [(load minus actual generation output) / load].
 - 3.1.1.** For each simulated event, frequency shall remain within the acceptable region of the frequency performance curves defined in Figure 1 of this standard.
 - 3.1.2.** Control voltage during and following UFLS operations such that the per unit Volts per Hz (V/Hz) does not exceed 1.18 for longer than 2 seconds, cumulatively per simulated event, and does not exceed 1.10 for longer than 45 seconds, cumulatively per simulated event at each generator bus and generator step-up transformer high-side bus associated with any:
 - 3.1.2.1** Individual generating unit greater than 20 MVA (gross nameplate rating) and directly connected to the SERC Bulk

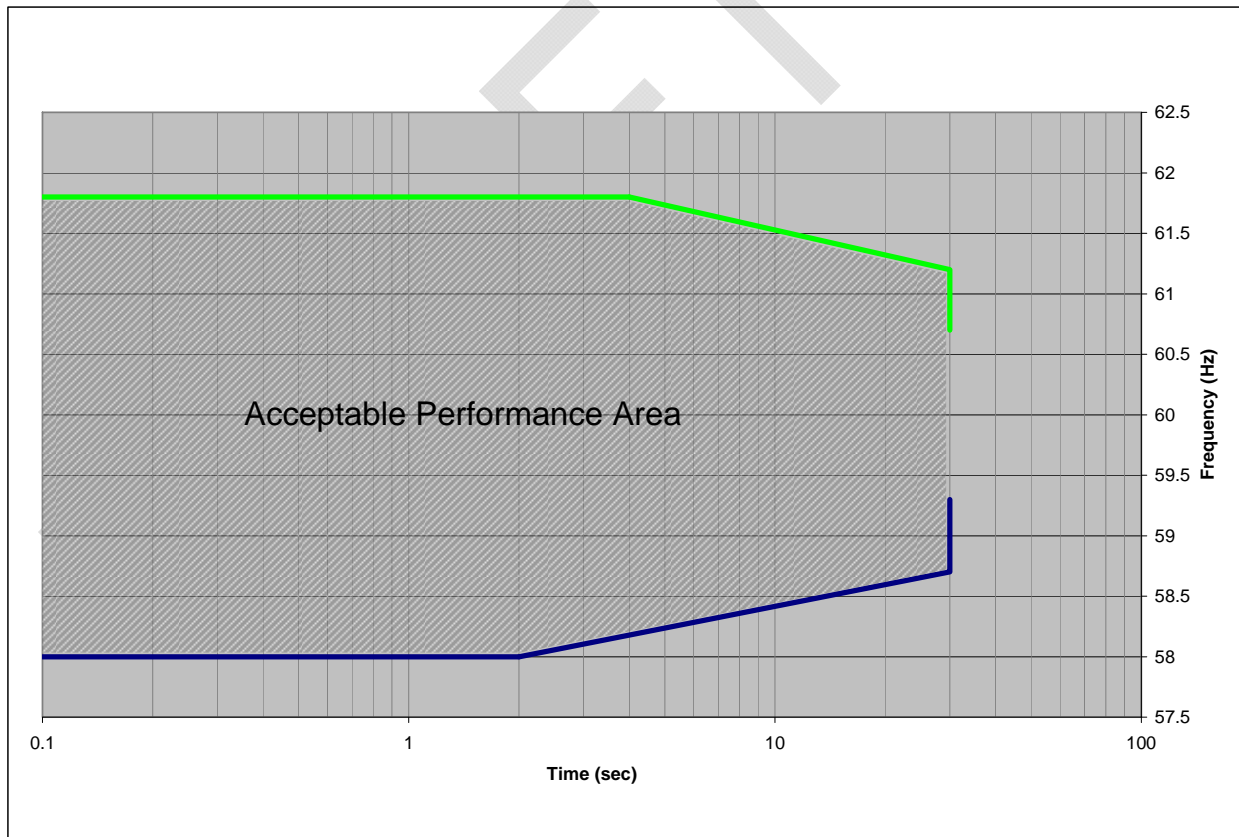
Electric System (BES).

3.1.2.2 Generating plant/facility greater than 75 MVA (gross aggregate nameplate rating) and directly connected to the SERC BES.

3.2. Transmission Planners shall verify UFLS schemes are coordinated by performing dynamic simulations that demonstrate that the performance requirements of 3.1 are met. Joint dynamic studies by multiple Transmission Planners can be used to meet this requirement.

3.2.1. If the aggregation of the Transmission Planners' UFLS schemes for an identified island or SERC Sub-region as an island or SERC Region as an island fails to meet all the requirements in 3.1, an individual Transmission Planner in that island can demonstrate that its UFLS scheme meets the requirements of 3.1 by performing dynamic simulations that apply its UFLS scheme on its individual system as an island or on the island that failed.

Figure 1: System Frequency Performance Curve



R4. Each Transmission Planner in the SERC Region is responsible for assessing its UFLS scheme, as designed, at least once every five years by performing dynamic simulations that demonstrate that the performance

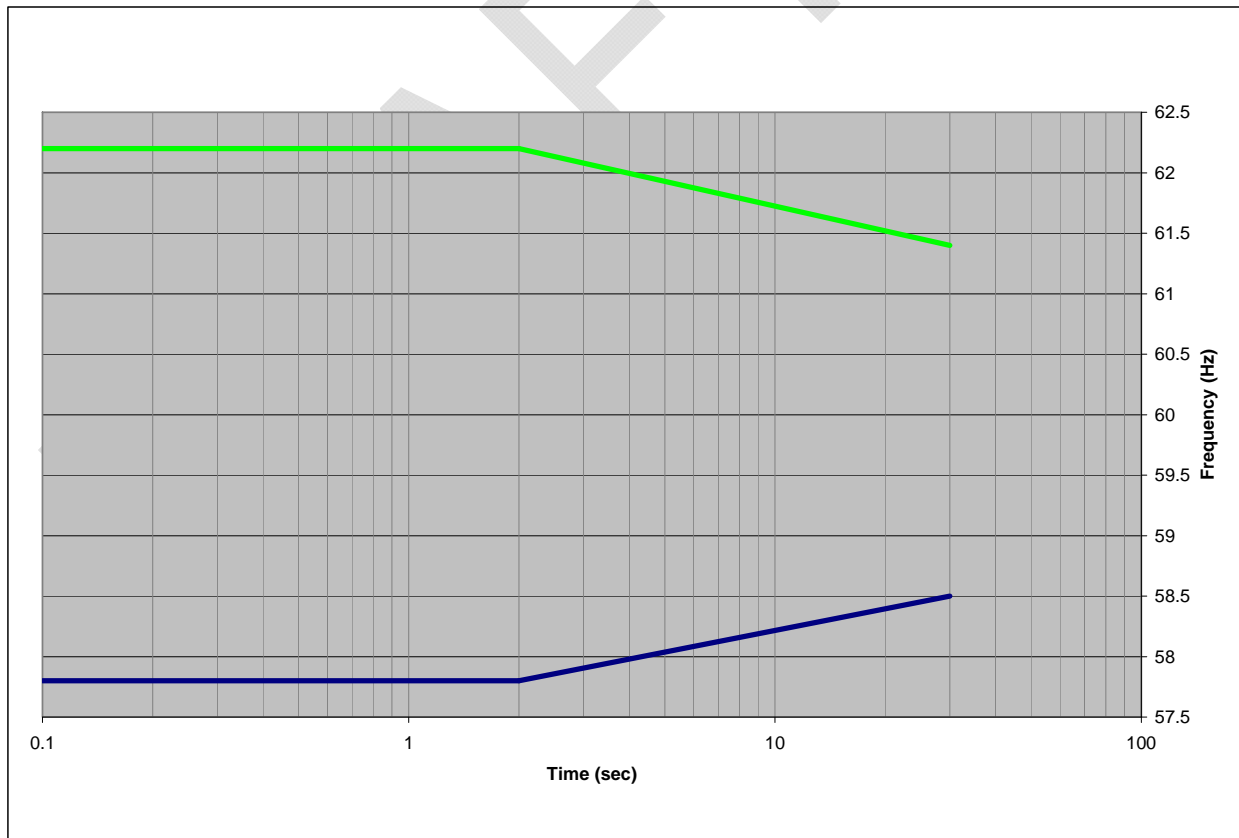
requirements of 3.1 are being met. Joint dynamic studies by multiple Transmission Planners can be used to meet this requirement [*Violation Risk Factor: Medium*] [*Time Horizon Long-term Planning*]

- 4.1. Each Transmission Planner in the SERC Region shall perform a dynamic simulation within one year for any of the following situations:
 - new islands are identified
 - material design changes are made to the scheme parameters defined in R2
 - material changes to the boundaries of a specified island are identified
 - an actuation of UFLS resulting in 500 MW or greater of loss of load

- 4.2. Each dynamic simulation shall include modeling of the following:
 - underfrequency trip settings of any generators that trip at or above the lower curve shown in Figure 2
 - over frequency trip settings of any generators that trip at or below the upper curve shown in Figure 2
 - any automatic load restoration that impacts stabilizing frequency and operates within the simulated event.

- 4.3. Each Transmission Planner in the SERC Region shall provide the study results to SERC or NERC within 30 calendar days of a request.

Figure 2: Generator Frequency Performance Curve



- R5** Each Participating Distribution Provider and each Participating Transmission Owner in the SERC Region shall be responsible for implementing the UFLS scheme developed by their Transmission Planner. Distribution Providers and Transmission Owners may coordinate with other Distribution Providers or Transmission Owners to implement the UFLS scheme developed by the Transmission Planner responsible for their collective systems. The percent load shedding implemented shall be based on the actual or estimated demand of the Participating Distribution Provider and/or Participating Transmission Owner at the time coincident with the previous year actual Peak Demand of the applicable Balancing Authority. Changes to the UFLS scheme which involve frequency settings or relay time delays must be implemented within 18 months of notification by the Transmission Planner. [*Violation Risk Factor: High*] [*Time Horizon: Operations Planning*]
- 5.1.** The Participating Distribution Providers and Participating Transmission Owners that have a total load of 100MW or greater shall implement the UFLS scheme to meet the following requirements:
- 5.1.1.** The amount of load in each load shedding step shall be within minus 1.0 and plus 2.0 of the percentage specified by the Transmission Planner. (For example, if the specified percentage step load shed is 12%, the allowable range is 11% to 14 %.)
- 5.1.2.** The amount of total UFLS load of all steps combined shall be within minus 1.0 and plus 3.0 of the percentage specified by the Transmission Planner for the total UFLS load in the UFLS scheme.
- 5.2.** The Participating Distribution Providers and Participating Transmission Owners that have a total load less than 100MW shall implement the UFLS scheme to meet the following requirements:
- 5.2.1.** Must have at least one UFLS step.
- 5.2.2.** The amount of total UFLS load of all steps combined shall be within minus 5.0 and plus 5.0 of the percentage specified by the Transmission Planner for the total UFLS load in the UFLS scheme.
- R6.** In those cases where a generator has an underfrequency setting that does not coordinate with the frequency performance curve listed in Figure 2 of this standard, the Generator Owner shall arrange for load shedding to be installed in addition to that required by the UFLS scheme. [*Violation Risk Factor: Medium*] [*Time Horizon: Long-term Planning*]
- 6.1.** This additional load shedding shall be equal to or greater than the maximum generator MW that could be tripped due to an underfrequency condition.
- 6.2.** This additional load shedding shall be instituted at the same frequency and time delay as the generator would trip.
- 6.3.** This additional load shedding shall be located within the same SERC Sub-region

and any identified islands as the generator. The Transmission Planner identifies islands as part of the development of the UFLS scheme.

- R7.** Each Participating Distribution Provider, Generator Owner, and Participating Transmission Owner in the SERC Region shall provide UFLS data for the SERC UFLS database. This data shall be provided annually to the SERC Region as scheduled or within 30 calendar days of a request by the SERC Region. [*Violation Risk Factor: Lower*]. [*Time Horizon: Operations Planning*]
- 7.1.** Each Participating Distribution Provider and Participating Transmission Owner in the SERC Region shall supply the following information, as implemented in the field:
- 7.1.1.** Underfrequency trip set points (Hz).
- 7.1.2.** Total time delay associated with each set point (sec). This includes the time from when frequency reaches the set point and ends when the breaker opens.
- 7.1.3.** Amount of previous year actual or estimated load associated with each set point, both in percent and in MW. The percentage and the Load demand (MW) shall be based on the time coincident with the previous year actual Peak Demand for the applicable Balancing Authority.
- 7.2.** The Generator Owner shall supply the following information as implemented in the field:
- 7.2.1.** Generator protection underfrequency trip set points (Hz).
- 7.2.2.** Indicate whether trip is manual or automatic.
- 7.2.3.** Time delay (from initiation to trip signal) associated with each set point (sec). This includes the time from when frequency reaches the set point and ends when the signal is generated to trip the breaker.
- 7.2.3.1.** For manual actuation, provide time based on plant specific guidance
- 7.2.3.2.** For automatic actuation, provide time based on actual protection scheme design
- 7.2.4.** Maximum generator MW that could be tripped due to an underfrequency condition.
- 7.2.5.** Provide the data specified in R7.1 for any additional UFLS required by R6.
- R8.** Coordination of UFLS programs with external entities shall be facilitated by the following requirements: [*Violation Risk Factor: Lower*] [*Time Horizon: Long-term Planning*]

- 8.1.** Transmission Planners in SERC with planning areas adjacent to other regions shall jointly review assessment results with their adjacent region's group of Planning Coordinators and/or Transmission Planners of any islands identified that straddle the respective interconnected regions.
- 8.2.** Transmission Planners shall provide when requested a description of the UFLS schemes and the results of the UFLS study required in R3 and R4 to neighboring entities responsible for UFLS assessment external to SERC within 30 calendar days of the request.
- 8.3.** Transmission Planners shall request a description of the UFLS schemes and the results of the UFLS study from all neighboring entities responsible for UFLS assessments external to SERC.

C. Measures

The following documentation will be used to determine compliance with the above requirements.

- M1.** Each Transmission Planner shall maintain documentation of the criteria used and the islands selected as the design basis for the UFLS scheme for its area.
- M2.** Each Transmission Planner shall maintain documentation that the UFLS scheme for its area meets the design requirements specified in 2.1 through 2.6.
- M3.** Each Transmission Planner shall maintain documentation that its UFLS scheme meets the performance requirements in R3.
- M4.** Each Transmission Planner shall maintain documentation that dynamic simulations were performed with the required modeling and that study results were provided as required by R4.
- M5.** Each Participating Distribution Provider or Participating Transmission Owner shall provide evidence, upon request of the Compliance Monitor, demonstrating that it has implemented a UFLS scheme, or its agreed to portion thereof, per Requirement R5. This evidence shall include documentation of how the installed scheme implements the requirements of the UFLS design provided by the Transmission Planner.
- M6.** The Generator Owner shall maintain documentation demonstrating one of the following:
 - M6.1.** The generating unit will not be tripped, automatically or manually, for underfrequency excursions (i.e., below 60 Hz) less severe than those described in Requirement R6.
 - M6.2.** An automatic underfrequency load shedding scheme meeting the requirements of R6 has been installed.
- M7.** Maintain documentation that the following data was provided to SERC as described in R7:

M7.1. For the Participating Distribution Provider and Participating Transmission Owner the data described in 7.1;

M7.2. For the Generator Owner, the data described in 7.2.

M8. The Transmission Planner shall maintain documentation of the following:

M8.1. Joint reviews of assessment results for islands identified that straddle SERC and an adjacent region.

M8.2. A list of neighboring entities that were provided a description and study results for the UFLS scheme and the timeframe in which information was provided as specified in 8.2.

M8.3. A list of neighboring entities from which UFLS information was requested and a list of the information received from those entities as specified in 8.3.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

SERC Reliability Corporation

1.2. Compliance Monitoring Period and Reset Time Frame

Not Applicable

1.3. Data Retention

Seven years

1.4. Compliance Monitoring and Assessment Process

Compliance Audit

Self-Certification

Spot Checking

Compliance Violation Investigation

Self-Reporting

Complaint

Periodic Data Submittals (frequency = annual)

1.5. Additional Compliance Information

None

2. Violation Severity Levels

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	N/A	<p>The Transmission Planner did not have documentation that identified a single island that includes all of the SERC Region.</p> <p>OR</p> <p>The Transmission Planner did not have documentation that identified a single island for its SERC Sub-region.</p>	N/A	<p>The Transmission Planner did not have documentation that identified a single island that includes all of the SERC Region.</p> <p>AND</p> <p>The Transmission Planner did not have documentation that identified a single island for its SERC Sub-region.</p> <p>OR</p> <p>The Transmission Planner did not have documentation of the criteria used to determine islands.</p>
R2	The Transmission Planner did not meet one of the UFLS system design requirements identified in 2.2 through 2.6.	The Transmission Planner did not meet two of the UFLS system design requirements identified in 2.2 through 2.6.	The Transmission Planner did not meet three of the UFLS system design requirements identified in 2.2 through 2.6.	The Transmission Planner did not meet 2.1 OR four or more of the UFLS system design requirements identified in 2.2 through 2.6.
3.1	N/A	The design of the UFLS scheme failed to satisfy part 3.1.2	The design of the UFLS scheme failed to satisfy part 3.1.1	The design of the UFLS scheme failed to satisfy both

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
		of the performance requirements for underfrequency conditions resulting from an imbalance between load and generation of 15%, 20%, or 25% for any design basis island.	of the performance requirements for underfrequency conditions resulting from an imbalance between load and generation of 15%, 20%, or 25% for any design basis island.	parts 3.1.1 and 3.1.2 of the performance requirements for underfrequency conditions resulting from an imbalance between load and generation of 15%, 20%, or 25% for any design basis island.
3.2	N/A	The Transmission Planner did not perform a dynamic simulation of one of the identified islands that demonstrates that the performance requirements listed in 3.1 were met.	N/A	The Transmission Planner did not perform a dynamic simulation of any of the identified islands that demonstrates that the performance requirements listed in 3.1 were met.
R4	The Transmission Planner did not perform the dynamic simulation that demonstrates that the performance requirements of 3.1 are met at least once every five years. OR The Transmission Planner provided its	The Transmission Planner provided its study results 46 to 60 calendar days after the request was made.	The Transmission Planner provided its study results 61 to 75 calendar days after the request was made.	The Transmission Planner provided its study results 76 or more calendar days after the request was made. OR The Transmission Planner did not perform the dynamic simulation that demonstrates that the

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
	<p>study results 31 to 45 calendar days after the request was made.</p> <p>OR</p> <p>The Transmission Planner did not perform the dynamic simulation within one year that demonstrates that the performance requirements of 3.1 are met when the conditions in 4.1 occurred.</p> <p>OR</p> <p>The simulations did not model all of the items listed in 4.2</p>			<p>performance requirements of 3.1 are met at least once within six years.</p> <p>OR</p> <p>The Transmission Planner did not perform the dynamic simulation within 18 months that demonstrates that the performance requirements of 3.1 are met when the conditions in 4.1 occurred.</p> <p>OR</p> <p>The simulations did not model any of the items listed in 4.2</p>
5.1	N/A	<p>The Participating Distribution Provider and Participating Transmission Owner's documentation of the implemented UFLS scheme indicated one load shedding step outside the range specified in 5.1.1.</p>	<p>The Participating Distribution Provider and Participating Transmission Owner's documentation of the implemented UFLS scheme indicated two load shedding steps outside the range specified in 5.1.1.</p>	<p>The Participating Distribution Provider and Participating Transmission Owner's documentation of the implemented UFLS scheme indicated three or more load shedding steps outside the range specified in 5.1.1.</p> <p>OR</p> <p>The Participating</p>

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
				Distribution Provider and Participating Transmission Owner's documentation of the implemented UFLS scheme indicated a total load in the UFLS scheme outside the range specified in 5.1.2.
5.2	N/A	N/A	N/A	The Participating Distribution Provider and Participating Transmission Owner's documentation of the implemented UFLS scheme indicated a total load in the UFLS scheme outside the range specified in 5.2.
R6	<p>The Generator Owner arranged for load shedding, but did not meet one of the requirements identified in 6.1 through 6.3.</p> <p>OR</p> <p>The Generator Owner did not have documentation showing that the generating unit</p>	<p>The Generator Owner arranged for load shedding, but did not meet two of the requirements identified in 6.1 through 6.3.</p>	<p>The Generator Owner arranged for load shedding, but did not meet any of the three requirements identified in 6.1 through 6.3</p>	<p>The Generator Owner did not arrange for load shedding as required per R6.</p>

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
	<p>will not be tripped, automatically or manually, for underfrequency excursions less severe than those described in Requirement R6.</p>			
<p>R7</p>	<p>The Participating Distribution Provider, Participating Transmission Owner, or Generator Owner provided the data requested in R7 to SERC 31 to 45 days after the request was made</p>	<p>The Participating Distribution Provider, Participating Transmission Owner, or Generator Owner provided the data requested in R7 to SERC 46 to 60 days after the request was made</p> <p>OR</p> <p>The Participating Distribution Provider or Participating Transmission Owner did not provide to SERC one piece of information listed in the 7.1</p> <p>OR</p> <p>The Generator Owner did not provide one of the pieces of information to SERC listed in 7.2</p>	<p>The Participating Distribution Provider, Participating Transmission Owner, or Generator Owner provided the data requested in R7 to SERC 61 to 75 days after the request was made</p> <p>OR</p> <p>The Participating Distribution Provider or Participating Transmission Owner did not provide to SERC two pieces of information listed in 7.1</p> <p>OR</p> <p>The Generator Owner did not provide two of the pieces of information to SERC listed in 7.2</p>	<p>The Participating Distribution Provider, Participating Transmission Owner, or Generator Owner did not provide or provided the data requested in R7 to SERC more than 75 days after the request was made</p> <p>OR</p> <p>The Participating Distribution Provider or Participating Transmission Owner did not provide to SERC any pieces of information listed in 7.1</p> <p>OR</p> <p>The Generator Owner did not provide three or more pieces of information to SERC listed in 7.2.</p>

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL
R8	<p>The Transmission Planner provided required data within 31 to 45 days after the request was made,</p> <p>OR</p> <p>The Transmission Planner did not request all neighboring entities to provide a description of the UFLS schemes and the results of the studies</p>	<p>The Transmission Planner provided required data within 46 to 60 days after the request was made</p>	<p>The Transmission Planner provided required data within 61 to 75 days after the request was made</p>	<p>The Transmission Planner did not provide the required data within 75 days after the request was made,</p> <p>OR</p> <p>Transmission Planner did not request any neighboring entities to provide a description of the UFLS schemes and the results of the studies</p> <p>OR</p> <p>The Transmission Planner did not have documentation of joint reviews of assessment results as required in 8.1.</p>

E. Regional Variances

None

F. Associated Documents

Version History

Version	Date	Action	Change Tracking
Draft-1	09/19/08 thru 10/20/08	Posted for 1 st Comment Period	Initial version
Draft-2	11/21/08 thru 12/22/08	Posted for 2 nd Comment Period	Revised to address comments received on Draft-1 and to include

			measures and compliance sections
Draft-3	02/09/09	Posted for information	Revised to address comments received on Draft-2
Draft-3a	09/15/09 thru 10/15/09	Posted for 3 rd Comment Period	Revised to make consistent with draft-2 of NERC continent-wide standard

DRAFT-3a