

A. Introduction

1. **Title:** Automatic Underfrequency Load Shedding Requirements
2. **Number:** PRC – 006 – RFC – 01
3. **Purpose:** To establish *ReliabilityFirst* requirements for automatic underfrequency load shedding (UFLS) to support NERC Reliability Standard PRC-006.
4. **Applicability:**
 - 4.1 **Distribution Provider**
 - 4.2 **Transmission Owners**
 - 4.3 **Load Serving Entity (all LSE’s regardless of size)**
 - 4.4 **Generator Owner (all generators with an individual nameplate rating or plants with an aggregate nameplate rating of 20 MVA or greater, connected at 69kV or above)**
 - 4.5 **Planning Coordinator**
5. **(Proposed) Effective Date:**

B. Requirements

- R1** Load Serving Entities shall furnish data in a pre-arranged format to their Distribution Providers and Transmission Owners with end-use load connected to their facilities in the *ReliabilityFirst* footprint as requested (within 45 days of request). These data shall include [*Violation Risk Factor: Medium*]:
- R1.1** The Load Serving Entities’ forecasted load magnitude and location for its next annual peak
 - R1.2** Load characteristics necessary to set the UFLS relays per R2.6 in the pre-arranged format requested by the Distribution Providers and Transmission Owners with end-use load connected to their facilities (where applicable) (e.g. large motor loads, etc.)
 - R1.3** Distributed generation characteristics necessary to set the UFLS relays per R2.6 in the pre-arranged format requested by the Distribution Providers and Transmission Owners with end-use load connected to their facilities (where applicable)
- R2** Each Distribution Provider and Transmission Owner with end-use load connected to their facilities in the *ReliabilityFirst* footprint shall implement an automatic UFLS program or shall participate with one or more Distribution Providers and Transmission Owners with end-use load connected to their facilities to collectively implement a single UFLS program. The automatic UFLS program shall include the following requirements: [*Violation Risk Factor: High*]
- R2.1** Have the capability of shedding at least 25 percent of connected load determined from the forecasted annual peak hour
 - R2.2** Shed load in a minimum of three steps

- R2.3** Size each step equally (the variance between steps shall be no more than two percent of forecasted annual peak hour load) (additional load shedding required per R4 or R5 is excluded from this requirement)
- R2.4** The first set point shall be no lower than 59.3 Hz and not higher than 59.5 Hz. The last set point shall be no lower than 58.5 Hz and not higher than 58.7 Hz (additional load shedding required per R4 or R5 is excluded from this requirement)
- R2.5** The difference between frequency set points shall be at least 0.2 Hz but no greater than 0.5 Hz (additional load shedding required per R4 or R5 is excluded from this requirement)
- R2.6** Intentional relay time delay shall be no greater than ten cycles, with the following exceptions:
- R2.6.1** For installations where large motor loads may be isolated, undercurrent supervision is preferred to avoid false operation during fault isolation. If this is not available, intentional relay time delay may be increased to no greater than 15 cycles.
- R2.6.2** For installations where distributed generation may be isolated, undercurrent supervision is preferred to avoid false operation during fault isolation. If this is not available, intentional relay time delay may be increased to no greater than 15 cycles.
- R2.7** Undervoltage inhibit (where applicable) shall be set as low as practical, but shall not be greater than 75 percent of nominal voltage
- R2.8** Each Transmission Owner owning bulk power capacitor banks shall trip bulk power capacitors to avoid excessive voltage during automatic UFLS events.
- R3** Each Planning Coordinator in coordination with the Distribution Providers and Transmission Owners with end-use load connected to their facilities in the ReliabilityFirst footprint, shall have a documented methodology to determine areas (or sub areas) of credible islanding. The methodology shall address at least the following to identify areas (or sub areas) of credible islanding [*Violation Risk Factor: Lower*]:
- Historical islanding scenarios
 - Areas with a limited number of connecting lines
 - System Operating Limit interfaces which define importing areas
 - A process to involve stakeholders in the analysis and results
- R3.1** Each Planning Coordinator shall make its credible island determination methodology available for inspection and technical review by those entities directly and materially affected by the reliability of ReliabilityFirst Bulk Electric System (BES), within 15 business days of the receipt of a request.

- R3.2** If entities directly and materially affected by the reliability of ReliabilityFirst BES provide written comments on the credible island determination methodology, the Planning Coordinator shall provide a written response to that commenting entity within 45 calendar days of receipt of those comments. The response shall indicate whether a change will be made to the credible island determination methodology and, if no change will be made, the reason why.
- R3.3** The Planning Coordinator shall use this methodology at least every five years to determine areas (or sub areas) of credible islanding within their area of responsibility.
- R3.4** The Planning Coordinator shall supply the results of the determination (within 30 days of completion of the process) to the Distribution Providers and Transmission Owners with end-use load connected to their facilities in the ReliabilityFirst footprint of identified areas (or sub areas) of credible islanding.
- R4** Distribution Providers and Transmission Owners with end-use load connected to their facilities in the ReliabilityFirst footprint in identified areas (or sub areas) of credible islanding (as determined in R3) shall utilize one or both of the following: *[Violation Risk Factor: Lower]*
- R4.1** Install UFLS capability in the island area so as to cover potential generation/load imbalances (the amount of load to be shed in the island area and the corresponding load shedding step sizes, relay trip and time delay settings shall be determined by appropriate engineering assessments that specifically address the islanding scenario)
- R4.1.1** Identified areas (or sub areas) of credible islanding with a forecasted annual peak load of 300 MW or less shall be exempt from any additional UFLS requirements
- R4.1.2** Distribution Providers and Transmission Owners with end-use load connected to their facilities in the ReliabilityFirst footprint are not required to install greater than 50 percent of the forecasted annual peak load in the identified areas (or sub areas) of credible islanding. If more than 50 percent is indicated then only the requirements in R2 apply.
- R4.2** Apply other methods of balancing load and resources.
- R4.2.1** Identified areas (or sub areas) of credible islanding with a forecasted annual peak load of 300 MW or less shall be exempt from any additional other methods of balancing load and resources requirements
- R4.3** Upon determination of a new credible island which requires mitigation as required in R4.1 or R4.2, the Distribution Providers and Transmission Owners with end-use load connected to their facilities shall have two years to comply with R4.1 or R4.2

R4.4 Generator Unit Owners in the Reliability *First* footprint in identified areas (or sub areas) of credible islanding (as determined in R3) shall participate in the study by the Planning Coordinator to possibly optimize unit trip setting changes to enhance the coordination within the potential area of credible islanding.

R5 If automatic underfrequency protection is installed, each Generator Owner’s unit shall not trip faster than the minimum tripping time delays in the following table:
[Violation Risk Factor: High]

<u>Frequency (Hz)</u>	<u>Minimum Time Delay (Sec)</u>
≥ 59.5	Automatic Frequency Dependent Tripping Not Permitted
<59.5 to > 59.2	2,700.0
≤59.2 to > 58.5	120.0
≤58.5 to > 58.2	15.0
≤58.2	Owner’s Discretion

R5.1 In those cases where a generator must be tripped for its own protection outside the specifications in the above Table 1, the Generator Owners may become compliant by arranging for load shedding to be installed, in addition to that required of Distribution Providers and Transmission Owners with end-use load connected to their facilities in R2.

R5.1.1 This additional load shedding shall be equal to or greater than the generator MW dispatch, instituted at the same frequency and time as the generator would be expected to trip.

R5.1.2 If the generator is located within a credible island, arrangement for additional load shedding shall be within the credible island.

R6 Distribution Providers or Transmission Owners owning non-fault clearing tie-tripping schemes, islanding schemes, automatic load-restoration schemes, additional load shedding schemes or any other schemes that are part of or impact the UFLS programs shall document such schemes in sufficient detail to allow modeling for dynamics simulations *[Violation Risk Factor: Lower]*.

R7 Each Planning Coordinator shall establish and maintain an UFLS database in a pre-arranged format *[Violation Risk Factor: Lower]*.

R7.1 The database shall be updated every 5 years or as required by changes in system conditions.

R7.2 The database shall include the areas of credible islanding determined in R3.3.

- R8** Distribution Providers, Transmission Owners with end-use load connected to their facilities and Generator Owners required to comply with the relevant sections of R2, R4, R5, or R6 shall populate the Planning Coordinator's UFLS database (within 45 days of request), in the pre-arranged format, as follows..
[Violation Risk Factor: Lower]:
- R8.1** Distribution Providers and Transmission Owners with end-use load connected to their facilities shall supply the following relevant information:
- R8.1.1** Frequency Trip Points
- R8.1.2** Percent of Forecasted Peak Hour Load dropped at each Trip Point
- R8.1.3** Relay Operating Time Delay, intentional and unintentional
- R8.1.4** Circuit Breaker Operating Time
- R8.1.5** UFLS relay undervoltage inhibit voltage level
- R8.1.6** Information describing any other schemes that are part of or impact the UFLS program
- R8.1.7** Any underfrequency trip set points, overvoltage trip set points and time delays of bulk power capacitor bank tripping
- R8.2** Generator Owners shall supply underfrequency trip set points and time delays of generating units
- R9** All Planning Coordinators within ReliabilityFirst shall perform a joint Assessment of the effectiveness of the design and implementation of the UFLS programs within ReliabilityFirst. This assessment shall include effects of neighboring areas. This assessment shall be conducted periodically (at least every five years or as required by changes in system conditions) and shall include, but not be limited to *[Violation Risk Factor: Lower]:*
- R9.1.** A review of the current frequency set points and timing
- R9.2.** Dynamic simulation of possible Disturbances that cause the Planning Coordinators' systems or portions of the Planning Coordinators' systems to experience significant imbalance between Demand (Load) and generation
- R9.3** Determination of the need to install underfrequency tripping of bulk power capacitor banks to avoid excessive voltage during automatic UFLS.

- R10** Coordination of UFLS programs shall be accomplished by the following requirements [*Violation Risk Factor: Lower*]:
- R10.1** Planning Coordinators shall provide the data in the database required in R8 to neighboring Planning Coordinators within *ReliabilityFirst*
 - R10.2** Planning Coordinators shall provide the data in the database required in R8 and Assessment results required in R9 to neighboring entities responsible for UFLS assessment external to *ReliabilityFirst*
 - R10.3** Planning Coordinators shall request UFLS data and Assessment results from neighboring entities responsible for UFLS assessment external to *ReliabilityFirst*

C. Measures

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

- M1** The Load Serving Entity shall have documentation showing that the information requested in R1 was supplied to its Distribution Provider and Transmission Owner when requested within the time period specified.
- M2** Every Distribution Provider and Transmission Owner in the *ReliabilityFirst* footprint shall have documentation showing they comply with all the requirements of R2.
- M3** The Planning Coordinator shall have documentation detailing processes to assess areas of credible islanding giving consideration to the items listed in R3. The Planning Coordinator shall have evidence that an assessment to determine if credible islands exist was performed within the past 5 years. The Planning Coordinator shall have documentation that the results of the assessment were supplied to the applicable Distribution Providers and Transmission Owners with end-use load connected to their facilities in the *ReliabilityFirst* footprint.
- M4** Distribution Providers and Transmission Owners with end-use load connected to their facilities in the *ReliabilityFirst* footprint in identified areas (or sub areas) of credible islanding (as determined in R3) shall have documentation of installed UFLS capability as required in R4.
- M5** The Generator Owner shall have documentation that it complies with the frequency protection settings of generators or has made arrangements for additional load shedding, if appropriate, as required in R5.
- M6** Distribution Providers and Transmission Owners owning tie-tripping schemes, islanding schemes, automatic load-restoration schemes or any other schemes that are part of or impact the UFLS programs shall have documentation of these schemes as required in R6 and evidence that this documentation was provided to the Planning Coordinator.
- M7** Planning Coordinator shall have evidence it established and maintained an UFLS database as required in R7.

- M8** The respective Distribution Providers, Transmission Owners and Generator Owners shall have evidence that the information as required in R8 was supplied to the Planning Coordinator to populate the UFLS Database.
- M9** The Planning Coordinator shall have evidence that the assessment of the design effectiveness and implementation of UFLS as required by R9 have been completed.
- M10** The Planning Coordinator shall have evidence that the data in the database and relevant study results have been exchanged with neighboring Planning Coordinators as required by R10.

D. Compliance

1 Compliance Monitoring Process

- 1.1** Compliance Monitoring Responsibility
Compliance Monitor: ReliabilityFirst
- 1.2** Compliance Monitoring Period and Reset
On request (within 45 calendar days)
- 1.3** Data Retention
5 years
- 1.4** Additional Compliance Information
None

2 Violation Severity Levels

Req. Number	VIOLATION SEVERITY LEVEL			
	LOWER	MODERATE	HIGH	SEVERE
R1		The Load Serving Entity did not send the information required in R1.2 and R1.3 to the Distribution Provider and Transmission Owner with directly connected end-use load in the ReliabilityFirst footprint as requested		The Load Serving Entity did not send the information required in R1.1 to the Distribution Provider and Transmission Owner with directly connected end-use load in the ReliabilityFirst footprint as requested
R2	The Distribution Provider and Transmission Owner with end-use load connected to their facilities total UFLS is less than 25% but greater than or equal to	The Distribution Provider and Transmission Owner with end-use load connected to their facilities total UFLS is less than 23% but greater than or equal to	The Distribution Provider and Transmission Owner with end-use load connected to their facilities total UFLS is less than 21% but greater than or equal to	The Distribution Provider and Transmission Owner with end-use load connected to their facilities total UFLS is less than 18% of the annual forecasted peak

	<p>23% of the connected load at the forecasted annual peak hour as required in R2.1; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities intentional relay time delays are greater than 10 cycles, but less than or equal to 12 cycles, except as allowed by R2.6.1 or R2.6.2, as required in R2.6</p>	<p>21% of the connected load at the forecasted annual peak hour as required in R2.1; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities UFLS program steps are not equal to within 2% of the forecasted annual peak hour load as required in R2.3; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities intentional relay time delays are greater than 12 cycles, but less than or equal to 14 cycles, except as allowed by R2.6.1 or R2.6.2, as required in R2.6</p>	<p>18% of the annual forecasted peak hour load, as required in R2.1; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities difference between frequency set points is less than 0.2 Hz or greater than 0.5 Hz, as required in R2.5; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities undervoltage inhibit (where applicable) is set greater than 75 % of nominal voltage, as required in R2.7; OR Transmission Owners Bulk capacitor banks are not tripped as specified in R2.8; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities intentional relay time delays are greater than 15 cycles, but less than or equal to 20 cycles, as required in R2.6</p>	<p>hour load, as required in R2.1; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities UFLS program contains less than three steps as required in R2.2; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities first set point of the UFLS program is less than 59.3 Hz, or the last set point is less than 58.5 Hz or greater than 58.7 Hz, as required in R2.4; OR The Distribution Provider and Transmission Owner with end-use load connected to their facilities intentional relay time delays are greater than 20 cycles, as required in R2.6</p>
<p>R3</p>	<p>The Planning Coordinator did not make its credible islanding determination methodology available within 15 business days of the receipt of a</p>	<p>The Planning Coordinator performed the assessment required in R3 but did not report the results to the Distribution Provider and Transmission</p>	<p>The Planning Coordinator did not perform the determination of credible islands as required in R3</p>	

	request, as required in R3.1; OR The Planning Coordinator did not respond to comments on its credible islanding determination methodology within 45 calendar days of receipt of a written comment, as required in R3.2	Owner with end-use load connected to their facilities in the ReliabilityFirst footprint affected by the credible islanding, as required in R3.4; OR The Planning Coordinator did not perform the assessment within 5 years of the previous determination, as required in R3.3		
R4			The Distribution Provider and Transmission Owner with end-use load connected to their facilities in the ReliabilityFirst footprint did not document the installation of UFLS capability as required in R4	
R5		Greater than 0% but less than or equal to 5% of a Generator Owner’s total MWs is tripped by UF protection sooner than the minimum time delays required in the Table 1 in R5 without using the mitigation technique suggested in R5.1		Greater than 5% of a Generator Owner’s total MWs is tripped by UF protection sooner than the minimum time delays required in the Table 1 in R5
R6			The Distribution Providers or Transmission Owners owning schemes that effect the UFLS program as mentioned in R6 are not documented in sufficient detail for dynamics modeling	
R7			The Planning Coordinator established and maintained the	The Planning Coordinator has not established and

			UFLS database required by R7 but areas of credible islanding were not included as required by R7.2	maintained UFLS database as required by R7 OR The Planning Coordinator has established and maintained the UFLS database as required by R7 but has not been updated within the last 5 years or as required by changes in system conditions as required by R7.1
R8	The Distribution Providers, Transmission Owners with end-use load connected to their facilities and Generator Owners failed to supply the information within 45 days but not longer than 90 days from the request	The Distribution Providers or Transmission Owners with end-use load connected to their facilities supplied the information within 45 days from the request but less than or equal to 3% of the information submitted for any of the individual applicable sub requirements listed in R8.1 is incomplete OR The Generator Owner supplied the information within 45 days from the request but failed to submit underfrequency trip set points and time delays for 1 generator as required by R8.2	The Distribution Providers or Transmission Owners with end-use load connected to their facilities supplied the information within 45 days from the request and greater than 3% of the information submitted for any of the individual applicable sub requirements listed in R8.1 is incomplete OR The Generator Owner supplied the information within 45 days from the request but failed to submit underfrequency trip set points and time delays for more than 1 generator as required by R8.2	The Distribution Providers or Transmission Owners with end-use load connected to their facilities supplied the information within 90 days from the request and greater than 3% of the information submitted for any of the individual applicable sub requirements listed in R8.1 is incomplete OR The Generator Owner failed to supply the information within 45 days from the request but failed to submit underfrequency trip set points and time delays for more than 1 generator as required by R8.2 OR The Distribution Providers or Transmission Owners with end-use load connected to their facilities failed to supply the information within 90 days of the request
R9		The Planning		Planning Coordinator

		Coordinator performed the assessment of the effectiveness of the design and implementation of the UFLS programs within its planning area, but the assessment was incomplete in one of the areas identified in R9.1 through R9.3.		performed the assessment of the effectiveness of the design and implementation of the UFLS programs within its planning area, but the assessment was incomplete in two of the areas identified in R9.1 through R9.3
R10		The Planning Coordinator did not exchange the data and study results with neighboring Planning Coordinators as required		

E. Terms

F. IntraRegional Differences

None

G. Notes

Version History

Version	Date	Action	Change Tracking
PRC-006-RFC-01 1 st Draft	05/16/07 Thru 06/14/07	Posted for 1 st Comment Period	
PRC-006-RFC-01 2 nd Draft	10/29/07 Thru 11/27/07	Posted for 2 nd Comment Period	
PRC-006-RFC-01 3 rd Draft	04/18/08 Thru 05/19/08	Posted for 3 rd Comment Period	