

Effective Date

Effective for SERC Region applicable Registered Entities on the first day of the first calendar quarter after approved by FERC.

Introduction

1. **Title:** Automatic Underfrequency Load Shedding Requirements
2. **Number:** PRC-006-SERC-3
3. **Purpose:** To establish consistent and coordinated requirements for the design, implementation, and analysis of automatic underfrequency load shedding (UFLS) programs among all SERC applicable entities.
4. **Applicability:**
 - 4.1 Planning Coordinators
 - 4.2 UFLS entities shall mean all entities that are responsible for the ownership, operation, or control of UFLS equipment as required by the UFLS program established by the Planning Coordinators. Such entities may include one or more of the following:
 - 4.2.1 Transmission Owners
 - 4.2.2 Distribution Providers
 - 4.3 Generator Owners
5. **Background**

The SERC UFLS Standard: PRC-006-SERC-01 (“SERC UFLS Standard”) was developed to provide regional UFLS requirements to entities in SERC. UFLS requirements have been in place at a continent-wide level and within SERC for many years prior to implementation of federally mandated reliability compliance standards in 2007.

When reliability standards were implemented in 2007, the Federal Energy Regulatory Commission (“FERC”), which is the government body with regulatory responsibility for electric reliability, issued FERC Order 693, recognizing 83 NERC Reliability Standards as enforceable by FERC and applicable to users, owners, and operators of the bulk power system (BPS). FERC did not approve the NERC UFLS standard, PRC-006-0 in Order 693. FERC’s reason for not approving PRC-006-0 was that it recognized PRC-006-0 as a “fill-in the blank standard,” and regional procedures associated with the standard were not submitted along with the standard. FERC’s ruling in Order 693 required Regional Entities to provide the regional requirements necessary for completing the UFLS standard.

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In 2008, SERC commenced work on PRC-006-SERC-01. NERC also began work on revising PRC-006-0 at a continent-wide level. The SERC standard has been developed to be consistent with the NERC UFLS standard. PRC-006-SERC-02 was developed per periodic review of the standard.

PRC-006-1 clearly defines the roles and responsibilities of parties to whom the standard applies. The standard identifies the Planning Coordinator (“PC”) as the entity responsible for developing UFLS schemes within their PC area. The regional standard adds specificity not contained in the NERC standard for development and implementation of a UFLS scheme in the SERC Region that effectively mitigates the consequences of an underfrequency event.

Requirements and Measures

R2. Each Planning Coordinator shall select or develop an automatic UFLS scheme (percent of load to be shed, frequency set points, and time delays) for implementation by UFLS entities within its area that meets the following minimum requirements: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

2.1. Have the capability of shedding at least 30 percent of the Peak Demand (MW) served from the Planning Coordinator’s transmission system. The Peak Demand may be either summer or winter as determined by the Planning Coordinator.

2.2. Shed load with a minimum of three frequency set points.

2.3. The highest frequency set point for relays used to arrest frequency decline shall be no lower than 59.3 Hz and not higher than 59.6 Hz.

2.3.1 This does not apply to UFLS relays with time delay of one second or longer and a higher frequency setpoint applied to prevent the frequency from stalling at less than 60 Hz when recovering from an underfrequency event.

2.4. The lowest frequency set point shall be no lower than 58.2 Hz.

2.4.1 At least 30% of peak demand shall be set greater than or equal to 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 setting shall be at least six cycles (0.1 seconds).

- M2.** Each Planning Coordinator shall have evidence such as reports or other documentation that the UFLS scheme for its area meets the design requirements specified in Requirement R2.
- R3.** Each Planning Coordinator, when performing design assessments specified in the NERC PRC standard on UFLS, shall conduct simulations of its UFLS scheme for an imbalance between load and generation of 13%, 22%, and 25% for all identified island(s) where such imbalance equals $[(\text{load minus actual generation output}) / \text{load}]$. *[Violation Risk Factor: High] [Time Horizon: Long-term Planning]*
- M3.** Each Planning Coordinator shall have evidence such as reports or other documentation that it performed the simulations of its UFLS scheme as required in Requirement R3.
- R4.** Each UFLS entity that has a total load of 100 MW or greater in a Planning Coordinator area in the SERC Region shall implement the UFLS scheme developed by their Planning Coordinator. UFLS entities may implement the UFLS scheme developed by the Planning Coordinator by coordinating with other UFLS entities. The UFLS scheme shall meet the following requirements on May 1 of each calendar year. *[Violation Risk Factor: Medium] [Time Horizon: Operations Planning]*
- 4.1.** The percent of load shedding to be implemented shall be based on either:
- A.** The actual or estimated substation or feeder demand (including losses) of the UFLS entities at the time coincident with the previous year's actual Peak Demand in the season specified by the Planning Coordinator in R2.
 - B.** The forecasted substation or feeder demand (including losses) of the UFLS entities at the time coincident with the next year's forecasted Peak Demand in the season specified by the Planning Coordinator in R2.
- 4.2.** The amount of load in each load shedding step shall be within -1.0 and +3.0 of the percentage specified by the Planning Coordinator (for example, if the specified percentage step load shed is 12%, the allowable range is 11 to 15%).
- 4.3.** The amount of total UFLS load of all steps combined shall be within -1.0 and +5.0 of the percentage specified by the Planning Coordinator for the total UFLS load in the UFLS scheme.
- M4.** Each UFLS entity that has a total load of 100 MW or greater in a Planning Coordinator area in the SERC Region shall have evidence such as reports or other documentation demonstrating that its implementation of the UFLS scheme on May 1 of each calendar year meets the requirements of Requirement R4

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(including all the data elements in Parts 4.1, 4.2, and 4.3) unless scheme changes per Requirement R6 are in process.

R5. Each UFLS entity that has a total load less than 100 MW in a Planning Coordinator area in the SERC Region shall implement the UFLS scheme developed by their Planning Coordinator, but shall not be required to have more than one UFLS step. UFLS entities may implement the UFLS scheme developed by the Planning Coordinator by coordinating with other UFLS entities. The UFLS scheme shall meet the following requirements on May 1 of each calendar year. [*Violation Risk Factor: Medium*] [*Time Horizon: Operations Planning*].

5.1. The percent of load shedding to be implemented shall be based on either:

A. The actual or estimated substation or feeder demand (including losses) of the UFLS entities at the time coincident with the previous year's actual Peak Demand in the season specified by the Planning Coordinator in R2.

B. The forecasted substation or feeder demand (including losses) of the UFLS entities at the time coincident with the next year's forecasted Peak Demand in the season specified by the Planning Coordinator in R2.

5.2. The amount of total UFLS load shall be within ± 5.0 of the percentage specified by the Planning Coordinator for the total UFLS load in the UFLS scheme.

M5. Each UFLS entity that has a total load less than 100 MW in a Planning Coordinator area in the SERC Region shall have evidence such as reports or other documentation demonstrating that its implementation of the UFLS scheme on May 1 of each calendar year meets the requirements of Requirement R5 (including all the data elements in Parts 5.1 and 5.2) unless scheme changes per Requirement R6 are in process.

R6. Each UFLS entity shall implement changes to the UFLS scheme which involve frequency settings, relay time delays, changes to the percentage of load in the scheme, or changes to the peak season selected in R2.1 within 18 months of notification by the Planning Coordinator. [*Violation Risk Factor: High*] [*Time Horizon: Long-term Planning*]

M6. Each UFLS entity shall have evidence such as reports or other documentation demonstrating that it has made the appropriate scheme changes within 18 months per Requirement R6. Such evidence is only required if the Planning Coordinator makes changes to the UFLS scheme as specified in Requirement R6.

- R8.** Each Generator Owner shall provide the following information within 30 days of a request by SERC or Planning Coordinator to facilitate post-event analysis of frequency disturbances. [*Violation Risk Factor: Lower*] [*Time Horizon: Long-term Planning*]
- 8.1.** Generator protection automatic underfrequency and overfrequency trip set points (Hz).
 - 8.2.** Total clearing time associated with each set point (sec). This is defined as the time that begins when frequency reaches the set point and ends when the breaker opens. If inverse time underfrequency relays are used, provide the total clearing time at 59.0, 58.5, 58.0, and 57.0 Hz.
 - 8.3.** Maximum generator net MW that could be tripped automatically due to an underfrequency or overfrequency condition.
- M8.** Each Generator Owner shall have evidence such as reports or other documentation that data specified in Requirement R8 was provided to SERC as requested.

Compliance

Compliance enforcement authority

SERC Reliability Corporation

Compliance monitoring and assessment process

- Compliance Audit
- Self-Certification
- Spot Checking
- Compliance Violation Investigation
- Self-Reporting
- Complaint

Evidence retention

Each Planning Coordinator, UFLS Entity and Generator Owner shall keep data or evidence to show compliance as identified below unless directed by SERC to retain specific evidence for a longer period of time as part of an investigation.

Each Planning Coordinator, UFLS Entity and Generator Owner shall retain the current evidence of each Requirement and Measure as well as any evidence necessary to show compliance since the last compliance audit.

If a Planning Coordinator, UFLS Entity or Generator Owner is found non-compliant, it shall keep information related to the non-compliance until found compliant or for the retention period specified above, whichever is longer.

The compliance enforcement authority shall keep the last audit records and all requested and submitted subsequent audit records.

Time Horizons, Violation Risk Factors, and Violation Severity Levels

Table 1						
R#	Time Horizon	VRF	Violation Severity Level			
			Lower	Moderate	High	Severe
R2	Long-term Planning	Medium	The Planning Coordinator's scheme did not meet one of the UFLS system design requirements identified in 2.2 through 2.6	The Planning Coordinator's scheme did not meet two of the UFLS system design requirements identified in 2.2 through 2.6.	The Planning Coordinator's scheme did not meet three of the UFLS system design requirements identified in 2.2 through 2.6.	The Planning Coordinator's scheme did not meet 2.1 OR Four or more of the UFLS system design requirements identified in 2.2 through 2.6.
R3	Long-term Planning	High	N/A	The Planning Coordinator failed to conduct one of the required simulations of its UFLS scheme.	N/A	The Planning Coordinator failed to conduct two of the required simulations of its UFLS scheme.

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R4	Operations Planning	Medium	The UFLS entity's implemented UFLS scheme had one load shedding step outside the range specified in 4.	The UFLS entity's implemented UFLS scheme had two load shedding steps outside the range specified in 4.	The UFLS entity's implemented UFLS scheme had three or more load shedding steps outside the range	The UFLS entity's implemented UFLS scheme had three or more load shedding steps outside the range
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Table 1

R#	Time Horizon	VRF	Violation Severity Level			
			Lower	Moderate	High	Severe
			2.	2.	specified in 4.2. OR The UFLS entity's implemented UFLS scheme had a total load outside the range specified in 4.3.	specified in 4.2. AND The UFLS entity's implemented UFLS scheme had a total load outside the range specified in 4.3.
R5	Operations Planning	Medium	N/A	N/A	N/A	The UFLS entity's implemented UFLS scheme had a total load outside the range specified in 5.2.

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R6	Long-term Planning	High	The UFLS entity implemented required scheme changes but made them 1 to 30 days after the scheduled date.	The UFLS entity implemented required scheme changes but made them 31 to 40 days after the scheduled date.	The UFLS entity implemented required scheme changes but made them 41 to 50 days after the scheduled date.	The UFLS entity implemented required scheme changes but made them more than 50 days after the scheduled date OR The UFLS entity failed to implement the required scheme changes.

Table 1						
R#	Time Horizon	VRF	Violation Severity Level			
			Lower	Moderate	High	Severe
			after the scheduled submittal date.	after the scheduled submittal date. OR The Planning Coordinator did not provide to SERC one piece of information listed in R7.	after the scheduled submittal date. OR The Planning Coordinator did not provide to SERC two pieces of information listed in R7.	days after the scheduled submittal date. OR The Planning Coordinator did not provide to SERC any of the information listed in R7.

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R8	Long-term Planning	Lower	The Generator Owner provided the data required in R8 to SERC or Planning Coordinator 1 to 10 days after the requested submittal date.	<p>The Generator Owner provided the data required in R8 to SERC or Planning Coordinator 11 to 20 days after the requested submittal date.</p> <p style="text-align: center;">OR</p> <p>The Generator Owner did not provide to SERC or Planning Coordinator one piece of information listed in R8.</p>	<p>The Generator Owner provided the data required in R8 to SERC or Planning Coordinator 21 to 30 days after the requested submittal date.</p> <p style="text-align: center;">OR</p> <p>The Generator Owner did not provide to SERC or Planning Coordinator two pieces of information listed in R8.</p>	<p>The Generator Owner provided the data required in R8 to SERC or Planning Coordinator more than 30 days after the requested submittal date.</p> <p style="text-align: center;">OR</p> <p>The Generator Owner did not provide to SERC or Planning Coordinator any of the information listed in R8.</p>
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Regional Variances

None

Interpretations

None

Guideline and Technical Basis

1. Existing UFLS schemes

Each Planning Coordinator should consider the existing UFLS programs which are in place and should consider input from the UFLS entities in developing the UFLS scheme.

2. Basis for SERC standard requirements

SERC Standard PRC-006-SERC-02 is not a stand-alone standard, but was written to be followed in conjunction with NERC Standard PRC-006-1. The primary focus of SERC Standard PRC-006-SERC-02 was to provide region-specific requirements for the implementation of the higher tier NERC standard requirements with the goals of a) adding clarity and b) providing for consistency and a coordinated UFLS scheme for the SERC Region as a whole.

Generally speaking, requirements already in the NERC standard were not repeated in the SERC standard. Therefore, both the NERC and SERC standards must be followed to ensure full compliance.

- ### 3. Basis for applying a percentage load shedding value to Forecast Load versus Actual Load
- The Planning Coordinator will develop a UFLS scheme to meet the performance requirements of NERC Standard PRC-006-2 Requirement R3 and SERC Standard PRC-006- SERC-02 Requirement R2. This development will result in certain percentages of load for each UFLS entity in the Planning Coordinator's area for which automatic under frequency load shedding must be implemented. The Planning Coordinator develops these percentages based on forecast peak load demand. However, the UFLS entity implements these percentages based on the previous year's actual peak demand in the season specified by the Planning Coordinator in R2. Applying the same percentage to these different base values was intentional to ensure that both the Planning Coordinator and UFLS entities had a clear, measurable value to use in performing their respective roles in meeting the standard. Planning Coordinators typically use forecast demands in their work. Whereas the previous year's actual (or estimated) demand is typically more available to UFLS entities. Additionally, the use of percentages based on these different base values tends to minimize the error due to the time lag between design and actual field implementation. Since a percentage is provided by the Planning Coordinator to the UFLS entities, any differences between the design values (i.e., forecast load) and the implemented values (i.e., previous year's actual) would naturally tend to match up reasonably well. For example, if the total planning area load in MW for which UFLS was installed during the time of implementation was slightly higher or lower than the MW value used in the design by the Planning Coordinator, multiplying by the specified percentage

would result in an implemented load shedding scheme that also had a reasonably similar higher or lower MW value.

4. Basis for May 1 and 18 month time frames

Each UFLS entity must annually review that the amount of UFLS load shedding implemented is within a certain tolerance as specified by SERC Standard PRC-006-SERC-02 Requirement R 4 or Requirement R5 by May 1 of the current year. May 1 was chosen to allow sufficient time after the previous year’s peak occurred to make adjustments in the field to the implementation if necessary to meet the tolerances specified in Requirement R4 or Requirement R5. Therefore, the May 1 date applies only to implementation of the existing percentages of load shedding specified by the Planning Coordinator. On the other hand, the 18-month time frame specified in PRC-006-SERC-02 Requirement R6 is intended to allow sufficient budgeting, procurement, and installation time for additional equipment, or for significant setting changes to existing equipment necessary to meet a revised load shedding scheme design that has been specified by the Planning Coordinator. During this 18-month transition period, the May 1 measurement of R4 or Requirement R5 would not apply.

5. Basis for smaller entity threshold of 100 MW

Most distribution substations have transformers rated in the range of 10 to 40 MVA. Usually most transformers would serve 1 to 4 feeders and each feeder will normally carry between 8 and 10 MVA. In general, assuming that each feeder would carry 10 MW, an entity with a load slightly greater than 100 MW would have at least 10 feeders available. For a program with three 10 % steps, only 3 feeders would be required to have under frequency load shed capabilities. The 100 MW threshold seems to provide adequate flexibility for implementing load shedding in three steps for entities slightly greater than 100 MW.

Version History

Version	Date	Action	Change Tracking
1	September 19, 2011	SERC Board Approved	
1	November 3, 2011	Adopted by NERC Board of Trustees	

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1	December 20, 2012	FERC Order issued approving PRC-006-SERC-01	
1	March 11, 2013	Modified the Rationale and changed the VRF for Requirement R6 from "Medium" to "High" per a compliance filing (Filed on 3/11/13)	
2	June 28, 2017	SERC Board Approved	
2	August 10, 2017	Adopted by NERC Board of Trustees	
2	October 16, 2017	FERC Order issued approving PRC-006-SERC-02	