

SERC Regional Criteria

Underfrequency Load Shedding (UFLS)

NERC Reliability Standards
PRC-006 through 009



Revision History

Revision	Date	Comments
0	September 3, 1999	EC approved both original IIIDM1 Supplement and original IIIDM3 Procedure
1	July 18, 2000	Updated IIIDM1 Supplement
2	March 8, 2002	Combined IIIDM1 Supplement and IIIDM3 Procedure into IIID Supplement. Changes made to make consistent with the NERC Planning Standard IIID.S1. M1-M4 dated June 15, 2001.
3	March 14, 2003	Clarified requirements; removed reporting forms
4	March 12, 2004	Added applicability clarification, technical assessment clarification, and references to all III.D measurements requirements.
5	March 11, 2005	Update to reflect new Version 0 NERC Standards
6	October 13, 2005	Revised M & T sections and added reference to Maintenance & Testing – Protection Systems (Transmission, UFLS, UVLS, & SPS) SERC Supplement
7	January 11, 2006	Clarified exception process and addition of load shed amount per step.
8	October 16, 2009	Updated group references and made other miscellaneous revisions.
	July 7, 2010	SERC Board Executive Committee approved as SERC Regional Criteria

Responsible SERC Reliability Corporation (SERC) Subgroup & Region Review Group

The Responsible SERC Subgroup and the Region Review Group is the SERC Dynamics Review Subcommittee (DRS) for NERC Reliability Standards PRC-006, 007, and 009. The Protection and Control Subcommittee (PCS) is the Region Review Group for PRC-008.

Review and Re-Certification Requirements

This supplement will be reviewed every three years or as appropriate by the DRS for possible revision. The existing or revised document will be re-certified and distributed to all members by the SERC Engineering Committee.

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I. Introduction/Purpose

This document serves as a supplement to the North American Electric Reliability Corporation (NERC) Reliability Standards on the development and documentation of underfrequency load shedding (UFLS) programs (reference NERC Reliability Standards PRC-006 through 009) for the SERC Region. The purpose of this document is to augment the NERC Reliability Standards for SERC members by 1) reinforcing and clarifying, as interpreted by SERC, the standard and measurements contained in the NERC Reliability Standards and 2) providing documentation on regional-specific practices related to UFLS programs and their assessment.

UFLS programs provide an automatic means of reducing load due to a load/generation imbalance. As load relative to generation rises or as generation relative to load declines, the frequency of the system drops. If the frequency falls to certain preset levels, relays will automatically operate to reduce load. UFLS systems are generally implemented in several steps, with a controlled amount of load shed in each step.

This document is not intended to address any manual load shedding systems, which may also be in place.

II. SERC Member Requirements / Expectations

- A. Each SERC member that serves load within SERC will be required to participate in a regional UFLS scheme and have the capability of shedding at least 30% of their peak hour load in a minimum of three steps distributed over the frequency range of 59.5 Hz to 58.4 Hz. Other minimum requirements are as follows:

- The first set point should be no lower than 59.3 Hz
- The range between set points should be at least 0.2 Hz but no greater than 0.5 Hz

These requirements constitute Regional UFLS Program Requirements (required by NERC Reliability Standard PRC-006). All SERC members required to have a UFLS Program shall adhere to these program requirements (reference NERC Reliability Standard PRC-007).

Any exceptions to the above minimum requirements will need to be reviewed and approved by the SERC DRS.

- B. Every year, SERC will request from SERC members information concerning their individual UFLS programs. This information request will include the following for underfrequency programs:
- Set points for load shedding
 - Any generator tripping information required to run the UFLS simulations
 - Time delays associated with each set point
 - Relay and breaker operating times
 - Amount of load at each load shedding set point in MWs and in percent of peak
 - Information describing any tie tripping and/or islanding schemes
 - Information describing any other schemes that are part of or impact the UFLS program

This information is necessary for SERC to evaluate the effectiveness of UFLS programs within the Region. This data request also facilitates SERC member requirements to “provide and annually update their UFLS data as necessary for the region to maintain and update an [sic] UFLS program” (reference NERC Reliability Standard PRC-007).

- C. Each SERC member required to participate in a UFLS program shall have an equipment maintenance and testing program. Members should reference the SERC Regional Criteria Maintenance & Testing – Protection Systems (Transmission, UFLS, UVLS, & SPS) document for maintenance and testing requirements of UFLS and other protection equipment.
- D. Any SERC member(s) experiencing a UFLS event shall analyze and document their program’s performance following the initiating conditions (reference NERC Reliability Standard PRC-009).

This analysis shall include

- 1. A description of the event, including initiating conditions
- 2. A review of the UFLS set points and tripping times
- 3. A simulation of the event
- 4. A summary of the findings

III. SERC Requirements

- A. The SERC office will prepare an annual request to acquire UFLS program data from SERC members.
- B. The SERC office will compile the information received from the above request to document the UFLS program on a regional basis. This will include an annual update to the SERC UFLS Program Database (reference NERC Reliability Standard PRC-006).
- C. The SERC office will review the information submitted and verify the data reported is complete and consistent with the reporting requirements. The DRS will review the information submitted and verify the data reported is reasonable. Questionable data will be returned to SERC member for resolution.
- D. The SERC Protection and Controls Subcommittee (PCS) will assess the efficacy of SERC member maintenance, testing, and calibration of UFLS equipment (NERC Reliability Standard PRC-008).
- E. The DRS will ensure that a Regional Technical Assessment is performed at least every five years (or sooner, as changes to the system warrant). This technical assessment will document the effectiveness of the design of the Regional UFLS program, and will include a dynamic simulation of possible disturbances that cause the Region (or portions of the Region) to experience the largest imbalances between demand and generation. This assessment shall also review and document the adequacy of UFLS frequency set points and their associated timing. The DRS will generally (but is not required to) solicit assistance from the Dynamics Study Group (DSG) for this assessment.

- F. The DRS will prepare a report regarding its findings and will submit the report to the SERC Engineering Committee (EC). This report will indicate the effectiveness of the design. .
- G. The EC will review the report and take any necessary action. The report will be provided to NERC upon request.

Attachment 1

NERC Reliability Standard

Standard PRC-006-0 — Development and Documentation of Regional UFLS Programs

A. Introduction

1. **Title:** Development and Documentation of Regional Reliability Organizations' Underfrequency Load Shedding Programs
2. **Number:** PRC-006-0
3. **Purpose:** Provide last resort system preservation measures by implementing an Under Frequency Load Shedding (UFLS) program.
4. **Applicability:**
 - 4.1. Regional Reliability Organization
5. **Proposed Effective Date:** April 1, 2005

B. Requirements

- R1. Each Regional Reliability Organization shall develop, coordinate, and document an UFLS program, which shall include the following:
 - R1.1. Requirements for coordination of UFLS programs within the subregions, Regional Reliability Organization and, where appropriate, among Regional Reliability Organizations.
 - R1.2. Design details shall include, but are not limited to:
 - R1.2.1. Frequency set points.
 - R1.2.2. Size of corresponding load shedding blocks (% of connected loads.)
 - R1.2.3. Intentional and total tripping time delays.
 - R1.2.4. Generation protection.
 - R1.2.5. Tie tripping schemes.
 - R1.2.6. Islanding schemes.
 - R1.2.7. Automatic load restoration schemes.
 - R1.2.8. Any other schemes that are part of or impact the UFLS programs.
 - R1.3. A Regional Reliability Organization UFLS program database. This database shall be updated as specified in the Regional Reliability Organization program (but at least every five years) and shall include sufficient information to model the UFLS program in dynamic simulations of the interconnected transmission systems.
 - R1.4. Assessment and documentation of the effectiveness of the design and implementation of the Regional UFLS program. This assessment shall be conducted periodically and shall (at least every five years or as required by changes in system conditions) include, but not be limited to:
 - R1.4.1. A review of the frequency set points and timing, and
 - R1.4.2. Dynamic simulation of possible Disturbance that cause the Region or portions of the Region to experience the largest imbalance between Demand (Load) and generation.

Attachment 1

NERC Reliability Standard

Standard PRC-006-0 — Development and Documentation of Regional UFLS Programs

- R2. The Regional Reliability Organization shall provide documentation of its UFLS program and its database information to NERC on request (within 30 calendar days).
- R3. The Regional Reliability Organization shall provide documentation of the assessment of its UFLS program to NERC on request (within 30 calendar days).

C. Measures

- M1. The Regional Reliability Organization shall have documentation of the UFLS program and current UFLS database.
- M2. The Regional Reliability Organization shall have evidence it provided documentation of its UFLS program and its database information to NERC as specified in Reliability Standard PRC-006-0_R2.
- M3. The Regional Reliability Organization shall have evidence it provided documentation of its assessment of its UFLS program to NERC as specified in Reliability Standard PRC-006-0_R3.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Monitoring Responsibility

Compliance Monitor: NERC.

1.2. Compliance Monitoring Period and Reset Timeframe

On request (within 30 calendar days) for the program, database, and results of assessments.

1.3. Data Retention

None specified.

1.4. Additional Compliance Information

None.

2. Levels of Non-Compliance

- 2.1. **Level 1:** Documentation demonstrating the coordination of the Regional Reliability Organization's UFLS program was incomplete in one of the elements in Reliability Standard PRC-006-0_R1.
- 2.2. **Level 2:** Not applicable.
- 2.3. **Level 3:** Not applicable.
- 2.4. **Level 4:** Documentation demonstrating the coordination of the Regional Reliability Organization's UFLS program was incomplete in two or more requirements or documentation demonstrating the coordination of the Regional Reliability Organization's UFLS program was not provided, or an assessment was not completed in the last five years.

E. Regional Differences

- 1. None identified.

Attachment 1

NERC Reliability Standard

Standard PRC-006-0 — Development and Documentation of Regional UFLS Programs

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New

Attachment 2

NERC Reliability Standard

Standard PRC-007-0 — Assuring Consistency with Regional UFLS Program Requirements

A. Introduction

- 1. Title:** Assuring Consistency of Entity Underfrequency Load Shedding Programs with Regional Reliability Organization's Underfrequency Load Shedding Program Requirements
- 2. Number:** PRC-007-0
- 3. Purpose:** Provide last resort System preservation measures by implementing an Under Frequency Load Shedding (UFLS) program.
- 4. Applicability:**
 - 4.1.** Transmission Owner required by its Regional Reliability Organization to own a UFLS program
 - 4.2.** Transmission Operator required by its Regional Reliability Organization to operate a UFLS program
 - 4.3.** Distribution Provider required by its Regional Reliability Organization to own or operate a UFLS program
 - 4.4.** Load-Serving Entity required by its Regional Reliability Organization to operate a UFLS program
- 5. Proposed Effective Date:** April 1, 2005

B. Requirements

- R1.** The Transmission Owner and Distribution Provider, with a UFLS program (as required by its Regional Reliability Organization) shall ensure that its UFLS program is consistent with its Regional Reliability Organization's UFLS program requirements.
- R2.** The Transmission Owner, Transmission Operator, Distribution Provider, and Load-Serving Entity that owns or operates a UFLS program (as required by its Regional Reliability Organization) shall provide, and annually update, its underfrequency data as necessary for its Regional Reliability Organization to maintain and update a UFLS program database.
- R3.** The Transmission Owner and Distribution Provider that owns a UFLS program (as required by its Regional Reliability Organization) shall provide its documentation of that UFLS program to its Regional Reliability Organization on request (30 calendar days).

C. Measures

- M1.** Each Transmission Owner's and Distribution Provider's UFLS program shall be consistent with its associated Regional Reliability Organization's UFLS program requirements.
- M2.** Each Transmission Owner, Transmission Operator, Distribution Provider, and Load-Serving Entity that owns or operates a UFLS program shall have evidence that it provided its associated Regional Reliability Organization and NERC with documentation of the UFLS program on request (30 calendar days).

D. Compliance

Attachment 2 NERC Reliability Standard

Standard PRC-007-0 — Assuring Consistency with Regional UFLS Program Requirements

1. Compliance Monitoring Process

1.1. Compliance Monitoring Responsibility

Compliance Monitor: Regional Reliability Organization.

1.2. Compliance Monitoring Period and Reset Timeframe

On request (within 30 calendar days).

1.3. Data Retention

None specified.

1.4. Additional Compliance Information

None.

2. Levels of Non-Compliance

2.1. Level 1: The evaluation of the entity's UFLS program for consistency with its Regional Reliability Organization's UFLS program is incomplete or inconsistent in one or more requirements of Reliability Standard PRC-006-0_R1, but is consistent with the required amount of Load shedding.

2.2. Level 2: The amount of Load shedding is less than 95percent of the Regional requirement in any of the Load steps.

2.3. Level 3: The amount of Load shedding is less than 90percent of the Regional requirement in any of the Load steps.

2.4. Level 4: The evaluation of the entity's UFLS program for consistency with its Regional Reliability Organization's UFLS program was not provided or the amount of Load shedding is less than 85 percent of the Regional requirement on any of the Load steps.

E. Regional Differences

1. None identified.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New

Attachment 3 NERC Reliability Standard

Standard PRC-008-0 — Underfrequency Load Shedding Equipment Maintenance Programs

A. Introduction

1. **Title:** Implementation and Documentation of Underfrequency Load Shedding Equipment Maintenance Program
2. **Number:** PRC-008-0
3. **Purpose:** Provide last resort system preservation measures by implementing an Under Frequency Load Shedding (UFLS) program.
4. **Applicability:**
 - 4.1. Transmission Owner required by its Regional Reliability Organization to have a UFLS program
 - 4.2. Distribution Provider required by its Regional Reliability Organization to have a UFLS program
5. **Proposed Effective Date:** April 1, 2005

B. Requirements

- R1. The Transmission Owner and Distribution Provider with a UFLS program (as required by its Regional Reliability Organization) shall have a UFLS equipment maintenance and testing program in place. This UFLS equipment maintenance and testing program shall include UFLS equipment identification, the schedule for UFLS equipment testing, and the schedule for UFLS equipment maintenance.
- R2. The Transmission Owner and Distribution Provider with a UFLS program (as required by its Regional Reliability Organization) shall implement its UFLS equipment maintenance and testing program and shall provide UFLS maintenance and testing program results to its Regional Reliability Organization and NERC on request (within 30 calendar days).

C. Measures

- M1. Each Transmission Owner's and Distribution Provider's UFLS equipment maintenance and testing program contains the elements specified in Reliability Standard PRC-008-0_R1.
- M2. Each Transmission Owner and Distribution Provider shall have evidence that it provided the results of its UFLS equipment maintenance and testing program's implementation to its Regional Reliability Organization and NERC on request (within 30 calendar days).

D. Compliance

1. Compliance Monitoring Process
 - 1.1. **Compliance Monitoring Responsibility**

Compliance Monitor: Regional Reliability Organization.
 - 1.2. **Compliance Monitoring Period and Reset Timeframe**

On request (within 30 calendar days).
 - 1.3. **Data Retention**

Attachment 3 NERC Reliability Standard

Standard PRC-008-0 — Underfrequency Load Shedding Equipment Maintenance Programs

None specified.

1.4. Additional Compliance Information

None.

2. Levels of Non-Compliance

- 2.1. **Level 1:** Documentation of the maintenance and testing program was incomplete, but records indicate implementation was on schedule.
- 2.2. **Level 2:** Complete documentation of the maintenance and testing program was provided, but records indicate that implementation was not on schedule.
- 2.3. **Level 3:** Documentation of the maintenance and testing program was incomplete, and records indicate implementation was not on schedule.
- 2.4. **Level 4:** Documentation of the maintenance and testing program, or its implementation was not provided.

E. Regional Differences

- 1. None identified.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New
0	September 26, 2005	Fixed reference in M1 from PRC-007-0_R1 to PRC -008-0_R1	Errata

Attachment 4

NERC Reliability Standard

Standard PRC-009-0 — UFLS Performance Following an Underfrequency Event

A. Introduction

1. **Title:** Analysis and Documentation of Underfrequency Load Shedding Performance Following an Underfrequency Event
2. **Number:** PRC-009-0 (067.4)
3. **Purpose:** Provide last resort System preservation measures by implementing an Under Frequency Load Shedding (UFLS) program.
4. **Applicability:**
 - 4.1. Transmission Owner required by its Regional Reliability Organization to own a UFLS program
 - 4.2. Transmission Operator required by its Regional Reliability Organization to operate a UFLS program
 - 4.3. Load-Serving Entity required by the Regional Reliability Organization to operate a UFLS program
 - 4.4. Distribution Provider required by the Regional Reliability Organization to own or operate a UFLS program
5. **Proposed Effective Date:** April 1, 2005

B. Requirements

- R1. The Transmission Owner, Transmission Operator, Load-Serving Entity and Distribution Provider that owns or operates a UFLS program (as required by its Regional Reliability Organization) shall analyze and document its UFLS program performance in accordance with its Regional Reliability Organization's UFLS program. The analysis shall address the performance of UFLS equipment and program effectiveness following system events resulting in system frequency excursions below the initializing set points of the UFLS program. The analysis shall include, but not be limited to:
 - R1.1. A description of the event including initiating conditions.
 - R1.2. A review of the UFLS set points and tripping times.
 - R1.3. A simulation of the event.
 - R1.4. A summary of the findings.
- R2. The Transmission Owner, Transmission Operator, Load-Serving Entity, and Distribution Provider that owns or operates a UFLS program (as required by its Regional Reliability Organization) shall provide documentation of the analysis of the UFLS program to its Regional Reliability Organization and NERC on request 90 calendar days after the system event.

C. Measures

- M1. Each Transmission Owner's, Transmission Operator's, Load-Serving Entity's and Distribution Provider's documentation of the UFLS program performance following an underfrequency event includes all elements identified in Reliability Standard PRC-009-0_R1.

Attachment 4

NERC Reliability Standard

Standard PRC-009-0 — UFLS Performance Following an Underfrequency Event

- M2.** Each Transmission Owner, Transmission Operator, Load-Serving Entity and Distribution Provider that owns or operate a UFLS program, shall have evidence it provided documentation of the analysis of the UFLS program performance following an underfrequency event as specified in Reliability Standard PRC-009-0_R1.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Monitoring Responsibility

Compliance Monitor: Regional Reliability Organization.

1.2. Compliance Monitoring Period and Reset Timeframe

On request 90 calendar days after the system event.

1.3. Data Retention

None specified.

1.4. Additional Compliance Information

None.

2. Levels of Non-Compliance

2.1. Level 1: Analysis of UFLS program performance following an actual underfrequency event below the UFLS set point(s) was incomplete in one or more elements in Reliability Standard PRC-009-0_R1.

2.2. Level 2: Not applicable.

2.3. Level 3: Not applicable.

2.4. Level 4: Analysis of UFLS program performance following an actual underfrequency event below the UFLS set point(s) was not provided.

E. Regional Differences

1. None identified.

Version History

Version	Date	Action	Change Tracking
0	April 1, 2005	Effective Date	New