A. Introduction

1. **Title:** Southwest Power Pool (SPP) Automatic Underfrequency Load Shedding

2. **Number:** PRC-006-SPP-01

3. **Purpose:** To develop, coordinate and document requirements for automatic underfrequency load shedding (UFLS) programs to arrest declining frequency and assist recovery of frequency following underfrequency events

4. **Applicability:**

   4.1. Planning Coordinator

   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. **Effective Date:** Requirements R4, R5, and R6 shall become effective the first day of the first calendar quarter one year after regulatory approval.

   The remaining requirements shall become effective the first day of the first calendar quarter three years after regulatory approval.

B. Requirements

   **R1.** Each UFLS entity that has a total forecasted peak Native Load greater than or equal to 100 MW shall develop and implement an automatic UFLS program that meets the following requirements. [VRF: High][Time Horizon: Long-term Planning]
1.1. The intentional relay time delay for UFLS shall be less than or equal to 30 cycles.

1.3. Undervoltage inhibit shall be less than or equal to 85 percent of nominal voltage.

**R2.** Each UFLS entity that has a total forecasted peak Native Load less than 100 MW shall develop and implement an automatic UFLS program that meets the following requirements. [VRF: Medium][Time Horizon: Long-term Planning]

2.1. A minimum of one UFLS step with the frequency set point as assigned by the Planning Coordinator.

2.2. The minimum accumulated Load relief shall be at least 30% of the forecasted peak Native Load.

2.3. The intentional relay time delay for UFLS shall be less than or equal to 30 cycles.

2.4. Undervoltage inhibit shall be less than or equal to 85 percent of nominal voltage.

**R3.** Each UFLS entity electing to use islanding schemes shall design those islanding schemes to operate after all 3 steps of UFLS have been exhausted and the frequency continues to fall below 58.5Hz. Islanding schemes shall be designed with a minimum time delay of 2 seconds for frequencies at or between 58.5 Hz and 58.0 Hz. [VRF: Lower][Time Horizon: Long-term Planning]

<table>
<thead>
<tr>
<th>(1) UFLS Step</th>
<th>(2) Frequency (hertz)</th>
<th>(3) Minimum accumulated load relief as percentage of forecasted peak Native Load (%)</th>
<th>(4) Maximum accumulated load relief as percentage of forecasted peak Native Load (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>59.3</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>59.0</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>58.7</td>
<td>30</td>
<td>45</td>
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</table>
**R4.** The Planning Coordinator shall perform and document a UFLS technical assessment to determine that the UFLS program meets Requirements R1 and R2. This assessment shall be performed at least once every five years or within one year for any of the following situations. [VRF: Medium][Time Horizon: Long-term Planning]

- Design changes are made to the parameters of the UFLS or SPP UFLS standards.
- Changes to the boundaries of a specified island are identified.

**R5.** Each UFLS entity shall maintain and submit the following UFLS data based on the forecasted peak Native Load to the Planning Coordinator within (30) calendar days upon request from the Planning Coordinator: [VRF: Lower][Time Horizon: Long-term Planning]

1. Location of installed UFLS equipment
2. Trip frequency(s) for each location
3. Total relay operating time of each location (time required for the relay to reliably sense the frequency + intentional delay time (if any))
4. Breaker operating time of each location
5. Percentage and/or MW of bus load to be shed at the location
6. Total amount of load shed by each trip frequency and the total amount of load the entity has
7. Tie tripping schemes and the frequency and time delay at which they operate
8. Islanding schemes and the frequency and time delay at which they operate

**R6.** Each Generator Owner shall maintain and submit the following UFLS data to the Planning Coordinator within (30) calendar days upon request from the Planning Coordinator: [VRF: Lower][Time Horizon: Long-term Planning]

1. Location of installed UFLS equipment
2. Trip frequency(s) for each location
6.3. Total relay operating time of each location (time required for the relay to reliably sense the frequency + intentional delay time (if any))

6.4. Breaker operating time of each location

6.5. MW of generation shed at each location

6.6. Data specified in R5 for any additional arranged load shed per R7. Specify the provider of the additional arranged load shed.

R7. Each Generator Owner shall verify by review of relay settings and generator control system settings that their generating unit(s) will not trip above the Generator underfrequency curve in Attachment 1 and will not trip below the Generator overfrequency curve in Attachment 2. Should this not be practical due to the operating characteristics of certain units, the Generator Owner shall arrange for Load shedding to be installed in addition to that required Load shedding as listed in R1 and R2. [VRF: Medium][Time Horizon: Long-term Planning]

7.1. This additional Load shedding shall be equal to or greater than the maximum amount of generation that can be tripped, instituted at the same frequency and time delays as the generator would be expected to trip and shall be within the same island.
C. Measures

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

M1. Each UFLS entity shall have dated evidence such as reports, program plans, or other documentation of its UFLS program that demonstrates it meets requirement R1 Parts 1.1 through 1.3.

M2. Each UFLS entity shall have dated evidence such as reports, program plans, or other documentation of its UFLS program that demonstrates it meets requirement R2 Parts 2.1 through 2.4.

M3. Each UFLS entity electing to use islanding schemes shall have dated evidence such as reports, program plans, or other documentation of its UFLS program that demonstrates it meets requirement R3.

M4. The Planning Coordinator shall have dated evidence that it performed a technical assessment per requirement R4.

M5. Each UFLS entity shall have dated evidence that the information was supplied to the Planning Coordinator per requirement R5.

M6. Each Generator Owner shall have dated evidence that the information was supplied to the Planning Coordinator per requirement R6.

M7. Each Generator Owner shall have dated evidence that it complies with R7 or has made arrangements for additional Load shedding, if appropriate, as required in R7. Generator Owners shall have dated evidence that it complies with additional Load shedding requirements, if appropriate, as required in R7.1.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

   SPP Regional Entity
   SERC (for Planning Coordinator only)

1.2. Data Retention

   The Planning Coordinator and each UFLS entity and Generator Owner shall keep data or dated evidence to show compliance as identified below
 unless directed by SPP Regional Entity to retain specific evidence for a longer period of time as part of an investigation:

- Each UFLS entity shall retain the current evidence of Requirements R1 or R2, and R3, Measures M1 or M2, and M3, as well as any evidence necessary to show compliance since the last compliance audit.

- Each UFLS entity shall retain evidence of UFLS data transmittal to the Planning Coordinator since the last compliance audit in accordance with Requirement R5, Measure M5.

- The Planning Coordinator shall retain the current evidence of Requirement R4, Measure M4 as well as any evidence necessary to show compliance since the last compliance audit.

- Each Generator Owner shall retain evidence of UFLS data transmittal to the Planning Coordinator since the last compliance audit in accordance with Requirement R6, Measure M6.

- Each Generator Owner shall retain evidence of Requirements R7, Measures M7 as well as any evidence necessary to show compliance since the last compliance audit.

If the 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.

1.3. Compliance Monitoring and Assessment Process

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

1.4. Additional Compliance Information

Not applicable
### 2. Violation Severity Levels

<table>
<thead>
<tr>
<th>R#</th>
<th>Time Horizon</th>
<th>VRF</th>
<th>Lower</th>
<th>Moderate</th>
<th>High</th>
<th>Severe</th>
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<tbody>
<tr>
<td>R1</td>
<td>Long-Term Planning</td>
<td>High</td>
<td>N/A</td>
<td>UFLS entity developed a program, but failed to meet any one (1) of the following 5 requirements: Part 1.1 (Step1-3) Part 1.2 Part 1.3</td>
<td>UFLS entity developed a program, but failed to meet any two (2) of the following 5 requirements: Part 1.1 (Step1-3) Part 1.2 Part 1.3</td>
<td>UFLS entity developed a program, but failed to meet three (3) or more of the following 5 requirements: Part 1.1 (Step1-3) Part 1.2 Part 1.3 OR Failed to develop a UFLS program</td>
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<td>R2</td>
<td>Long-Term Planning</td>
<td>Medium</td>
<td>UFLS entity developed a program, but failed to meet one (1) of the requirements in Parts 2.1 through 2.4</td>
<td>UFLS entity developed a program, but failed to meet two (2) of the requirements in Parts 2.1 through 2.4</td>
<td>UFLS entity developed a program, but failed to meet three (3) of the requirements in parts 2.1 through 2.4</td>
<td>UFLS entity developed a program, but failed to meet all four (4) of the requirements in Parts 2.1 through 2.4 OR Failed to develop a UFLS program</td>
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### Regional Reliability Standard: PRC-006-SPP-01

**Title:** SPP Automatic Underfrequency Load Shedding

<table>
<thead>
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<th>VRF</th>
<th>Violation Severity Level</th>
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<td></td>
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<td>R3</td>
<td>Long-Term Planning</td>
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<td>R4</td>
<td>Long-Term Planning</td>
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<td>The Planning Coordinator performed a technical assessment within five years and three months or within one year and three months after one of the situations listed in R4</td>
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<td>R5</td>
<td>Long-Term Planning</td>
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<td>UFLS entity provided required data more than 30 calendar days and up to and including 45 calendar days following the request</td>
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<td><strong>Time Horizon</strong></td>
<td><strong>VRF</strong></td>
<td><strong>Violation Severity Level</strong></td>
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<td><strong>Lower</strong></td>
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<td>R6</td>
<td>Long-Term Planning</td>
<td>Lower</td>
<td>Generator Owner provided required data more than 30 calendar days and up to and including 45 calendar days following the request OR Generator Owner did not provide one piece of information listed in R6 (e.g., 6.1.)</td>
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<tr>
<td>R7</td>
<td>Long-Term Planning</td>
<td>Medium</td>
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- and 7.1.
- R7 and 7.1.
- listed in R7 and 7.1.
### E. Associated Documents

#### Version History

<table>
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<tr>
<th>Version</th>
<th>Date</th>
<th>Action</th>
<th>Change Tracking</th>
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<td>8/31/2009 thru 9/30/2009</td>
<td>Posted for 2nd Comment Period</td>
<td>Revised to address comments from Draft 1</td>
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<tr>
<td>Draft 3</td>
<td>3/29/2010 thru 4/28/2010</td>
<td>Posted for 3rd Comment Period</td>
<td>Revised to address comments from Draft 2</td>
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PRC-006-SPP-1 - Attachment 1
Underfrequency Curves for Requirement R7

Time (sec)

Frequency (Hz)

Generator Underfrequency Trip Modeling
PRC-006-SPP-1 - Attachment 2
Overfrequency Curves for Requirement R7