

Title: SPP Automatic Underfrequency Load Shedding

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. Distribution Provider or any provider that does not have an agreement with a Transmission Owner to provide UFLS (referred to hereafter as a UFLS Participating Distribution Provider)
 - 4.3. Transmission Owner that has an agreement to provide UFLS for a Distribution Provider (referred to hereafter as a UFLS Participating Transmission Owner)
 - 4.4. Generator Owners
5. **Effective Date:** Requirements R1, R6 and R7 shall become effective 1 year after the first day of the first quarter following regulatory approval. This 1 year period is needed to allow time for Planning Coordinator to perform the studies necessary to assess the effectiveness of the UFLS program.

The remaining requirements shall become effective 3 years after the first day of the first quarter following regulatory approval. This additional 2 years is needed to allow time for any necessary changes to be made to the existing UFLS schemes in the SPP.

B. Requirements

- R1. The Planning Coordinator shall identify an island(s) as a basis for designing a UFLS program. These islands shall be chosen from historical events, system studies, any portion 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, or any other islands necessary to ensure that all portions of the region's BES are included in at least one island. Identified islands will be assessed to determine if any additional UFLS capability should

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be installed and how it should be designed and implemented. [VRF: High][Time Horizon: Long-term Planning]

- R2.** Each UFLS Participating Distribution Provider, UFLS Participating Transmission Owner and Generator Owner identified in those island(s) identified in R1 shall participate with the Planning Coordinator in an engineering assessment and mitigation plan that specifically addresses the Generation/Load imbalances. [VRF: High][Time Horizon: Long-term Planning]

- R3.** Each UFLS Participating Distribution Provider and UFLS Participating Transmission Owner shall develop and implement an automatic UFLS program. UFLS Participating Distribution Providers and UFLS Participating Transmission Owners may coordinate with other UFLS Participating Distribution Providers or UFLS Participating Transmission Owners to collectively implement the UFLS scheme. Each UFLS Participating Distribution Provider and UFLS Participating Transmission Owner will have until June 1st of the current calendar year to implement changes in their UFLS scheme as required by R4. These changes may include changes in relay locations, frequency set points, relay time delays, or any other items requested in R7. [VRF: High][Time Horizon: Long-term Planning]

The automatic UFLS program shall include the following requirements:

- 3.1.** Automatic UFLS program for UFLS Participating Distribution Providers and UFLS Participating Transmission Owners that have a total forecasted peak Native Load greater than or equal to 100 MW shall be initiated in three separate steps as indicated in the table below.

(1) UFLS Step	(2) Frequency (hertz)	(3) Minimum accumulated load relief as percentage of forecasted peak Native Load (%)	(4) Maximum accumulated load relief as percentage of forecasted peak Native Load (%)
1	59.3	10	15
2	59.0	20	30
3	58.7	30	45

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- 3.2.** Automatic UFLS program for UFLS Participating Distribution Providers and UFLS Participating Transmission Owners that have a total forecasted peak Native Load less than 100 MW and have not aggregated their Load with other UFLS Participating Distribution Providers or UFLS Participating Transmission Owners to implement a collective UFLS program shall implement the following requirements:
 - 3.2.1.** Must have a minimum of one UFLS step with the frequency set point as assigned by the Planning Coordinator.
 - 3.2.2.** The minimum accumulated Load relief shall be at least 30% of the forecasted peak Native Load.
- 3.3.** The intentional relay time delay for UFLS shall not be greater than 30 cycles.
- 3.4.** Undervoltage inhibit shall be set as low as practical, but shall not be greater than 85 percent of nominal voltage.
- 3.5.** Each UFLS Participating Distribution Provider and UFLS Participating Transmission Owner electing to use islanding schemes shall only 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 between 58.5 Hz and 58.0 Hz.
- R4.** Each UFLS Participating Distribution Provider and UFLS Participating Transmission Owner shall report by April 1st of each year to the Planning Coordinator the amount of Load as a percentage of forecasted peak Native Load it expects to automatically shed for each step identified in R3.1 or R3.2 for the current calendar year. This reported amount of Load shed shall include revisions and additions projected to be in-service by June 1st. [VRF: Medium][Time Horizon: Long-term Planning]
- R5.** The Planning Coordinator shall create and maintain an UFLS equipment database. This database shall include all information identified in R7. [VRF: Lower][Time Horizon: Long-term Planning]
- R6.** The Planning Coordinator shall periodically conduct and document a technical assessment of the effectiveness of the design of the UFLS program. [VRF: Medium][Time Horizon: Long-term Planning]
 - 6.1.** These assessments shall be completed at least every five years or within one year for any of the following situations:

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- An actuation of UFLS resulting in 500 MW or greater loss of load.
 - Design changes are made to the scheme parameters.
 - Changes to the boundaries of a specified island are identified.
- R7.** Each UFLS Participating Distribution Provider, UFLS Participating Transmission Owner and Generator Owner shall maintain and submit the following UFLS data to the Planning Coordinator at least every 5 years or within (30) calendar days upon request from the Planning Coordinator: [VRF: Medium][Time Horizon: Long-term Planning]
- 7.1.** Each UFLS Participating Transmission Owner and UFLS Participating Distribution Provider shall supply the following data based on the forecasted peak Native Load:
- 7.1.1.** Location of installed UFLS equipment
 - 7.1.2.** Trip frequency(s) for each location
 - 7.1.3.** Total relay operating time of each location (time required for the relay to reliably sense the frequency + intentional delay time (if any))
 - 7.1.4.** Breaker operating time of each location
 - 7.1.5.** Percentage and/or MW of bus load to be shed at the location
 - 7.1.6.** Total amount of load shed by each trip frequency and the total amount of load the entity has
 - 7.1.7.** Tie tripping schemes
 - 7.1.8.** Islanding schemes and the frequency and time delay at which they operate
- 7.2.** Each Generation Owner shall supply the following:
- 7.2.1.** Underfrequency trip set points
 - 7.2.2.** Overfrequency trip set points
 - 7.2.3.** Time delays

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7.2.4. Provide the data specified in R7.1 for any additional arranged load shed per R8.1. Also, specify the provider of the additional arranged load shed.

R8. Each Generator Owner with individual generating units greater than 20 MVA (gross nameplate rating) or generating plant/Facilities greater than 75 MVA (gross nameplate rating) directly connected to the BES shall verify by review of relay settings, generator control system settings, and generator operating guides 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 R3. [VRF: Medium][Time Horizon: Long-term Planning]

8.1. 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.

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C. Measures

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

- M1.** The Planning Coordinator shall have evidence that islands were studied as required in R1.
- M2.** Each UFLS Participating Distribution Provider, UFLS Participating Transmission Owner, Generator Owner and the Planning Coordinator identified in areas of island shall have evidence of an engineering assessment and mitigation plan per requirement R2.
- M3.** Each UFLS Participating Transmission Owner and UFLS Participating Distribution Provider shall have evidence that its UFLS scheme meets requirement R3.
- M4.** Each UFLS Participating Distribution Provider and UFLS Participating Transmission Owner shall have evidence of reporting load requirement per R4.
- M5.** The Planning Coordinator shall have evidence that it established and maintained an UFLS database as required in R5.
- M6.** The Planning Coordinator shall have evidence that it performed technical assessment per requirement R6.
- M7.** Each UFLS Participating Distribution Provider, UFLS Participating Transmission Owner and Generator Owner shall have evidence that the information as required in R7 was supplied to the Planning Coordinator.
- M8.** Each Generator Owner shall have evidence that it complies with the R8 or has made arrangements for additional Load shedding, if appropriate, as required in R8.

D. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

SPP Regional Entity

1.2. Compliance Monitoring Period and Reset

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Upon request (within 30 calendar days)

1.3. Data Retention

Six 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	N/A	N/A	The Planning Coordinator did not have documentation that identified an island(s).
R2	N/A	N/A	N/A	UFLS Participating Distribution Provider, UFLS Participating Transmission Owner or Generator Owner did not participate with the Planning Coordinator in an engineering assessment and mitigation plan that specifically address the Generation/Load imbalances
R3.1	N/A	UFLS	UFLS	UFLS Participating

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		Participating Distribution Provider or UFLS Participating Transmission Owner did not demonstrate one of the three separate steps as indicated in the table	Participating Distribution Provider or UFLS Participating Transmission Owner did not demonstrate two of the three separate steps as indicated in the table	Distribution Provider or UFLS Participating Transmission Owner did not demonstrate any of the three separate steps as indicated in the table
R3.2	N/A	N/A	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner did not demonstrate one UFLS step with the frequency set point as assigned by the Planning Coordinator OR Did not demonstrate the accumulated load relief of 30 % or greater of forecasted peak Native Load	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner did not demonstrate one UFLS step with the frequency set point as assigned by the Planning Coordinator AND Did not demonstrate the accumulated load relief of 30 % or greater of forecasted peak Native Load
R4	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner did not report by April 1 st to the Planning Coordinator the	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner did not report by June 1 st to the Planning Coordinator the	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner did not report by August 1 st to the Planning Coordinator the	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner did not report until after August 1 st to the Planning Coordinator the amount of load as a percentage of forecasted peak Native

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	amount of load as a percentage of forecasted peak Native Load it expects to automatically shed for each step identified in R3.1 or R3.2 for the current calendar year	amount of load as a percentage of forecasted peak Native Load it expects to automatically shed for each step identified in R3.1 or R3.2 for the current calendar year	amount of load as a percentage of forecasted peak Native Load it expects to automatically shed for each step identified in R3.1 or R3.2 for the current calendar year	Load it expects to automatically shed for each step identified in R3.1 or R3.2 for the current calendar year
R5	The Planning Coordinator did create and maintain UFLS equipment database with part of the information identified in R7	The Planning Coordinator did create but failed to maintain UFLS equipment database with all the information identified in R7	N/A	The Planning Coordinator did not create or maintain UFLS equipment database with all the information identified in R7
R6	The Planning Coordinator did not conduct and perform technical assessment within five years or within one year after one of the situations listed in 6.1	N/A	N/A	The Planning Coordinator did not conduct and perform technical assessment within six years or within two years after one of the situations listed in 6.1
R7	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner or Generator Owner provided required data within 31 to 45 days after the request was made	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner or Generator Owner provided required data within 46 to 60 days after the request was	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner or Generator Owner provided required data within 61 to 75 days after the request was	UFLS Participating Distribution Provider or UFLS Participating Transmission Owner or Generator Owner did not provide required data after the request was made. OR UFLS Participating Distribution Provider or UFLS Participating

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		made. OR UFLS Participating Distribution Provider or UFLS Participating Transmission Owner or Generator Owner did not provide one piece of information listed in R7 (e.g., 7.1.1)	made. OR UFLS Participating Distribution Provider or UFLS Participating Transmission Owner or Generator Owner did not provide two pieces of information listed in R7 (e.g., 7.1.1. and 7.1.2)	Transmission Owner or Generator Owner did not provide three or more pieces of information listed in R7 (e.g., 7.1.1. and 7.1.2 and 7.1.3)
R8	N/A	The Generator Owner did not comply with one of the requirements listed in R8 and 8.1	The Generator Owner did not comply with two of the requirements listed in R8 and 8.1	The Generator Owner did not comply with three or more of the requirements listed in R8 and 8.1

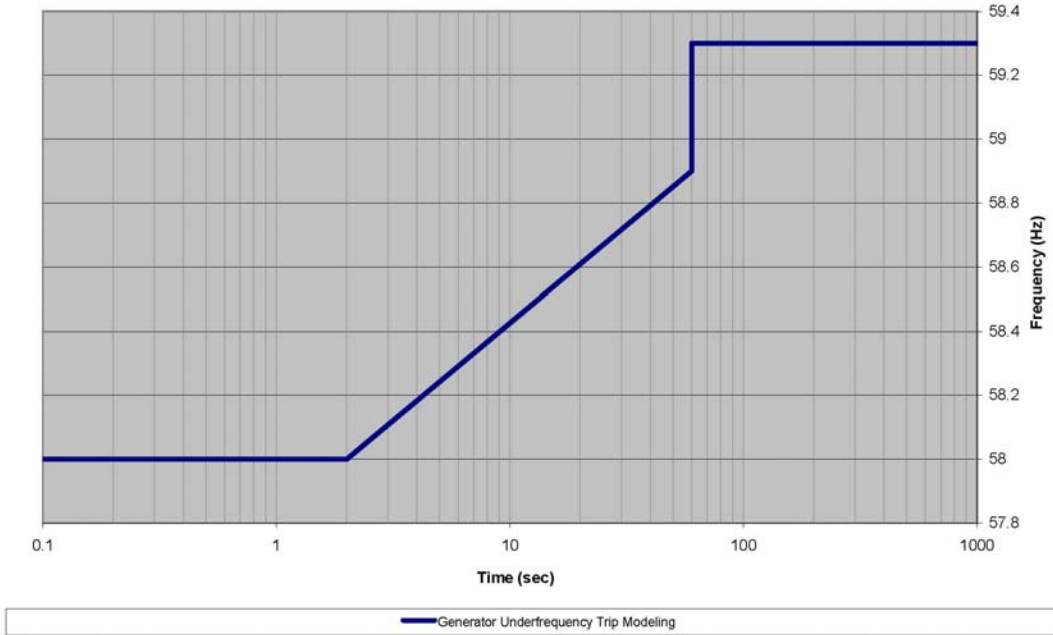
E. Associated Documents

Version History

Version	Date	Action	Change Tracking
Draft 1	3/31/2009 thru 4/30/2009	Posted for 1 st Comment Period	Initial version
Draft 2	8/31/2009 thru 9/30/2009	Posted for 2 nd Comment Period	Revised to address comments from Draft 1
Draft 3	3/29/2010 thru 4/28/2010	Posted for 3 rd Comment Period	Revised to address comments from Draft 2

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**Attachment 1
Underfrequency Curves for Requirements R8**



**Attachment 2
Overfrequency Curves for Requirements R8**

