


# SPP PC UFLS Plan

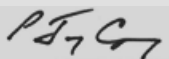
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SME Signature	Date

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## Revision History

Date or Version Number	Author	Change Description	Comments
7/2/2013	SPCWG	Rev. 0	Initial draft
7/16/2013	SPP Planning Coordinator	Rev. 1	MOPC approved SPCWG's Recommendation to endorse the UFLS Plan from the Consent Agenda
6/03/2014	SPP Planning Coordinator	Rev. 2	Incorporated RCWG revisions. Added Appendices A-E. Grammatical and formatting edits.
6/20/2014	SPP Planning Coordinator	Rev. 2.1	RCWG, SPCWG, UFLS Entities comments
6/24/2014	SPP Planning Coordinator	Rev. 3	For final RCWG, SPCWG recommendations
10/21/2014	SPP Planning Coordinator	Rev. 3.1	Stakeholder process cleanup. Section 6.0 – UFLS Program < 100MW: specified frequency setpoints. Appendix B – UFLS Data: enhanced instructions.
8/18/2015	SPP Planning Coordinator	Rev. 4	For final SPCWG recommendations. Definition for UFLS Entity modified to include PC authority to require an Entity to install UFLS equipment. Posted for comment. Inclusion of PRC-006-2 "Corrective Action Plan" changes. Nonmaterial change in Section 9.0: change "survey form" to "the Attestation Form" to clarify which form is uploaded.
9/17/2015	SPP Planning Coordinator	Rev. 4.1	Considers submitted comments and September 11, 2015 conference call input. Final.
9/30/2015	SPP Planning Coordinator	Rev. 4.2	Language cleanup "TO, DP" language to include "TO, DP, and GO" (PRC-006-2, R4.1 through R4.6).

# Table of Contents

<b>Revision History</b> .....	<b>2</b>
<b>Introduction</b> .....	<b>5</b>
<b>SPP PC UFLS Plan</b> .....	<b>6</b>
Section 1.0 - Study Island Identification (PRC-006-2.R1).....	6
Section 2.0 - Island Selection (PRC-006-2.R2).....	6
Section 3.0 – Performance Characteristics (PRC-006-2.R3, R10) .....	6
3.1 Volts/Hz (V/Hz) limits (R3.3).....	6
3.2 Automatic switching of equipment for over-voltage control (R10).....	7
Section 4.0 – PC Coordination (PRC-006-2.R5 and R7).....	7
4.1 Island and Program Design (R5) .....	7
4.2 Data (R7).....	7
Section 5.0 - UFLS Program > 100MW .....	7
Section 6.0 – UFLS Program < 100MW .....	8
Section 7.0 – Islanding Schemes .....	8
Section 8.0 –Technical Assessment .....	8
Section 9.0 - UFLS Entity (TO and DP) Data Submittal.....	8
9.1 Attestation Form .....	9
9.2 UFLS Data (PRC-006-2, R6) .....	9
9.3 SPP PC UFLS Contact .....	9
9.4 TO/DP Contact and Changes .....	10
9.5 SPP PC Planning Model .....	10
Section 10.0 – Generator Owner Data Submittal .....	10
Section 11.0 – Generator Owner Trip Verification .....	10
Section 12.0 – Supplemental Load Shedding.....	10
Section 13.0 – Implementation of Supplemental Load Shedding .....	11
Section 14.0 - Data Coordination with other Planning Coordinators (PRC-006-2.R7) .....	11

Section 15.0 – Post Event UFLS Plan Design Assessment (PRC-006-2.R11-12, R15) .....	11
Section 16.0 – Post Event Island Assessment Coordination (PRC-006-2.R13) .....	11
Section 17.0 – Plan Change Coordination (PRC-006-2.R12) .....	12
17.1 Modification .....	12
17.2 Appeal Process .....	12
17.3 Comment Period .....	12
Section 18.0 – Notifications (PRC-006-2.R3).....	13
Section 19.0 – Schedule for Implementation (PRC-006-1.R3).....	13
Section 20.0 – Corrective Action Plan (PRC-006-2.R15) .....	13
<b>Appendices .....</b>	<b>14</b>
Appendix A – SPP UFLS Plan Contacts .....	14
Appendix B – UFLS Data.....	15
Definitions (tab) in the UFLS Entity Inventory DB: .....	15
Appendix C – Schedule for Implementation .....	17
SPP Underfrequency Load Shedding (UFLS) Plan Implementation Schedule .....	17
Appendix D – Attestation Form (Example) .....	18
Appendix E – Reporting Instructions .....	19
Check List.....	19
Data Posting .....	19
Subject Matter Expert (SME).....	20
Attestation Form .....	20
Dynamic Stability Model .....	20
UFLS Model DB.....	20
Entity UFLS Inventory DB .....	20

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# Introduction

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The Southwest Power Pool Planning Coordinator (SPP PC) Automatic Underfrequency Load Shedding Plan (UFLS Plan) is designed to develop, coordinate, and document requirements for automatic underfrequency load shedding (UFLS) programs to arrest declining frequency and to assist with the recovery of frequency following underfrequency events. In order to evaluate the UFLS Plan, the SPP PC will collect UFLS data annually and perform the design assessment at least once every five years.

The SPP PC UFLS Plan applies to Generator Owners (GO) and UFLS entities. UFLS entities are entities responsible for the ownership, operation, or control of UFLS equipment as required by the UFLS program established by the PCs. Such entities may include one or both of the following: Transmission Owners (TO) and Distribution Providers (DP). This UFLS Plan requires annual updates to the UFLS data by UFLS entities.

An SPP PC UFLS entity can be either a TO or a DP. In order to meet the definition of a UFLS entity, a DP must meet all the following conditions:

- Owns and operates (armed) automatic UFLS equipment to arrest frequency decline for UFLS events defined by PRC-006-1 as of October 1, 2013.
- Has total DP load greater than or equal to what is specified by NERC in the most current Statement of Compliance Registry Criteria for a Distribution Provider.

In order to meet the definition of a UFLS entity, a TO must meet the following condition:

- Owns and operates (armed) automatic UFLS equipment to arrest frequency decline for UFLS events defined by PRC-006-1 as of October 1, 2013.
- UFLS entities seeking changes to the status of their UFLS equipment shall coordinate with TOs/DPs that are directly impacted by the operation of UFLS equipment and obtain SPP PC approval.
- New Entities being added to the SPP PC footprint who qualify as UFLS entities based on the criteria above shall coordinate their UFLS equipment data with the SPP PC UFLS contact and adhere to the SPP PC UFLS implementation schedule [Appendix C](#). These New Entities shall also coordinate with TOs/DPs that are directly impacted by the operation of UFLS equipment if applicable.

The SPP PC may require TOs, DPs, and GOs within its Island(s) to install UFLS relays based on the Island(s) need to meet NERC PRC-006-2 as a result of an event, study, and or mitigation plan.

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# SPP PC UFLS Plan

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## **Section 1.0 - Study Island Identification (PRC-006-2.R1)**

PRC-006-2-R1 requires criteria be specified for the selection of a study island. The SPP PC will examine historical events as well as conduct future studies to determine the adequacy of its UFLS system. When the SPP PC has evidence to warrant investigation of including more than one UFLS island, it will coordinate the analysis with the System Protection and Control Working Group (SPCWG), UFLS entities, and other affected PCs to develop a subsequent UFLS Plan to meet NERC PRC-006-2.

## **Section 2.0 - Island Selection (PRC-006-2.R2)**

The SPP PC has identified one island consisting of the SPP PC footprint to serve as a basis for designing its UFLS program. The SPP PC island was selected by considering the following:

- Those islands selected by applying the criteria in Section 1.
- Any portions of the bulk electric system (BES) designed to detach from the Interconnection (planned islands) as a result of the operation of a relay scheme or Special Protection System.
- A single island that includes all portions of the BES in either the Regional Entity area or the Interconnection in which the PC's area resides. If a PC's area resides in multiple Regional Entity areas, each of those Regional Entity areas will be identified as an island. PCs may adjust island boundaries to differ from Regional Entity area boundaries by mutual consent where necessary for the sole purpose of producing contiguous regional islands more suitable for simulation.
- System studies.
- Changes to the PC island boundary.
- Review of historical events.

## **Section 3.0 – Performance Characteristics (PRC-006-2.R3, R10)**

### **3.1 Volts/Hz (V/Hz) limits (R3.3)**

As a part of the SPP PC UFLS evaluation, V/Hz for all SPP PC UFLS entities' generators at a generator terminal bus and/or a generator step-up (GSU) transformer high-side bus will be studied. This study is performed to assess generators and transformers magnetic flux during a 25% generation loss scenario. The actual magnitude of magnetic flux in the generator stator or transformer core is difficult to measure; however, it can be quantified in terms of per unit V/Hz, since the operating magnetic flux in electric machines is proportional to the ratio of the operating voltage to the electrical frequency. Therefore, V/Hz provides a measure of generator stator and transformer core magnetic flux. Excessive magnetic flux in the transformer or generator results in thermal damages to the generator and GSU transformer. These damages are typically cumulative and include, but are not limited to, generator stator and GSU transformer core damage and degradation of insulation material. Excessive magnetic flux may also cause unwanted operation of protection system. The objective of the study is to identify generator terminal or GSU transformer high-side buses for which V/Hz exceeds stipulated values of 1.18 PU for longer than two seconds cumulatively, or 1.1 PU for longer than 45 seconds cumulatively for the simulated event of 25% generation loss scenario.

Therefore, Volts per Hz (V/Hz) will not exceed 1.18 per unit for longer than two seconds cumulatively per simulated event and will not exceed 1.10 per unit for longer than 45 seconds cumulatively per simulated event at each generator bus and generator step-up transformer high-side bus associated with each of the following:

- Individual generating units greater than 20 MVA (gross nameplate rating) directly connected to the bulk electric system (BES).
- Generating plants/facilities greater than 75 MVA (gross aggregate nameplate rating) directly connected to the BES.
- Facilities consisting of one or more units connected to the BES at a common bus with total generation above 75 MVA gross nameplate rating.

### **3.2 Automatic switching of equipment for over-voltage control (R10)**

The SPP PC has not identified the need to require Transmission Owners (TO) to provide automatic switching of its existing equipment (capacitor banks, Transmission Lines, and reactors) to control over-voltage as a result of Underfrequency load shedding. When the SPP PC has identified the need to require Transmission Owner to provide automatic switching of its existing equipment to control over-voltage as a result of Underfrequency load shedding the SPP PC will notify the TOs of the effective date to implement this section of the SPP PC UFLS Plan. The TO will follow the Schedule for Implementation, [Appendix C](#), upon notification by the SPP PC.

## **Section 4.0 – PC Coordination (PRC-006-2.R5 and R7)**

### **4.1 Island and Program Design (R5)**

When multiple PCs are included in the SPP PC UFLS island, SPP, as the PC, will coordinate its UFLS program design with adjacent PCs whose areas or portions of whose areas are also part of the same identified island through one of the following:

- Develop a common UFLS program design and schedule for implementation among the PCs whose areas or portions of whose areas are part of the same identified island; or
- Conduct a joint UFLS design assessment at least every five years among the PCs whose areas or portions of whose areas are part of the same identified island; or
- Conduct an independent UFLS design assessment per the SPP PC UFLS Plan, and if the assessment fails to meet SPP PC UFLS Plan, identify modifications to the UFLS program(s) to meet the SPP PC UFLS Plan and report these modifications as recommendations to the other PCs whose areas or portions of whose areas are also part of the same identified island and the ERO.

### **4.2 Data (R7)**

The SPP PC will provide its UFLS database containing data necessary to model its UFLS program to other PCs within its Interconnection within 30 calendar days of a request for data.

## **Section 5.0 - UFLS Program > 100MW**

Each UFLS entity that has a total forecasted peak Load as specified in the annual data request (see Appendix B) greater than or equal to 100 MW will develop and implement an automatic UFLS program that meets the following requirements:

- A minimum of 10% will be shed at each UFLS step in accordance with the table below.

UFLS Step	Frequency (hertz)	Minimum accumulated load relief as percentage of forecasted peak Load (%)	Maximum accumulated load relief as percentage of forecasted peak Load (%)
1	59.3	10	25
2	59.0	20	35
3	58.7	30	45

- The intentional relay time delay for UFLS will be less than or equal to 30 cycles.
- There is no minimum total clearing time (relay operating time + breaker trip time).
- Undervoltage inhibit setting will be less than or equal to 85% of nominal voltage.

UFLS entities may implement an aggregated UFLS program with other UFLS entities. The 100 MW limit refers to the aggregated plan, if one exists.

### **Section 6.0 – UFLS Program < 100MW**

Each UFLS entity that has a total forecasted peak Load as specified in the annual data request (see Appendix B) less than 100 MW will develop and implement an automatic UFLS program that meets the following sections:

- A minimum of one UFLS step with the frequency set point that can be any of the following: 59.3 Hz, 59.0 Hz, or 58.7 Hz. If the current frequency set point is not 59.3 Hz, 59.0 Hz, or 58.7 Hz then the UFLS Entity will change the set point to the nearest of 59.3 Hz, 59.0 Hz, or 58.7 Hz per the SPP PC UFLS Schedule of Implementation.
- The minimum accumulated Load relief will be at least 30% of the forecasted peak Load.
- The intentional relay time delay for UFLS will be less than or equal to thirty (30) cycles.
- Undervoltage inhibit setting will be less than or equal to 85% of nominal voltage.
- UFLS entities may implement an aggregated UFLS program with other UFLS entities. The 100 MW limit refers to the aggregated plan, if one exists.

### **Section 7.0 – Islanding Schemes**

Each UFLS entity electing to use underfrequency islanding schemes will design those islanding schemes to operate after all three steps of UFLS have been exhausted and the frequency continues to fall to 58.5 Hz or below. For islanding schemes designed to operate at or between 58.5 Hz and 58.0 Hz, the minimum time delay will be two seconds. For islanding schemes designed to operate below 58.0 Hz, no time delay is required.

### **Section 8.0 –Technical Assessment**

The PC will perform and document a UFLS technical assessment according to PRC-006.

### **Section 9.0 - UFLS Entity (TO and DP) Data Submittal**

The PC will annually request the completion of an Attestation Form and UFLS data from each registered TO ,DP, and GO in its PC area. Each TO, DP, and GO will provide the requested information to the PC



within 30 calendar days. The Attestation Form is in [Appendix D](#). Details on the UFLS data are in [Appendix B](#).

For those entities with TrueShare access upload the Attestation Form to:

[www.TrueShare.com](http://www.TrueShare.com)

↳ **SPP UFLS Plan Data (folder)**

↳ **“Individual TO, DP, and GO” (sub-folder).**

**Note: DO NOT** post data in the root folder “SPP UFLS Plan Data” on [www.TrueShare.com](http://www.TrueShare.com).

**Example:** The DP “ABC” will post their signed Attestation Form and Inventory Spreadsheet in the sub-folder “ABC” within [www.TrueShare.com](http://www.TrueShare.com).

For those entities without TrueShare access submit survey form via email to:

The UFLS subject matter expert, see [Appendix A](#).

## 9.1 Attestation Form

The Attestation Form announces the Submission Period (example, Annual submittal for 2013) and the required Reporting Period (example, October 1 through October 30, 2013) for the Entity to complete the form and if applicable supply the UFLS data. The responding Entity will complete the Form by checking all the following items that apply:

- Entity is a Transmission Owner.
- Entity is a Distribution Provider.
- Entity is a Generator Owner.
- Entity owns Automatic Underfrequency Load Shedding (UFLS) Relay(s). (PRC-006-2).
- Entity does not own any UFLS Relays (PRC-006-2).
- Entity owns Automatic Load Restoration (ALR) Relay(s). (PRC-006-2, Req. 4.7).
- Entity does not own any ALR Relays (PRC-006-2).
- Entity owns frequency generation protection equipment.

The Entity must sign and complete the remainder of the form.

## 9.2 UFLS Data (PRC-006-2, R6)

The UFLS data is necessary to model the SPP PC UFLS program for use in event analysis and assessments of the UFLS program. The data and format for the data will be reviewed by the SPCWG. Requirements for the UFLS Data are specified in the data request. Requirements for the UFLS Data or database are in [Appendix B](#).

## 9.3 SPP PC UFLS Contact

If TrueShare access is denied by an entity, the entity is to submit the UFLS Data and Attestation Form via email to the SPP PC UFLS Subject Matter Expert (SME), see [Appendix A](#).

## 9.4 TO/DP/GO Contact and Changes

The SPP PC requires a registered TO/DP/GO in the PC to provide at minimum the Compliance Contact. Changes or additions to the TO/DP/GO contact(s) should be submitted via email to the SPP PC SME, [Appendix A](#).

## 9.5 SPP PC Planning Model

The SPP PC typically uses the next year Summer Peak planning stability model and power flow model to perform required UFLS Plan assessment. The location of the model will be specified in the data request.

Percentage of UFLS Entity load shed is based on that entities' total load in the specified model.

**Example 9.5.1:** The October 2013 UFLS request based UFLS load shed amount on the SPP Model Development Working Group (MDWG) 2013 Series, Summer Peak 2014 case.

Registered TO/DPs submitting UFLS data on behalf of their members will group the data in such a way as to clearly identify compliance with the UFLS Plan.

**Example 9.5.2:** A TO who report UFLS data for multiple DP's might show an unbalanced mixture of DP's loads being shed in each UFLS Step 1, 2, and 3 while each step meets the 10% total trip requirement. UFLS data can be grouped by DP's within each Step with subtotals of percent load shed by group within the Step.

Access to the models is controlled through CEII. If you require access to these models please contact the SPP UFLS Plan SME, [Appendix A](#).

## **Section 10.0 – Generator Owner Data Submittal**

Each Generator Owner registered within the SPP PC with armed frequency protection relaying equipment will submit the completed UFLS Data Form, [Appendix B](#) – Generation UF Data, sub-Section 5 to the PC within 30 calendar days upon request from the PC.

## **Section 11.0 – Generator Owner Trip Verification**

Each Generator Owner will verify that their generating unit(s) will not trip above the generator underfrequency curve and will not trip below the generator overfrequency curve in NERC PRC-006-2 Attachment 1 as a result of the unit(s) frequency protective relay settings.

For generating units with operating characteristics that limit the unit's ability to perform in accordance with this requirement, the Generator Owner will provide to the PC technical evidence demonstrating that the unit cannot operate within the specified frequency range without causing equipment damage or violating manufacturer's published equipment ratings.

PRC-006-2 Requirements 4.1 through 4.6 requires SPP to consider and model protective relays for generators that trip in the "no trip zone" defined in the diagram during the development of SPP UFLS Program. The diagram in PRC-006-2 Attachment 1 shows the "no trip zone" as the area between the two outside curves. At a minimum, during the UFLS design assessment SPP PC will simulate generator protection systems that trip generation when frequency is in the "no trip zone". This action applies to units that are identified in PRC-006-2 Requirements 4.1 through 4.6.

## **Section 12.0 – Supplemental Load Shedding**

The PC will determine if the Generator Owner has provided technical evidence demonstrating the unit cannot operate within the specified frequency range without causing equipment damage or violating manufacturer's published equipment ratings.

The PC will determine if the UFLS program performance is degraded due to the removal of any generation identified in accordance with Section 11 and verified in accordance with Section 11.

If the PC determines the UFLS program is degraded in accordance with Section 11 and supplementary load shedding is, therefore, required, the PC will notify the Generator Owner or UFLS entity(s) in accordance with the following:

- Where the Generator Owner is a UFLS entity and has the required amount of supplementary load available, the PC will notify the Generator Owner of load the entity is required to shed (in addition to that required in accordance with Section 5 and Section 6).
- Where the Generator Owner is not a UFLS entity, or does not have the required supplementary load available for shedding, the PC will notify any other UFLS entity(s) within the PC's area of load the entity(s) is required to shed (in addition to that required in accordance with Section 5 and Section 6).

### **Section 13.0 – Implementation of Supplemental Load Shedding**

The Generator Owner or other UFLS entity(s) will implement supplementary shedding of load required by the PC in accordance with Section 12.

### **Section 14.0 - Data Coordination with other Planning Coordinators (PRC-006-2.R7)**

SPP PC will provide its UFLS database containing data necessary to model its UFLS program to other PCs within its Interconnection within 30 calendar days of a request for data.

### **Section 15.0 – Post Event UFLS Plan Design Assessment (PRC-006-2.R11-12, R15)**

The SPP PC, in whose area a BES islanding event results in system frequency excursions below the initializing set points of the UFLS program, will conduct and document an assessment of the event within one year of event actuation to evaluate the performance of the UFLS equipment and the effectiveness of the UFLS program.

When UFLS program deficiencies are identified, the SPP PC will conduct and document a UFLS design assessment within two years of event actuation to consider the identified deficiencies, see Section 20.

### **Section 16.0 – Post Event Island Assessment Coordination (PRC-006-2.R13)**

The SPP PC, in whose area a BES islanding event occurred that also included the area(s) or portions of area(s) of other PCs in the same islanding event and that resulted in system frequency excursions below the initializing set points of the UFLS program, will coordinate its event assessment with all other PCs whose areas or portions of whose areas were also included in the same islanding event through one of the following:

- Conduct a joint event assessment among the PCs whose areas or portions of whose areas were included in the same islanding event; or
- Conduct an independent event assessment that reaches conclusions and recommendations consistent with those of the event assessments of the other PCs whose areas or portions of whose areas were included in the same islanding event; or

- Conduct an independent event assessment and where the assessment fails to reach conclusions and recommendations consistent with those of the event assessments of the other PCs whose areas or portions of whose areas were included in the same islanding event, identify differences in the assessments that likely resulted in the differences in the conclusions and recommendations and report these differences to the other PCs whose areas or portions of whose areas were included in the same islanding event and the ERO.

## **Section 17.0 – Plan Change Coordination (PRC-006-2.R12)**

Changes to the SPP PC Plan could be initiated by a UFLS study, UFLS event, identified deficiency in the Plan, TO or DP changes in the PC footprint, or UFLS entity requests. UFLS entities may request changes to the SPP PC UFLS Plan through the SPCWG and the PC. Communication to the SPCWG is through the SPCWG Secretary and Chair. The SPCWG contact information is on the SPP corporate web site:

[www.spp.org](http://www.spp.org) > Org Groups.

Appeals on the UFLS Plan may be brought to the PC and the SPCWG. If the appeal(s) is accepted by the PC, SPP staff will revise the UFLS Plan and resubmit the revised plan to SPCWG for review.

### **17.1 Modification**

- **UFLS entities** and **Transmission Owners** within its Planning Coordinator area may request changes to the SPP UFLS Plan through the SPCWG and the SPP PC. Modifications to the UFLS Plan may be made by the PC.
- **The SPP PC may designate TO/DP/GO(s) within its PC footprint to meet performance requirements under the SPP PC UFLS Plan per PRC-006-2.**
- The Reliability Compliance Working Group (**RCWG**) may request changes to the UFLS Plan.
- The **SPP PC** will consider and respond to all written comments and will approve appropriate changes to the Plan at its discretion. The SPP PC is the final authority in Plan changes.
- The **SPCWG** will review changes to the SPP PC UFLS Plan.
- **Conflicts** that arise in SPP PC changes to the UFLS Plan and UFLS entities will be resolved by the SPCWG.
- The **Appendices** contain information that aids in supporting the SPP PC UFLS Plan. This information may require changes that facilitate the program implementation that should not require SPCWG review. Examples of these changes could include contacts or data formats related to UFLS Data. These changes will be reviewed by the SPCWG Chair. Significant changes to the SPP PC UFLS Plan will follow the above Modification procedures.

### **17.2 Appeal Process**

Appeals on the UFLS Plan may be brought to the PC and the SPCWG. If the appeal(s) is accepted by the SPP PC, SPP staff will revise the UFLS plan and resubmit the revised plan to the SPCWG for review.

### **17.3 Comment Period**

The SPP PC will provide a comment period of 15 days and respond to comments from its UFLS entities, TO, DP, and GOs on changes to the SPP PC UFLS Plan. The revised SPP UFLS Plan will be posted on [www.spp.org](http://www.spp.org), in ORG Groups, System Protection and Control Working Group, SPCWG Documents. Notification will also be sent to the SPCWG, RCWG, and the UFLS entities email lists.

## **Section 18.0 – Notifications (PRC-006-2.R3)**

The SPP PC Plan notifications are by email to SPP PC registered TO, DP, and GOs. The notification will:

- Include the UFLS data submittal 30-day open and close dates.
- Reference the applicable **SPP UFLS Plan**.
- Include the applicable **Implementation Schedule**, [Appendix C](#).
- Include **Reporting Instructions**, [Appendix E](#), which provide details on how the TO/DP/GO is to post and complete data for the request.
- Include the applicable **Attestation Form**, [Appendix D](#), for the TO/DP/GO to complete and post per the Reporting Instructions.
- Provide location and access instructions to the **UFLS Plan Database**, [Appendix B](#), also known as the **Inventory Spreadsheet**.

## **Section 19.0 – Schedule for Implementation (PRC-006-1.R3)**

The initial Schedule for Implementation of the SPP PC UFLS Plan was based on the MOPC approved Plan, July 16, 2013 UFLS Plan, see [Appendix C](#). The Schedule for Implementation will be updated as required by NERC applicable standards or by the SPP PC to reflect changes to the SPP UFLS Plan.

## **Section 20.0 – Corrective Action Plan (PRC-006-2.R15)**

Should the design assessment performed after an event reveal a UFLS deficiency, the PC shall develop a Corrective Action Plan within two years of the event (R12).

Should the five-year design assessment reveal a UFLS deficiency, the PC shall develop a Corrective Action Plan within five years of the design assessment (R4 and R5).

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# Appendices

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## **Appendix A – SPP UFLS Plan Contacts**

The SPP PC contacts are:

**SPP Planning Coordinator**

Director of Research Development & Special Studies Department

**Subject Matter Expert (SME)**

Send email to [ufls@spp.org](mailto:ufls@spp.org)

**Compliance Contact**

Compliance Engineer (Planning)

**System Protection and Controls Working Group (SPCWG)**

Chairman & Staff Secretary

[http://www.spp.org/committee\\_detail.asp?commID=18](http://www.spp.org/committee_detail.asp?commID=18)

**Data Transfer**

GIS Analyst Transmission Engineering & Modeling

**UFLS Data Sharing site**

[www.Trueshare.com](http://www.Trueshare.com) >> SPP UFLS Plan Data >> UFLS Entity Folders

**UFLS Model**

The current UFLS Model is posted on [www.TrueShare.com](http://www.TrueShare.com) with location specified data request.

Access to the models is controlled through CEII. If you require access to these models please contact the UFLS Plan SME in this Appendix.

## Appendix B – UFLS Data

Entities (TO/DP/GO) who submit UFLS data on behalf of their Members or other UFLS Entities that own/operate UFLS equipment will complete the UFLS Entity Inventory DB and the Model DB. The Reporting Instructions (**Appendix E**) contains details on how to complete the databases.

The data in the UFLS Entity Inventory DB “Definitions” tab (below) contains the details for the requested data. Optional items are not required; however, they are helpful in identifying location of equipment, etc.

### Definitions (tab) in the UFLS Entity Inventory DB:

UFLS Inventory Database TAB	Term	Definitions	Example
Details	Entity Name	NERC Entity Name	
	Total Entity Load (MW) responsibility	UFLS Entity Sum of SPP Model UFLS Model real power load (MW) responsibility. Includes both UFLS load shed amount and non-UFLS loads. SPP Model Entity TO/DP Total forecasted peak load (MW). This MW value is used to calculate the percent load shed per relay.	
UFLS Inventory Database TAB	Term	Definitions	Example
Load Shed	Substation Name (Optional)		
	Bus Number (F <sub>x</sub> sensing relay)	Bus number in powerflow model where the relay senses/measures frequency. This location may be different from the breaker location.	
	Bus Name (Optional)	Bus Name in powerflow model where the relay senses/measures frequency. This location may be different from the breaker location.	
	Feeder Number (Optional)	Names of distribution feeders that trip when Model Load-ID trips. Show all that apply. This data is optional.	Feeder 1 Name; Feeder 2 Name
	Bus Number (P <sub>L</sub> )	SPP model bus number where load is shed.	
	SPP Model Bus Name (Optional)	SPP model bus name where load is shed.	
	Load ID	SPP model Load ID unique identifier for load on bus.	
	Breaker Number (Optional)		
	T <sub>b</sub> (seconds)	The breaker trip time in seconds – distribution, transmission, or generator. This is not total clearing time.	T <sub>b</sub> = 0.05 is 3 cycles. This represents typical breaker trip time at this location.
	P <sub>L</sub> (MW)	SPP model amount of total load with ID on bus in MW.	
	T <sub>R1</sub> , T <sub>R2</sub> , T <sub>R3</sub> , T <sub>RX</sub> (seconds)	Relay operating time in seconds includes the time required for the relay to reliably sense the frequency + intentional delay time (if any). This is not total clearing time. T <sub>R1</sub> = Load shed in Step 1 frequency, 59.3 HZ T <sub>R2</sub> = Load shed in Step 2 frequency, 59.0 HZ T <sub>R3</sub> = Load shed in Step 3 frequency, 58.7 HZ T <sub>RX</sub> = Load shed in other frequency settings.	T <sub>R</sub> = 0.25 is 15 cycles. This represents typical relay operating time at this location and frequency step.
	F <sub>R</sub> (HZ)	Relay frequency setpoint/pickup in Hertz.	
P <sub>1</sub> , P <sub>2</sub> , P <sub>3</sub> , P <sub>X</sub> (MW)	The total amount of load shed (MW) at that frequency. P <sub>1</sub> = Load shed in Step 1 frequency, 59.3 HZ P <sub>2</sub> = Load shed in Step 2 frequency, 59.0 HZ P <sub>3</sub> = Load shed in Step 3 frequency, 58.7 HZ P <sub>X</sub> = Load shed in other frequency settings.	P <sub>X</sub> = P <sub>L</sub> * (previous data submitted aggregate P <sub>X</sub> at F <sub>R</sub> ) / (previous data submitted P <sub>L</sub> ). These values come directly from the 2013 UFLS data submitted and represent the sum of all feeder load tripped. SPP PC assumes that the UFLS Entity will populate these values with the new expected total amount of UFLS MW to shed on the Bus with this ID.	
Fraction	Fraction of total load with ID shed / P <sub>L</sub> .		
Comments	UFLS Entity comments.		

UFLS Inventory Database TAB	Term	Definitions	Example
<b>Branch Shed</b>	Substation Name (Optional)		
	Bus Number (F <sub>X</sub> sensing relay)	Bus numer in powerflow model where the relay senses/measures frequency. This location may be different from the breaker location.	
	Bus Name (F <sub>X</sub> sensing relay)	Bus Name in powerflow model where the relay senses/measures frequency. This location may be different from the breaker location.	
	Bus Number (From)	SPP model branch or transformer 1st bus number.	
	Bus Name (From)	SPP model branch or transformer 1st bus name.	
	Bus Number (To)	SPP model branch or transformer 2nd bus number.	
	Bus Name (To)	SPP model branch or transformer 2nd bus name.	
	Branch ID	SPP model branch or transformer unique identifier, ID.	
	F <sub>R</sub> (Hz)	Relay frequency setpoint/pickup in Hertz.	
	T <sub>R</sub> (seconds)	Relay operating time in seconds includes the time required for the relay to reliably sense the frequency + intentional delay time (if any). This is not total clearing time. T <sub>R</sub> = Load shed in frequency, F <sub>R</sub> .	T <sub>R</sub> = 0.25 is 15 cycles. This represents typical relay operating time at this location and frequency step.
T <sub>b</sub> (seconds)	The breaker trip time in seconds – distribution, transmission, or generator. This is not total clearing time.	T <sub>b</sub> = 0.05 is 3 cycles. This represents typical breaker trip time at this location.	
P <sub>L</sub> (MW)	The total amount of load shed (MW) at that frequency.	These values come directly from the 2013 UFLS data submitted and represent the sum of all feeder load tripped. SPP PC assumes that the UFLS Entity will populate these values with the new expected total amount of UFLS MW to shed on the Bus with this ID.	
Comments	UFLS Entity comments.		

UFLS Inventory Database TAB	Term	Definitions	Example
<b>Gen Shed</b>	Substation Name (Optional)		
	Bus Number (F <sub>X</sub> sensing relay)	Bus numer in powerflow model where the relay senses/measures frequency. This location may be different from the breaker location.	
	Bus Name (Optional)	Bus Name in powerflow model where the relay senses/measures frequency. This location may be different from the breaker location.	
	F <sub>RL</sub> (Hz)	Relay frequency low setpoint/pickup in Hertz.	
	F <sub>RH</sub> (Hz)	Relay frequency high setpoint/pickup in Hertz.	
	T <sub>R</sub> (seconds)	Relay operating time in seconds includes the time required for the relay to reliably sense the frequency + intentional delay time (if any). This is not total clearing time. T <sub>R</sub> = Load shed in other frequency settings.	T <sub>R</sub> = 0.25 is 15 cycles. This represents typical relay operating time at this location and frequency step.
	T <sub>b</sub> (seconds)	The breaker trip time in seconds – distribution, transmission, or generator. This is not total clearing time.	T <sub>b</sub> = 0.05 is 3 cycles. This represents typical breaker trip time at this location.
	Unit Bus Number	SPP model generator unit bus number.	
	Unit Bus Name (Optional)	SPP model generator unit bus name	
	Unit ID	SPP model generator unit ID.	
P <sub>G</sub> (MW)	SPP model generation real power (MW) shed.		
Comments	UFLS Entity comments.		

UFLS Inventory Database TAB	Term	Definitions	Example
<b>Automatic Load Restoration (ALR)</b>	Substation Name (Optional)		
	Bus Number (F <sub>X</sub> sensing relay)	Bus numer in powerflow model where the relay senses/measures frequency. This location may be different from the breaker location.	
	Bus Name	Bus Name in powerflow model where the relay senses/measures frequency. This location may be different from the breaker location.	
	Feeder Number (Optional)	Names of distribution feeders that trip when Model Load-ID trips. Show all that apply. This data is optional.	Feeder 1 Name; Feeder 2 Name
	ALR F <sub>R</sub> (HZ)	Relay frequency setpoint/pickup in Hertz for Load <b>restoration</b> .	
	ALR T <sub>R</sub> (seconds)	Relay operating time in seconds includes the time required for the relay to reliably sense the frequency + intentional delay time (if any). This is not total clearing time.	T <sub>O</sub> = 0.25 is 15 cycles.
	Bus Number (ALR)	SPP model bus number where load is <b>restored</b> .	
	Bus Name (ALR) (Optional)	SPP model bus name where load is <b>restored</b> .	
	Load ID (ALR)	SPP model Load ID unique identifier for load on bus.	
	P <sub>L</sub> (MW)	SPP model amount of total load with ID on bus in MW.	
	ALR P <sub>R</sub> (MW)	The total amount of load <b>restored</b> (MW) at that frequency.	These values come directly from the 2013 UFLS data submitted and represent the sum of all feeder load <b>restored</b> .
	ALR Fraction	Fraction of total load with ID <b>restored</b> / P <sub>L</sub> .	
	ALR T <sub>b</sub> (seconds)	The breaker <b>close</b> time in seconds – distribution, transmission, or generator. This is not total clearing time.	T <sub>b</sub> = 0.05 is 3 cycles.
System voltage for load restoration (PU).	SPP model bus Voltage in kV / system nominal kV.	If system voltage to restore load is 69 kV and sytem nominal voltage is 69 kV then = 1.0 PU.	
Comments	UFLS Entity comments.		
<b>Load Removed</b>	See tab for details		
<b>Branch Removed</b>	See tab for details		
<b>Gen Removed</b>	See tab for details		



## **Appendix C – Schedule for Implementation**

### **SPP Underfrequency Load Shedding (UFLS) Plan Implementation Schedule**

The Southwest Power Pool UFLS Plan shall be effective **October 1, 2013**.

Sections 3, 5, 6, 7, 11, 12, and 13 shall be completed by the first day of the first calendar quarter 36 months after Planning Coordinator (PC) notification.

Section 8 shall be completed within one year after the occurrence of any of the following situations:

- Performance characteristic changes to PRC-006-2 or the SPP UFLS Plan.
- Changes to the boundaries of a specific island are identified.

Sections 9 and 10 shall be completed within 30 calendar days from PC notification.

Section 14 shall be completed by SPP within 30 calendar days from a request for data by a PC with its interconnection.

Section 15 shall be completed by the PC and:

- An assessment shall be conducted and documented for the event within one year of event actuation to evaluate the performance of the UFLS equipment and the effectiveness of the UFLS program.
- If UFLS program deficiencies are identified as a result of the islanding event assessment, a UFLS design assessment will be conducted and documented within two years of the event.
- The PC shall provide a Corrective Action Plan and schedule of implementation for the above deficiencies.

Section 20: The PC shall provide the affected UFLS entities a schedule of implementation when a UFLS design assessment has identified a need for a Corrective Action Plan.

**Appendix D – Attestation Form (Example)**

**UFLS Data Submittal  
PRC-006-2**

Reporting Period: Annual Submittal for “APPLICABLE YEAR”  
Submission Period: “30 days from the receipt of the request”

Responding Entity is a:

Transmission Owner                       Distribution Provider    Generator Owner

Mark all the following that are applicable:

- Entity owns armed Automatic Underfrequency Load Shedding (UFLS) Relay(s). (PRC-006-2) (Entities that own UFLS Relays are required to upload a UFLS Inventory Spreadsheet. The UFLS Inventory Spreadsheet is available in the document download section in TrueShare)
- Entity does not own any armed UFLS Relays (PRC-006-2)
- Entity owns armed Automatic Load Restoration (ALR) Relay(s). (PRC-006-2, Req. 4.7) (Entities that own UFLS Relays are required to upload a UFLS Inventory Spreadsheet. The UFLS Inventory Spreadsheet is available in the document download section in TrueShare)
- Entity does not own any armed ALR Relays (PRC-006-2)
- Entity does own generator protective relays (PRC-006-2, Req. 4.1 through 4.6)
- Entity does not own generator protective relays (PRC-006-2, Req. 4.1 through 4.6)
- Entity owns automatic equipment (capacitor banks, Transmission Lines, and reactors) used to control over-voltage as a result of Underfrequency load shedding. (PRC-006-2, Req. 10)
- Entity does not own automatic equipment used to control over-voltage as a result of Underfrequency load shedding. (PRC-006-2, Req. 10)
- Entity reports UFLS Plan data on behalf of itself, its membership, or other TO/DP/GOs (PRC-006-2)

As a member of senior management (Vice President, Director, or other senior management), I am the responsible person for the oversight of the entity’s implementation of, and compliance with NERC-approved reliability standard requirements. I certify that the answers provided above are true to the best of my knowledge for the Reporting Period and Submission Period noted above.

Signature: \_\_\_\_\_

Name (print): \_\_\_\_\_

Title: \_\_\_\_\_

Registered Entity: \_\_\_\_\_

NCR: \_\_\_\_\_

Signature Date: \_\_\_\_\_

The completed and signed form should be uploaded to TrueShare prior to submitting the annual UFLS Data Submittal, which is due 30 days from the receipt of the request.

## **Appendix E – Reporting Instructions**

Below is the Reporting Instructions to be used as Guideline for UFLS Data requests.

### ***Southwest Power Pool***

201 Worthen Drive  
Little Rock, AR 72223-4936

[Date]

### **All Transmission Owners, Distribution Provider, and Generator Owner Primary Compliance Contacts:**

To fulfill the requirements of PRC-006-2, the Southwest Power Pool (SPP) Planning Coordinator (PC) will request UFLS data annually not to exceed fifteen months via TrueShare and Email.

This document contains specific guidelines on the Under Frequency Load Shedding (UFLS) data submittal. Guidelines on completing the UFLS Inventory Database (DB) are based on SPP UFLS Plan, Section 9 & 10 – UFLS Entity Data Submittal & Generator Owner Data Submittal.

The SPP PC is requesting TO/DP/GO UFLS data updates. This document provides instructions on completing the data request. The “Attestation Form”, “Dynamic Stability Model”, “UFLS Model Database (DB)”, and “Entity UFLS Inventory DB” and are used to support the data request.

### **Check List**

#### **TO/DP/GO Non-UFLS Entity**

- Post completed and signed Attestation Form.

#### **TO/DP/GO UFLS Entity**

- Post completed and signed Attestation Form.
- Post updated UFLS Entity Inventory DB in the Entity Folder.
- Post updated UFLS Model DB in Entity Folder. *Mark all Entity loads in the UFLS Model DB, tab “Available Loads”, column A “Entity Load (1 = Yes)”.*

### **Data Posting**

The SPP PC has a secure cloud data service, [www.TrueShare.com](http://www.TrueShare.com), for posting UFLS data requested material. TO/DP/GOs who are authorized to use this serve will post their Entity data in the Entity assigned folder in “SPP UFLS Plan Data”.

[www.TrueShare.com](http://www.TrueShare.com)

↳ SPP UFLS Plan Data

↳ “Individual TO, DP, and GO” (sub-folder)

**Note:** DO NOT post data in the root folder “SPP UFLS Plan Data” on [www.TrueShare.com](http://www.TrueShare.com).

**Example:** The DP “ABC” will post their signed Attestation Form and Inventory Spreadsheet in the sub-folder “ABC” within [www.TrueShare.com](http://www.TrueShare.com).

The SPP PC TO/DP/GOs who are restricted from using a cloud service will email their Entities requested material to the Subject Matter Expert (SME). Use **UFLS** in the subject line of the email.

## **Subject Matter Expert (SME)**

[SME contact information goes here]

## **Attestation Form**

All SPP PC TO/DP/GOs shall complete, sign, and post the required Attestation Form regarding ownership of UFLS, Automatic Load Restoration (ALR) relays, generator protective relays, and/or automatic equipment used to control over-voltage as a result of Underfrequency load shedding.

## **Dynamic Stability Model**

SPP PC is collecting UFLS data in 2015. The SPP planning stability model and power flow (UFLS Model) to use for this data request is the 2015 Model Development Working Group, 2016 Summer Peak Dynamic Stability model.

The 2015 UFLS Model is posted on:

[www.TrueShare.com](http://www.TrueShare.com)

↳ SPP UFLS Plan Data

↳ Models

↳ Year

**Note:** The folder “Year” contains the Year + 1 available dynamics model. Example: the 2015 request for UFLS data uses the 2016 Summer Peak dynamics model. Access to the models is controlled through CEII. If your Entity requires access to these models please contact the SME.

## **UFLS Model DB**

The UFLS Model DB contains the current powerflow model bus, load, machine, branch, and transformer data. The UFLS Model DB can be used as the source data to update the UFLS Inventory DB. The UFLS Model DB is posted in the Model folder on [www.TrueShare.com](http://www.TrueShare.com).

The SPP PC UFLS Entities will mark all their loads with a “1” in the tab “Available Loads”. The sum of all Entities Available load should equal the total “UFLS Entity Load” which is used to determine the amount of load shed at the SPP Plan steps.

## **Entity UFLS Inventory DB**

The Entity UFLS Inventory Database includes prepopulated load shed, branch shed, generation shed, and automatic load restoration data. The initial request for data is considered draft, since it is estimated from the previous data submittals and the current UFLS model.

The data is posted in the assigned UFLS Entity folder.

A comprehensive list of data definitions is in the tab, “Instructions and Definitions”.

*The UFLS Entity will validate/populate the UFLS data in the UFLS Inventory DB.*

## **ENTITY DETAILS**

The Entity name, NERC NCR ID#, and total model summer peak load (MW) are in the tab, “Entity Details”. The reported UFLS Entity “Total Forecasted Peak Load per SPP Model MW” is the UFLS Entities peak demand for the TO/DP in the SPP Model.

### **LOAD SHED**

The initial draft version of the Inventory DB posted by SPP PC contains load shed by frequency based on the previous UFLS data submitted, i.e. 2013, scaled up or down based on the current model, i.e. 2014, load MW.

Load shed amounts ( $P_x$ ) are estimates from the previous UFLS data submitted and represent the sum of all distribution feeder load tripped. The initial total bus load shed with ID at the frequency pickup is the new SPP model bus load with ID ( $P_L$ ) multiplied by the ratio of the previous sum of loads shed at the frequency setpoint ( $F_R$ ) divided by the *previous* SPP Model load with ID ( $P_L$ ).

$P_x$  = aggregated load shed with ID at frequency setpoint.

$P_L$  = load with ID in model.

$F_R$  = frequency setpoint.

$P_x = P_L * (\text{previous data submitted aggregate } P_x \text{ at } F_R) / (\text{previous data submitted } P_L)$

Loads not found in the current powerflow model are in the tab, "Load, Branch, or Generation Removed".

### **BRANCH SHED**

Refer to "Definition" for data details. Branch data not found in the current powerflow model is in the tab, "Load, Branch, or Generation Removed".

### **GEN SHED**

Refer to "Definition" for data details. Generation data not found in the current powerflow model is in the tab, "Load, Branch, or Generation Removed".

### **AUTOMATIC LOAD RESTORATION (ALR)**

Refer to "Definition" for data details. ALR data not found in the current powerflow model is in the tab, "Load, Branch, or Generation Removed".

### **LOAD, BRANCH, GENERATION REMOVED**

The buses, loads, branches, transformers, or generator units not found in the current UFLS Model DB are in the Load, Branch, or Generation Removed tabs.

Please contact the SPP PC Subject Matter Expert (SME) by phone, or by email with any questions.

Sincerely,

[SME contact information goes here]

Copy to: AO for Transmission Owners (TO), Distribution Providers (DP), and Generation Owner (GO) that are participating in SPP Underfrequency Load Shedding (UFLS) Plan