A. Introduction

1. **Title: Automatic Underfrequency Load Shedding Requirements**

2. **Number: PRC-006-SERC–01**

3. **Purpose: To establish SERC requirements for automatic underfrequency load shedding (UFLS)**

4. **Applicability:**
   - **4.1 Distribution Provider (?)**
   - **4.2 Transmission Owners (?)**
   - **4.3 Load Serving Entity (LSE's > xx MW)? (all LSE's regardless of size)**
   - **4.4 Generator Owner (all generators with an individual nameplate rating or plants with an aggregate nameplate rating of 50 MVA (20?) or greater, connected at 100 kV or above**
   - **4.5 Transmission Planner**
   - **4.6 Planning Coordinator (?)**

5. **(Proposed) Effective**

B. Requirements

R1 Each Transmission Planner in the SERC footprint shall determine appropriate islands to study as a design basis for UFLS. These islands shall be chosen from system studies, actual system operations, or other islands as deemed appropriate. Islands identified~~, as deemed appropriate,~~ to form a design basis for UFLS shall include at least the following two islands: [Violation Risk Factor: Lower]: ~~[Purpose: Appropriate islands shall be identified as a design basis for UFLS]~~

R1.1. A single island that includes all of the SERC footprint to verify that all SERC UFLS schemes ~~are coordinated when acting together and~~ meet the performance requirements when acting together.

R1.2 A single island for each SERC Sub~~-~~region to verify that all ~~SERC~~ UFLS schemes within ~~each~~ the sub~~-~~region ~~are coordinated when acting together and~~ meet the performance requirements when acting together. ~~[Purpose: The test of the performance requirements are applied to each sub region.~~

~~**Comment: there may be a significant problem as to how to determine which UFLS scheme must change when simulations at the Sub-regional level do not meet performance requirements. One solution is to require that each scheme be tested separately.**~~

R2 Each Transmission Planner in the SERC footprint shall ~~develop an~~design an automatic UFLS scheme ~~which~~that ~~has~~ meets the following minimum ~~characteristics~~requirements: [*Violation Risk Factor: High]*

R2.1 Have the capability of shedding at least 30 ~~(25?)~~ percent of connected load determined from the forecasted annual peak hour load. ~~[Purpose: To provide sufficient capacity and capability to arrest frequency decline and restore system frequency within required timeframe.] **[No concern over this requirement]**~~

R2.2 Shed load ~~in~~ with a minimum of three ~~steps~~frequency set points. ~~[Purpose: To provide sufficient spacing between frequency steps to provide for adequate response and prevent frequency overshoot.] **[No concern over this requirement] SERC Supplement states "approximately equal increments"**~~

R2.3 The ~~first~~ highest frequency set point with time delay of less than one second shall be no lower than 59.3 Hz and not higher than 59.~~7~~ 5 Hz. ~~(additional load shedding required per R4 or R5 is excluded from this requirement) [Purpose: The first set point needs to be high enough to arrest frequency decline.] **[Concern was raised over including a maximum threshold]**~~

R2.4 The ~~last~~ lowest frequency set point shall be no lower than 58.4 Hz ~~and not higher than 58.8 Hz (additional load shedding required per R4 or R5 is excluded from this requirement) [Purpose: Frequency set points should be high enough to coordinate with generation protection. The spacing between set points and number of set points provide load / generation mismatch selectivity and should be sufficient to prevent overshoot.] **[Concern was raised over including a maximum threshold]**~~

R2.5 The difference between frequency set points shall be at least 0.2 Hz but no greater than 0.5 Hz. ~~(additional load shedding required per R4 or R5 is excluded from this requirement) [Purpose: The spacing between set points provide load/generation mismatch selectivity and should be sufficient to prevent overshoot.] **[No concerns over this requirement]**~~

R2.6 Intentional relay time delay shall be ~~no less than~~at least 6 cycles ~~and less than xx cycles, with the following exceptions: [Purpose: Time delay not less than 6 cycles prevents spurious trips. If time delay is too long, then performance requirements cannot be met - exception R3.6.3 provides for kick-up frequency step(s)]: **[Concern was raised over the exception]**~~

R3 The Transmission Planner shall design his UFLS scheme to meet performance requirements R3.1 through R3.4 for each identified island (if any) in his footprint. The Transmission Planner shall design his UFLS scheme such that when taken together with all of the other UFLS schemes in the Region, the composite will meet performance requirements ~~R4~~R3.1 through R~~4~~3.4 for the Region considered as an island. The Transmission Planner shall design his UFLS scheme such that when taken together with

all of the other UFLS schemes in his Subregion, the composite will meet performance requirements ~~R4~~R3.1 through ~~R4~~R3.4 for the Subregion considered as an island. These performance requirements shall be satisfied for underfrequency conditions resulting from an imbalance between load and generation of 25 percent for all design basis islands (generation equals 75% of load). [*Violation Risk Factor: High]* ~~[Purpose: Satisfy NERC requirements and assure coordination between UFLS schemes with different set points within an interconnection, region, or identified island(s) within or between regions.]~~

R3.1 Frequency decline shall be arrested at no less than 58.0 Hz.

R3.2 Frequency shall not remain below 58.5 Hz for greater than 10 seconds, cumulatively, and shall not remain below 59.5 Hz for greater than 30 seconds, cumulatively. **[Note: ~~we are~~the SERC UFLS Standard Drafting Team ~~requesting~~ requested these criteria be changed by NERC]**

R3.3 Frequency overshoot resulting from operation of UFLS relays shall not exceed 61.0 Hz for any duration and shall not exceed 60.5 Hz for greater than 30 seconds, cumulatively. **[Note: we are requesting these criteria be changed by NERC]**

R3.4 Bulk Electric System voltage during and following UFLS operations shall be controlled such that the per unit Volts per Hz (V/Hz) will not exceed 1.18 for longer than 2 seconds, cumulatively, and will not exceed 1.10 for longer than 45 seconds, cumulatively. **[Note: we are requesting these criteria be changed by NERC]**

R4 All Transmission Planners within the SERC footprint are responsible for assessing the effectiveness of the design of their UFLS schemes. [*Violation Risk Factor: High]*

R4.1 Transmission Planners shall verify UFLS schemes are coordinated by performing ~~through~~ dynamic simulations that demonstrate that the performance requirements of R3 are met. ~~implementation of the Standard is adequate for: [Matches Characteristic 10.1-.3]~~

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~~**R4.1.1**. The requirements in items R2 and R3,~~

~~**R4.1.2**. The system boundaries, conditions, and the identified islands specified in accordance with item R1.~~

R4.2a If the aggregation of the subregion's UFLS schemes fails to meet all the requirements in R3:

R4.2.1 An individual TP in that subregion can demonstrate that its UFLS scheme meets the requirements of R3 by performing dynamic simulations that apply its UFLS scheme on its individual system or on the entire subregion

and all identified islands in which it would be required to operate.

R4.2.2. If the footprint of a UFLS scheme has peak system load that is less than 3% of SERC's has peak system load, then the TP will be compliant to this standard if it's UFLS scheme meets the requirements in items R3.1 and R3.2 when the scheme is applied alone to the Subregion

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R4.2 Transmission Planners shall conduct a UFLS assessment at least once every five years.

R4.2.1. {shall specify any conditions under which the TP conduct the assessment at more frequent intervals.}
? if new islands are identified [by experience]
? material changes to the scheme
? material changes to the specified islands

R4.3 Transmission Planners shall provide the assessment results to SERC or NERC within 30 calendar days of a request.

R5 Each Transmission Owner in the SERC footprint shall coordinate with all Distribution Providers and Load Serving entities serving the connected load to implement the automatic UFLS scheme developed by the Transmission Planner responsible for their system. Transmission Owners may participate with other Transmission Owners to implement the UFLS scheme developed by the Transmission Planner responsible for their collective systems.

R6 **? Should we have a section like this?** If automatic underfrequency protection is installed, each Generator Owner's unit shall not trip faster than the minimum tripping time delays in the following table:
[Violation Risk Factor: High]

Table 1

Frequency (Hz)	Minimum Time Delay (Sec)
≥ 59.5	
<59.5 to > 59.2	
≤59.2 to > 58.5	
≤58.5 to > 58.2	
≤58.2	

R6.1 In those cases where a generator must be tripped for its own protection outside the specifications in the above Table 1, the Generator Owners shall arrange for load shedding to be installed, in addition to that required by the UFLS scheme.

R6.1.1 This additional load shedding shall be equal to or greater than the generator MW, instituted at the same frequency and time as the generator would be expected to trip.

R6.1.2 If the generator is located within a credible island, arrangement for additional load shedding shall be within the credible island.

Minutes of 8/28/08 WebEx:
R6: The Standard Drafting Team agreed that this requirement on generators that trip early providing replacement load shedding was needed.

Sharma's comments:
During WebEx on 8/28, there was a discussion on whether UFLS requirement R6 is needed as part of this standard and whether this standard should be applicable to Generator Owners. **My recommendation is to delete this requirement as it is covered well under PRC 024 which will be soon posted for comments and is applicable to GO's.** Some of the verbiage in PRC 024 for discussion purposes is listed below:

Purpose: To ensure that generators remain connected to the electrical grid during voltage and frequency excursions and are not normally tripped manually or by preset protection schemes during frequency and voltage excursions

R2. The Regional Reliability Organization shall establish and maintain requirements for generators to remain connected during frequency and voltage excursions. These requirements shall include:

R2.1. Coordination between the generator under frequency protection and the regional Under Frequency Load Shedding (UFLS) program.

R7. Generator Owners and Transmission Owners shall comply with the regional requirements for coordination of generator protection defined in R2 and any approved variances.

I want to point out that coordination portion is covered under R2.1 and R7.

R7 Each Transmission Owner shall provide UFLS data for the SERC UFLS database. This data shall be provided within 30 calendar days of a request by the Region. The data will be requested by the Region at least once every five years. *[Violation Risk Factor: Lower]*.

R7.1 Each DP and LSE having load in the UFLS program shall provide UFLS data to their TO within 30 calendar days of a request by the TO.

R7.2 The data to be provided by each applicable entity (TO, DP, LSE) shall be in the format shown in Attachment 1.

R7.3 Generator Owners shall supply underfrequency trip set points and time delays for generating units within 30 calendar days of a request by the TO.

(Attachment 1 will be the current SERC portal form and will be attached to the standard)

R8 Coordination of UFLS programs with external entities shall be accomplished by the following requirements *[Violation Risk Factor: Lower]*:

R8.1 Transmission Planners shall provide the data in the database required in R7 and Assessment results required in R4 to neighboring entities responsible for UFLS assessment external to SERC.

R8.2 Transmission Planners shall request UFLS data and assessment results from neighboring entities responsible for UFLS assessment external to SERC.

Notes: (To be removed when incorporated into document)… Thought of SERC being required to perform studies with neighbor's UFLS settings or reviewing results from reports done for adjacent regions, but what could we do if such a study failed performance requirements or showed another type of lack of coordination? SERC could make recommendations that another region changes their settings, but we would have no authority to enforce the change to ensure that performance requirements are achieved.

C. Measures

D. Compliance

1 Compliance Monitoring Process

2 Violation Severity Levels