

Unofficial Comment Form for the Second Draft of the Underfrequency Load Shedding Program Requirements — Project 2007-01

Please **DO NOT** use this form. **Please use the electronic comment form located at the link below** to submit comments on the proposed second draft of the Underfrequency Load Shedding Program Requirements developed by the standard drafting team for Project 2007-01 – Underfrequency Load Shedding. Comments must be submitted by **May 20, 2009**. If you have questions please contact Stephanie Monzon at stephanie.monzon@nerc.net or by telephone at 610-608-8084.

http://www.nerc.com/filez/standards/Underfrequency_Load_Shedding.html

Background Information

The major objectives of Project 2007-01 Underfrequency Load Shedding are to:

- 1) Ensure UFLS programs are developed that meet the requirements of the proposed continent wide standard to provide an appropriate level of reliability (not least common denominator).
- 2) Ensure that the standard is enforceable with clearly defined requirements and unambiguous language.
- 3) Address the issues raised by FERC Order 693 and other applicable orders.
- 4) Address the issues raised in the original Standards Authorization Request (SAR) for this project.
- 5) Address coordination between underfrequency load shedding and generator trip settings during frequency excursions.

The standard drafting team (SDT) for Project 2007-01 Underfrequency Load Shedding (UFLS) based its work on the existing NERC standards:

- PRC-006-0 — Development and Documentation of Regional UFLS Programs,
- PRC-007-0 — Assuring Consistency with Regional UFLS Program Requirements, and
- PRC-009-0 — UFLS Performance Following an Underfrequency Event.

Project 2007-01 Under Frequency Load Shedding is one of four projects¹ identified in the Reliability Standards Development Plan 2008-2010 as requiring a set of Regional Standards to support a continent-wide standard.

In accordance with the associated SAR, a standard drafting team was appointed to draft the continent-wide UFLS standard with consideration of developing supporting regional standards. For the first posting the team recommended that, instead of developing a continent-wide standard, NERC issue a set of UFLS performance characteristics required in regional reliability standards for implementing automatic UFLS programs to arrest declining

¹ The other three projects were, Project 2007-05 Balancing Authority Controls; Project 2007-11 Disturbance Monitoring; and Project 2008-04 Protection Systems

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Bulk Electric System frequency. The team posted the set of UFLS performance characteristics for comment and received valuable feedback. However, many comments expressed concern that a directive containing these performance characteristics was a new form of “requirement” and would not necessarily follow the NERC standards development process including future revisions to the performance characteristics with industry input.

The team recommended that NERC use its authority from section 312.2 of the Rules of Procedure to direct each Regional Entity to develop a regional UFLS reliability standard based on approved UFLS Regional Reliability Standard Characteristics. Section 312.2 of the Rules of Procedure of the North American Electric Reliability Corporation states:

Regional Reliability Standards That are Directed by a NERC Reliability Standard — Although it is the intent of NERC to promote uniform reliability standards across North America, in some cases it may not be feasible to achieve a reliability objective with a reliability standard that is uniformly applicable across North America. In such cases, NERC may direct regional entities to develop regional reliability standards necessary to implement a NERC reliability standard. Such regional reliability standards that are developed pursuant to a direction by NERC shall be made part of the NERC reliability standards.

While the Rules of Procedure allow NERC to direct the development of Regional Reliability Standards, the regional reliability standards must be developed to implement a NERC reliability standard. The standard drafting team’s initial proposed approach of establishing common system performance characteristics rather than prescribing a uniform design specification for all UFLS programs within a continent-wide standard recognizes that the objective of the UFLS programs is to arrest and recover frequency in islanded portions of an interconnection. In addition, UFLS programs with differing design specifications can be successfully coordinated if they are designed to achieve the same system performance characteristics, even across interconnected regions. Nevertheless, the initial approach taken by the drafting team is not achievable absent a continent wide standard.

Considering industry feedback and the intent of the Rules of Procedure regarding directing regional reliability standards the team evaluated many options that would preserve the existing regional entity expertise relative to defining credible islands within or between its region and neighboring regions and expertise in assessing islands within their regions based on electrically interconnected areas. The team also considered the role of the Planning Coordinators in their analysis as the functional entity most suitable to determine the UFLS program design given that the Regional Entities are not user, owners, or operators of the Bulk Electric System and should not be assigned responsibility for requirements.

After much deliberation, the team decided to convert the “Characteristics of UFLS Regional Reliability Standards” into a continent wide standard that will follow the standards development process. The team acknowledges that this is a shift in approach but sees many benefits to proceeding with a continent-wide standard.

- While the majority of the comments indicated support for the creation of Regional Standards that determine the details of the UFLS programs the majority of the comments also generally supported the concept of applying common continent-wide characteristics. The original intent was for the Regional Standards to meet these common performance characteristics. The creation of a continent-wide standard does not deviate from this approach but rather eliminates the confusion caused with this new form of requirement that was intended to direct the Regions to create Regional Reliability Standards for UFLS that met the common performance characteristics.

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- The creation of a continent-wide standard does not prohibit the creation of Regional Standards for UFLS. Regional Entities may develop other performance requirements through Regional Standards or Regional Variances as permitted by the NERC Rules of Procedure. This approach still allows each region to develop requirements that meet the specific needs of the region while still maintaining a continent-wide level of reliability.
- The team's original intent with the performance characteristics to ensure coordination among the programs is still being preserved by proposing a continent-wide standard. The team assigned the responsibility of designing the UFLS program to the Planning Coordinator (Requirement R2). The Planning Coordinators within a region will define the amount of load shed required, how many blocks, at what frequency, etc. (these specific requirements will not be contained in the proposed continent wide standard).

In the development of the proposed continent wide standard, the SDT recognized that UFLS programs typically have been developed within each Region by representatives from the vertically integrated utilities, Control Areas, power pools, etc. in that Region. The SDT initially proposed that all UFLS requirements be contained within regional UFLS standards to utilize specific expertise within the regions and recognize that UFLS programs can be successfully coordinated if they are designed to achieve the same system performance characteristics, even across interconnected regions. In developing the proposed continent wide standard the SDT wanted to preserve and leverage the expertise within the regions. Since requirements should only be assigned to users, owners and operators of the Bulk Electric System, the SDT considered that the most appropriate entity to develop the UFLS programs based on function are the Planning Coordinators.

The proposed standard requires that all Planning Coordinators within a Region work together as a group to develop the UFLS program for that Region that conforms to the performance characteristics contained in the proposed continent wide standard. As proposed, the continent wide standard does not specify "how" the regional programs are to be developed. For instance, Planning Coordinators may elect to use their Regional Standards Development process to develop the programs (but this is not required) or they may determine that their existing programs fully meet the requirements of this proposed continent wide standard.

In the proposed standard the SDT has assigned applicability to "groups" of Planning Coordinators rather than individual Planning Coordinators with the intention of ensuring coordination among the entities developing the UFLS programs within and across the Regions. The concept of "groups" of Planning Coordinators also is intended to replicate historical practice where groups of entities within Regions have formed for the purpose of developing coordinated underfrequency load shedding programs.

The following questions will assist the SDT in finalizing the development of the Under Frequency Load Shedding continent wide standard. For questions where you agree with the SDT, please state that you agree and if available, please provide supporting documentation. If you disagree with the SDT, please explain why you disagree and provide data to support your position. To improve the Under Frequency Load Shedding continent wide standard, the SDT would appreciate responses to as many of these questions as you can answer.

Characteristics of UFLS Regional Reliability Standards

1. UFLS programs typically have been developed within each Region by representatives from the vertically integrated utilities, Control Areas, power pools, etc. in that Region. The SDT initially proposed that all UFLS requirements be contained within regional UFLS standards to utilize specific expertise within the regions and recognize that UFLS programs can be successfully coordinated if they are designed to achieve the same system performance characteristics, even across interconnected regions. However, based on the rationale contained in the background, the SDT has developed a continent wide standard consistent with the historical practice that promotes the utilization of previous experience and expertise. As proposed, the continent-wide standard requires that all Planning Coordinators within a Region work together as a group to develop the UFLS program for that Region that conforms to the performance characteristics.

a. Do you agree that creating a continent wide standard preserves the intent of utilizing specific expertise within the regions to develop UFLS programs that meet common performance characteristics?

Yes

No

Comments:

b. Do you agree that the SDT has assigned responsibility to the appropriate entity?

Yes

No

Comments:

We agree with the assignment of selected responsibilities to the Planning Coordinator (PC) and suggest that the NERC Compliance Registry Criteria be revised to add the Planning Coordinator function and the Regional Entities be directed to register applicable entities to this function.

Responsibility for several requirements are assigned to a "group" of Planning Coordinators. However, these groups do not presently exist and are not registered or legal entities. Perhaps a Planning Coordinator Group (PCG) should be added to the Applicability section and the NERC Compliance Registry Criteria be revised to add the PCG function, similar to the Reserve Sharing Group (RSG) function. Then, Regional Entities might be directed to register applicable entities to this function. Establishing PCGs would help PCs clarify how the group's responsibilities for compliance and liabilities would be assigned to each of its members.

If a registered PCG function is not established, then drafting team should revise R1 to require all Planning Coordinators in a region to form a joint agreement to cover fulfillment of the subsequent UFLS requirements. See details in response to question 8.

Transmission Owners function should be removed because it is unnecessary and redundant with the Distribution Provider function. Per NERC Compliance Registry Criteria Rev. 5.0 (Sections II.b and III.b.2), any Transmission Owner that provides

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and operates the “wires” to end-use Load served at transmission voltages must register as a Distribution Provider or transfer the responsibility for applicable UFLS requirements to a registered Distribution Provider by written agreement. However, the TO function should be retained if SDT adopts the suggestion of adding R11 and R12 regarding reactive power devices (in Q8).

Generator Owners should be assigned responsibility for coordinating any generator off nominal frequency protection with any applicable UFLS relaying and for providing generator off nominal frequency protection information to the Planning Coordinator. So, the Generator Owner function should be added to the Applicability section. The SDT should coordinate with PRC-024 so that requirements do not overlap.

- 2. The SDT has strived to draft the applicability in a manner that includes all load while avoiding assigning applicability to more than one entity for the same load. The Functional Model indicates the Distribution Provider is not defined by a specific voltage, but rather as performing the Distribution function at any voltage. Considering the Functional Model definition of Distribution Providers please indicate whether you believe it is necessary to assign applicability to "Transmission Owners with end-use Load connected to their Facilities where such end-use load is not part of a Distribution Provider's load".**

Yes

No

Comments: The MRO NSRS believes that the definition of Distribution Provider assures that there are no gaps or holes in coverage of the applicable load. As noted in the response to Question 1, it is unnecessary to also assign applicability to Transmission Owners with end-use Load connected to their Facilities because according to the NERC Compliance Registry Criteria Rev 5.0 (Sections II.b and III.b.2) these entities must register as a Distribution Provider or transfer the responsibility for applicable UFLS requirements to a registered Distribution Provider by written agreement.

- 3. The proposed continent-wide standard requires that Planning Coordinators model the trip settings of any generators that trip at or above 58.0 Hz (Requirement R8) when verifying through dynamic simulation that the UFLS program design is adequate to meet the continent-wide performance characteristics specified in Requirement R6.**

Do you agree with this approach to ensure that effectiveness of the UFLS program is not jeopardized by units that trip at or above the minimum frequency (58.0 Hz) at which the UFLS program may arrest frequency decline?

Yes

No

Comments: [This question actually applies to Requirement R7, not R8.]

We agree that PCs should model the trip settings of any generators that may be tripped during the simulated operation of the UFLS program. However, the applicable

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generator trip settings may vary depending on the set points and time delays of the underfrequency relays of the UFLS program for a given island.

We suggest that R7.1 be reworded to "that trip at or above the minimum frequency set points and time delays of the applicable island's UFLS program". This approach gives consideration to the time delay aspect and allows the frequency limit to be higher (or lower), if it is permitted by the applicable island's UFLS program.

We suggest similar rewording for R7.2, "that trip at or above the maximum frequency set points and time delays of the applicable island's UFLS program".

On a related matter, the existing Requirement R7 states "conduct a UFLS assessment . . . through dynamic simulations". Therefore, we suggest that the following rewording for R7, "shall conduct a UFLS assessment . . . that determines whether the UFLS program design meets . . . R6. The assessment shall include: " This would allow other analytical methods, such as the Equivalent Inertia Analysis, to be used to perform an appropriate UFLS assessment. The Equivalent Inertia method can also be used to check for proper coordination between the underfrequency relay settings and the generator trip settings.

R7.1 "Analysis of the trip settings of any generators that . . ."

R7.2 "Analysis of the trip settings of any generators that . . ."

R7.3 "Analysis of any automatic load restoration that . . ."

See response to comment 8 regarding the 58 Hz limit.

- 4. The SDT added a requirement that requires the Planning Coordinators model, in the five year assessments, any automatic load restoration that is designed to assist in stabilizing system frequency (Requirement R9). The team decided to add this requirement as a result of a comment during the first posting. Do you agree that this requirement is necessary for reliability?**

Yes

No

Comments: [This question actually applies to Requirement R7.3, not R9.]

We agree that any automatic load restoration that is designed to assist in stabilizing the system frequency should be modeled in the ULFS Program assessment.

- 5. The SDT added a requirement in the underfrequency load shedding performance characteristics that requires (in simulations) frequency to not remain below 58.2 Hz for greater than four seconds cumulatively per simulated event (Requirement R6.2). The SDT added this requirement to better coordinate with the Generator Verification Project (PRC-024) tripping curve. Do you agree with this additional requirement?**

Yes

No

Comments: Please provide the technical justification for this performance criteria.

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We suggest the addition of the statement "Unless generation capability or protection warrants or allows for a lower limit" to the end of Requirement R6.2. In the MRO region, this qualification would help Manitoba Hydro and Saskatchewan that need to shed more than 30% of the area load to achieve reasonable frequency recovery in these islands. In these areas, the shedding of a higher percentage of load may allow the frequency to drop below 58.2 Hz for longer than 4 seconds, but the subsequent impacts on the hydro generator in these islands are acceptable.

On a related note, we suggest the addition of the statement "Unless generation capability or protection warrants or allows for a higher limit" to the end of Requirement R6.3, if the impacts of island equipment are acceptable.

- 6. In the first posting, the Characteristics of UFLS Regional Reliability Standards required that UFLS programs be designed to limit the potential for overexcitation (V/Hz) of power system equipment at all Bulk Electric System buses. Based on industry comments, the SDT has revised this requirement in the proposed continent-wide standard to apply only at generator buses and generator step-up transformer high-side buses associated with individual generating units greater than 20 MVA (gross nameplate rating) and generating plants/facilities greater than 75 MVA (gross aggregate nameplate rating) that are directly connected to the BES. The SDT believes this change better addresses the need to have UFLS programs designed to coordinate with protection that may trip generators during an underfrequency event. Do you agree with this change?**

Yes

No

Comments: Please provide the technical justification for this performance criteria. We are unaware of any UFLS event where V/Hz protection tripped a generator unit.

This requirement should not be included with this standard because it cannot be properly simulated. The voltage regulator V/Hz controls are not presently included in generator exciter/voltage regulator models of the present power system modeling programs that are used for dynamic power system simulation.

The volts per hertz language does not belong in this load shedding document. Voltage regulators automatically reduce voltage according to volts per hertz when in automatic mode. Industry recommendations/standards (IEEE C37.102 or IEEE C37.106, ANSI C50.13-1989, IEEE C57.12.00-2000) already exist to address volts/Hz. If voltage regulators fail, or are in manual control, then there is additional volts/Hz relaying to trip generation if needed. We believe the volts per hertz issues are already taken care of outside of this UFLS standards document.

- 7. If you are aware of any conflicts between the proposed standard and any regulatory function, rule order, tariff, rate schedule, legislative requirement, or agreement please identify the conflict in the comments section.**

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Comments:

8. Please provide any other comments (that you have not already provided in response to the questions above) that you have on the draft standard PRC-006-1.

Comments:

R1 - Reword the requirement to state the Planning Coordinators within a region shall have an agreement with all the Planning Coordinators rather than creating a new group. (For example similar to agreement requirements between BAs in EOP-001, between GOs and transmission entities in NUC-001, and RCs to form an agreement in IRO-001 R7.) Proposed wording for R1: "Planning Coordinators shall have agreements with all Planning Coordinators in the region, that shall, at a minimum, contain provisions for cover fulfillment of the subsequent UFLS requirements in the standard."

This agreement would clarify how "group" responsibilities for compliance and penalties would be assigned to its member entities. For example, would all Planning Coordinators be non-compliant, if one or more members of the group is non-compliant or if a group could not come to consensus on elements needed to fulfill a requirement? Would the financial penalty be shared among the group or would each member be assessed separate penalties?

R2 – We suggest the following revised wording, "shall design a load shedding program or multiple load shedding programs so that all areas of the region are covered." In the MRO, the Canadian portions of the system need to shed more load than the U.S. portion of the system. There needs to be coordination within each potential island, but not necessarily consistent across each, entire NERC region. Perhaps what was intended is to state that load shedding should be applied uniformly across an island footprint.

R4 - Revise text so that the "agreement" between all entities is well documented through several examples: meeting minutes, a formal agreement to work together, results of common drills, examples of coordination of UFLS models, etc.) We would propose that the assessment for non-compliance would be located in the formal agreement to work together since all parties should understand the risk or consequences of the group effort.

R6.1 – To match the design emphasis that is included in R6.2 and R6.3, we suggest ". . . no less than 58.0 Hz per simulated event."

R8 - Since the interpretation of "annually" can vary widely, we suggest this rewording, "each calendar year and within 15 months of the last update".

R9 – If the inclusion of Transmission Owner is determined to be redundant, reword to, "Each Distribution Provider shall provide. . .", as noted in response to Q1.b.

R10 – If the inclusion of Transmission Owner is determined to be redundant, reword to, "Each Distribution Provider shall provide . . .", as noted in response to Q1.b.

add R11 - Since reactive power device overvoltage or underfrequency protection may be included to the UFLS program assessment, we suggest adding the Requirement, "R11. Each Distribution Provider and Transmission Owner shall provide its reactive

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power device overvoltage or underfrequency protection information in the format and according to the schedule specified by the applicable Planning Coordinator." [If this requirement is added and includes the Transmission Owner, then the Transmission Owner should be included in the Applicability section.]

add R12 - Since reactive power device overvoltage or underfrequency protection should be included in the UFLS program design for a specific island, we suggest adding the Requirement, "R12. Each Distribution Provider and Transmission Owner shall provide reactive power device tripping in accordance with the UFLS program designed by the applicable Planning Coordinator for each region in which they operate." [If this requirement is added and includes the Transmission Owner, then the Transmission Owner should be included in the Applicability section.]

add R13 - Since generator off nominal frequency protection information may be included to the UFLS program assessment, we suggest adding the Requirement, "R13. Each Generator Owner shall provide its off nominal frequency protection information in the format and according to the schedule specified by the applicable regional group of Planning Coordinators."

add R14 - Since the coordination of generator off nominal frequency protection should be included to the UFLS program design for a specific island, we suggest adding this Requirement "R14. Each Generator Owner shall have evidence that they provided any coordination that is required by the applicable regional group of Planning Coordinators to meet UFLS program specifications."

It is not clear if the standard requires one specific UFLS scheme for the entire Region. One scheme for the Region should not be mandated.

Flexibility should be allowed for different schemes within the Region as long as each scheme meets the performance characteristics.

Below is a list of technical requirements or issues the MRO NSRS would like the UFLS DT to consider for either a reference document or for regional variances.

A. Limited Number of Island Loads - What allowance should be made for Distribution Providers with a limited number of loads in a designated island?

B. 58 Hz Limit - Consideration should be given to circumstances in some islands where a lower frequency limit would allow better UFLS program performance. For instance the the Canadian example mentioned above.

C. Coordination with the Proposed PRC-024 Standard - Consideration should be given for proper coordination for of this standard (UFLS) with the PRC-024 standard especially with regard to off-nominal frequency settings for generation.

D. Reference Document - We think it would be valuable to develop a companion reference document that may contain the following expectations and intentions:

- The intent of this standard is to ensure UFLS programs are effective, and to the extent possible, that potential problems have been addressed in the design phase.

- This standard should achieve an appropriate level of reliability and not just the least common denominator. An evaluation should be made to determine if the minimum load shedding requirement is sufficient and appropriate for a given geographic region. Although no geographic region (potential island) is obligated to exceed the minimum

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load shedding requirement, load shedding beyond the minimum requirement is encouraged when there is an identified advantage of doing so.

- Overall coordination issues are easier to satisfy for programs that shed the minimum amount of load. Such programs will be better behaved over the smaller range of overloads, but the system will collapse if loss of generation (or import) exceeds the amount of load shed. Larger, more aggressive load shedding programs will provide a larger safety net at the expense of wider voltage and frequency deviations, and generation in those areas will need to accept more off-nominal frequency exposure to achieve coordination with load shedding.

- UFLS analysis has to deal with considerable uncertainty in a multitude of variables. It is assumed that conflicting performance requirements and tradeoffs will be documented and resolved through application of engineering judgment.

- This standard acknowledges that performance measures such as frequency and voltage deviation are subjective. Both voltage and frequency are influenced by hard-to-quantify factors that vary in real time, such as load damping, the net governor response, and inertia of spinning on-line units. Such performance measures can only be applied in consistent fashion to a tightly defined set of qualifying assumptions.

- This standard acknowledges that UFLS is basically a last ditch effort to prevent system collapse and that it has limits. It is not possible to achieve desired performance for all of the unlikely events that may occur in real life.

- Performance characteristics given in this standard should be treated as design targets or design guidelines. Studies run to develop UFLS programs may indicate different design criteria is appropriate as part of the overall compromise that has to be struck between performance and the level of load shedding coverage that is desired.

- There is no perfect tool for studying UFLS, and this standard is not meant to prescribe any particular engineering approach to system analysis and review of UFLS performance. For example, the equivalent inertia method allows for sensitivity analysis and broader insight into the frequency decay dynamics. Likewise, the full transient stability case is more useful for simulating actual disturbance conditions including voltage transients.