

## Conference Call Notes Underfrequency Load Shedding SDT — Project 2007-01

September 8, 2009 | 9:00 a.m. –12:00 p.m. Eastern

### 1. Administrative

#### Roll Call

Stephanie Monzon welcomed the members and guests of the Standard Drafting Team for Project 2007-01 Underfrequency Load Shedding (see Roster — **Attachment 1a**).

- Philip Tatro — National Grid (Chair)
- Paul Attaway — Georgia Transmission Corporation
- Brian Bartos — Bandera Electric Cooperative
- Jonathan Glidewell — Southern Company Transmission Co.
- Gary Keenan — Northwest Power Pool Corporation
- Robert W. Millard — ReliabilityFirst Corporation
- Steven Myers — Electric Reliability Council of Texas, Inc.
- Mak Nagle — Southwest Power Pool
- Robert J. O'Keefe — American Electric Power
- Brian Evans Mongeon — Utility Services, LLC
- Tony Rodrigues — PacifiCorp
- Si Truc Phan — TransEnergie
- Scott Berry — Indiana Municipal Power Agency
- Frank Gaffney — Florida Municipal Power Agency
- Stephanie Monzon — NERC

#### Observers

- Anthony Jablonski — ReliabilityFirst Corporation
- Pete Heidrich — FRCC
- Steve Wadas — Nebraska Public Power District
- Carol Gerou — Midwest Reliability Organization
- Eric Mortenson — Commonwealth Edison
- Scott Sells — FERC Staff
- Laura Zotter — ERCOT
- Jill Loewer — Utility Services, LLC

**NERC Antitrust Compliance Guidelines**

Stephanie Monzon reviewed the NERC Antitrust Compliance Guidelines.

**2. Review Meeting Agenda**

The team reviewed the agenda and did not make revisions.

**3. Review of Question 6**

**(Email from Phil T.):**

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I have attached draft responses to comments on Question 6. There are only a few unique comments; however, some comments will require deliberation by the SDT to establish the direction we want to proceed before agreeing on a response. I have queued up the key issues below to facilitate our discussion on August 24. For the first issue I also have prepared draft responses for each alternate approach we might take.

1. Several commenters, mostly entities in the Midwest, have questioned the ability to make a meaningful assessment of V/Hz at a generator bus due to the lack of modeling the V/Hz limiter in the excitation system models. I have provided below two possible approaches on how to address this comment.

a. Retain this requirement in the standard on the basis that it is necessary to ensure reliability and note that simulations without the V/Hz limiter will be conservative, and that additional modeling could be included for units connected to buses at which the observed excitation level in simulations exceeds the V/Hz performance characteristics in the standard.

b. Retain the requirement in the standard on the basis that it is necessary to ensure reliability, but acknowledge the limitation in existing excitation system modeling and provide a longer implementation plan in the standard for requirement R6.4 to allow time for development of models that include V/Hz limiters. Two variations of this approach may be to draft a SAR to require such modeling in an MOD standard or to rely on the industry need for such modeling to meet PRC-006 drive development of models by the software vendors.

A third approach which I would not recommend is to withdraw this requirement. We also can consider variations of these two approaches and any other approaches that SDT members may propose.

2. We should consider the issue of consistency between Requirements R7.1 and R7.2 which imply all generators are included and Requirement R6.4 which limits the monitored buses based on generator/plant size and interconnection voltage. This is especially true if the Planning Coordinators will interpret Requirements R7.1 and R7.2 as being limited by the Compliance Registry Criteria, in which case we should I

believe we should include the same the generator/plant size and interconnection voltage thresholds.

A few other minor issues are highlighted in the attached draft responses.

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The team discussed the options proposed and many team members indicated their support for option “b”. There was agreement to keep the requirement. There is agreement that there should not be a SAR to include this as part of the model for the generators because it is not appropriate or necessary to include as part of MOD-012. The team debated included a delayed implementation schedule for 4.4 only or to provide implementation transition time for all of the requirements accounting for 4.4. The preference is for the latter, the team will come up with a proposed implementation time and in the next posting solicit industry comments.

The team conducted a complete first pass at responses to question 6. The team highlighted one remaining issue that requires group discussion:

- 60 kV threshold which will clarify the 98% installed capacity statement in the responses

The team discussed the action plan for determining the appropriate kV threshold. RFC stated that the person who coordinated the RFC analysis presented in Montreal created an IPlan based on the MMWG model to come up with the data/graphs. The team discussed that basing their analysis on the MMWG model would not be accurate as it does not represent all generation. As a result, the team did not decide on this call whether to pursue an analysis emulating the RFC analysis based on the MMWG or to perform the analysis on the model containing all generation for their region. This will be dependent on whether or not the data is available.

**ACTION ITEM:** Each team member will query their region to determine if data is readily available to perform the installed capacity analysis for the purposes of determining the appropriate MVA threshold. The team will have feedback by the call on Friday, September 11.

**4. Action Items**

Stephanie Monzon reviewed the actions that were open at the end of the meeting.

Action Items:	Status:	Assigned To:
Stephanie will follow up with Gerry regarding the FERC direction to include the PRC-009 requirements into the draft standard. FERC did not support the team’s argument that they could be covered under the NERC ROP data request.  The team reviewed the requirements in PRC-009 in Montreal and felt	<b>Created 6/11/09</b>	Stephanie

Action Items:	Status:	Assigned To:
that part of the requirement to perform the post-mortem was necessary to include in PRC-006-2.	<b>Updated 9/2/09</b>	
<p>The sub-teams will begin writing formal responses to the comments based on the discussion of issues at the June 10<sup>th</sup> meeting.</p> <p><b>Question 1 and 2:</b>            Bob and Carol will finalize the responses by June 19 — the team will review and discuss by exception on the July 7<sup>th</sup> meeting — <b>Complete</b></p> <p><b>Question 3:</b>            The team will discuss response to comments (not done at the June in person meeting). Jonathan will lead the discussion and identify the major issues for discussion. — <b>Complete</b></p> <p><b>Question 4:</b>            The team will discuss on the August 6<sup>th</sup> call – <b>Complete (on the July 20 call)</b></p> <p><b>Barry Francis:</b>            The team will discuss on the August 6<sup>th</sup> call – <b>Complete</b></p> <p><b>Question 5:</b>            The team will discuss on the August 24<sup>th</sup> - <b>Complete</b></p> <p><b>Question 6:</b>            August 24<sup>th</sup> call – the team did not discuss Question 6 responses. The team will discuss on conference calls after the meeting in Montreal.  <b>Complete on the September 8<sup>th</sup> call</b></p> <p><b>Question 7:</b>            By exception on the September 11<sup>th</sup> call</p> <p><b>Question 8:</b>            August 24<sup>th</sup> call – the team did not discuss Question 6 responses. The team will discuss on conference calls after the meeting in Montreal. on September 11, 2009</p>		

## 5. Next Steps

Date	Location	Comments
August 6, 2009 from 9:30 a.m.–noon EST	Conference Call and WebEx	Barry Francis
August 24, 2009 from 1–3:30 p.m. EST	Conference Call and WebEx	Question 5, 6, 7 and 8
September 1–2, 2009 from 8 a.m.–5 p.m.	In person meeting — Montreal	Confirmed

(both days)		
September 8, 2009 from 9 a.m.–noon EST	Conference Call and WebEx	Question 6
September 9, 2009 from 1–3 p.m. EST	Conference Call	FERC Staff review of standard
September 11, 2009 from 12:30–2:30 p.m. EST	Conference Call and WebEx	Question 7 by exception and Question 8
September 14, 2009 from 1:30–4 p.m. EST	Conference Call and WebEx	Second Pass Review of Requirements
September 24, 2009 from 10 a.m.–noon EST	Conference Call and WebEx	Compliance Elements
September 25, 2009 from 9–11 a.m. EST	Conference Call and WebEx	Implementation Plan, Standard Final Pass
October 5, 2009 and October 6, 2009 from 8 a.m.–5 p.m. both days	In person meeting FMPA Orlando, FL	Comment Form, Mapping Document, Remaining issues

## 6. Adjourn

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?

Summary Consideration: [26Y/12N](#)

Organization	Yes or No	Question 6 Comments:
TRE UFLS Standard Drafting Team	Yes	The TRE UFLS SDT believes this change creates a clear definition for equipment at generator buses and step-up transformer high-side buses for which the standard applies. However, the NERC UFLS SDT may want to consider adapting the definition of applicable generating units to conform to NERC's Compliance Registry Criteria (NERC Statement Compliance Registry Criteria Rev 5.0 (October 16, 2008) <a href="http://www.nerc.com/files/Statement_Compliance_Registry_Criteria-V5-0[1].pdf">www.nerc.com/files/Statement_Compliance_Registry_Criteria-V5-0[1].pdf</a> for Generator Owner/Operator:- Individual generating unit greater than 20 MVA (gross nameplate rating) and is directly connected to the bulk power system;- Generating plant/facility greater than 75 MVA (gross aggregate nameplate rating) or when the entity has responsibility for any facility consisting of one or more units that are connected to the bulk power system at a common bus with total generation above 75 MVA gross nameplate rating.This change would bring consistency to the definition of applicable generating units and would ensure that there is no confusion for wind farms and other generating plants/facilities.
<p>Response: Thank you for your suggestion. The SDT has modified 4.4.2 to include a reference to “any facility consisting of one or more units that are directly connected at 60 kV and above at a common bus with total generation above 75 MVA gross nameplate rating.” The SDT has expanded the applicability beyond units directly connected to the Bulk Electric System based on data that indicates this modification addresses approximately 98 percent of the installed generating capacity in North America. The SDT believes that reliability of the UFLS program is supported by assessing the potential for this amount of generation to trip during events involving off-nominal frequency and voltage.</p>		
Pepco Holdings, Inc - Affiliates	Yes	
Bonneville Power	Yes	

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Organization	Yes or No	Question 6 Comments:
Administration		
Northeast Power Coordinating Council	No	We agree with the intent of the change to focus the concern on buses where V/Hz protection may trip generators rather than broadly applying to all BES buses. However, reliability of underfrequency load shedding (UFLS) programs is dependent on assurance that the UFLS program will shed load prior to generation tripping in islanded conditions. The frequency response to generator tripping is primarily a function of the amount of generation tripped and is substantially independent of the location of the generator interconnection. Therefore, the standard should not specify a threshold on interconnection voltage or generating unit/plant nameplate MVA. We recommend that R6.4 apply to all generator buses and generator step-up (GSU) high-side buses similar to R7.1 and R7.2 applying to all generators that trip above 58.0 Hz or below 61.8 Hz.
<p><b>Response:</b> The SDT agrees that the impact of generator tripping on system frequency is independent of the interconnection voltage. However, the SDT believes it is not necessary or practical to assess the potential for tripping of every generator unit. The SDT has further revised the buses included in Requirement R4.4 to include generating units 20 MVA or greater and generating plants 75 MVA or greater directly connected at 60 kV and above based on data that indicates these criteria represent approximately 98 percent of the installed generating capacity in North America. The SDT believes that reliability of the UFLS program is supported by assessing the potential for this amount of generation to trip during events involving off-nominal frequency and voltage.</p> <p><u>Add a note if we decide to change R7.</u></p>		
Southern Company	Yes	No additional comment.
ERCOT ISO	Yes	ERCOT ISO agrees with the change.
<b>Response: Thank you for your support.</b>		
Electric Market Policy	Yes	
Midwest ISO Stakeholders Standards Collaborators	No	Please provide the technical justification for this performance criteria. We are presently unaware of any UFLS event where V/Hz tripped a unit. This requirement should not be included with this standard because it cannot be properly simulated because the voltage regulator V/Hz controls are not presently included in generator exciter/voltage regulator models that are used for stability 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

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Organization	Yes or No	Question 6 Comments:
		generation if needed. We believe the volts per hertz issues are already taken care of outside of this UFLS standards document. During an under frequency event, generators should be working to pull voltages down anyway. Please see response to question 8 regarding overvoltages related to tripping load without tripping capacitors.
<p><b>Response:</b></p> <p>It is appropriate to include this performance characteristic in this project because overexcitation that occurs as a direct result of UFLS operations must be considered when UFLS programs are designed. The SDT notes that the subject of the cited IEEE and ANSI standards is design and protection of generators and transformers. The proposed Requirement R4.4 is a system performance requirement that is coordinated with these standards. If design verification studies demonstrate the potential for generator tripping, corrective measures must be applied to prevent further unnecessary outages or disturbances that would result from tripping the generator.</p> <p>The SDT acknowledges excitation models do not include V/Hz limiters; however, we also believe that meaningful results can be obtained from conservative simulations without the V/Hz limiter. If the simulated system response exceeds the V/Hz performance characteristics in the standard the group of Planning Coordinators would have the option of developing corrective actions as part of the UFLS program design or including additional modeling for generator units to demonstrate that the V/Hz limiter would prevent the overexcitation condition.</p>		
SERC UFLS Standards Drafting Team	Yes	
FRCC Standards & Operations Departments	Yes	
Florida Municipal Power Agency and Select Members	Yes	
MRO NERC Standards Review Subcommittee	No	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

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Deleted: Option 2: It is appropriate to include this performance characteristic in this project because overexcitation that occurs as a direct result of UFLS operations must be considered when UFLS programs are designed. The SDT notes that the subject of the cited IEEE and ANSI standards is design and protection of generators and transformers. The proposed Requirement R6.4 is a system performance requirement that is coordinated with these standards. If design verification studies demonstrate the potential for generator tripping, corrective measures must be applied to prevent further unnecessary outages or disturbances that would result from tripping the generator.¶  
The SDT acknowledges excitation models do not include V/Hz limiters and proposes to factor this into the implementation plan. The effective date for Requirement R6.4 in the proposed implementation plan is XX months later than the rest of the standard to allow time for development of excitation models that include the V/Hz limiter.¶



Organization	Yes or No	Question 6 Comments:
		taken care of outside of this UFLS standards document.
Response:		<p><u>It is appropriate to include this performance characteristic in this project because overexcitation that occurs as a direct result of UFLS operations must be considered when UFLS programs are designed. The SDT notes that the subject of the cited IEEE and ANSI standards is design and protection of generators and transformers. The proposed Requirement R4.4 is a system performance requirement that is coordinated with these standards. If design verification studies demonstrate the potential for generator tripping, corrective measures must be applied to prevent further unnecessary outages or disturbances that would result from tripping the generator.</u></p> <p><u>The SDT acknowledges excitation models do not include V/Hz limiters; however, we also believe that meaningful results can be obtained from conservative simulations without the V/Hz limiter. If the simulated system response exceeds the V/Hz performance characteristics in the standard the group of Planning Coordinators would have the option of developing corrective actions as part of the UFLS program design or including additional modeling for generator units to demonstrate that the V/Hz limiter would prevent the overexcitation condition.</u></p>
Kansas City Power & Light	No	Do not agree with requirement R6.4 regarding the criteria for ensuring control voltage at the generator does not exceed 1.18 V/Hz for a duration longer than 2 seconds. The operating boundaries and control schemes at the generators are in place for the protection and reliable operation of the generator and should be modeled as they are and UFLS design should be modeled around the generator in the attempt to maintain generator connection to the grid.
Response:		Thank you for your comment. The intent of this requirement is as the commenter suggests: to design the UFLS program around the generator in an attempt to maintain generator connection to the grid. However, instead of requiring the Planning Coordinators to model the overexcitation protection of each generator unit and generator step-up transformer the SDT has developed this performance characteristic based on the relevant IEEE standards governing equipment design and protection. The SDT believes this approach achieves the same objective without requiring extensive collection of data and modeling of overexcitation protection.
IRC Standards Review Committee	No	We do not see the need to specify these criteria in the standard. Applicable requirements should be assigned to all generators that meet the compliance registry criteria.
Response:		<p>The SDT notes that this requirement is associated with design of the UFLS program; not protection of generator units. As such the SDT believes the requirement is correctly assigned to the group of Planning Coordinators who assess performance of the UFLS program design. The requirement is applicable to Planning Coordinators to ensure that the UFLS program design within each region considers the potential for UFLS program operation to result in high voltage/low frequency conditions that may result in <u>flux beyond design limits</u> of generators and generator step-up transformers. This requirement ensures these impacts are considered during UFLS program design to minimize the likelihood that generation will trip by overexcitation protection which would exacerbate the underfrequency condition, potentially preventing recovery and stabilization of system frequency leading to a blackout.</p>

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Organization	Yes or No	Question 6 Comments:
Cowlitz County PUD	Yes	
Edward C. Stein		
Colmac Clarion	Yes	Be aware that some small generators (>20 MVA but <75 MVA with 'extended' tielines may have difficulty meeting this requirement with some 'older' voltage regulators and stepup transformer arrangements.
<p>Response: The SDT notes that this requirement is not applicable to Generator Owners. The requirement is applicable to Planning Coordinators to ensure that the UFLS program design within each region considers the potential for UFLS program operation to result in high voltage/low frequency conditions that may result in <u>flux beyond design limits</u> of generators and generator step-up transformers. This requirement ensures these impacts are considered during UFLS program design to minimize the likelihood that generation will trip by overexcitation protection which would exacerbate the underfrequency condition, potentially preventing recovery and stabilization of system frequency leading to a blackout.</p>		
City of Bedford	Yes	
Alabama Municipal Electric Authority	Yes	The SDT should consider the potential discrepancy with the generator side and their desire to include automatic load reduction. I assume automatic load reduction would not take place at a generator bus.
<p>Response: The SDT agrees <u>with the commenter's assumption</u> that automatic load reduction would not <u>necessarily</u> take place at a generator bus <u>although this is not precluded by the standard.</u></p>		
US Army Corps of Engineers	Yes	
NIPSCO	No	Since much of the future generation seems to be wind power- they should be included
<p>Response: The SDT had intended to include wind generators and has modified Requirement R4.4.2 to clarify this intent. <u>The SDT has modified 4.4.2 to include a reference to "any facility consisting of one or more units that are directly connected at 60 kV and above at a common bus with total generation above 75 MVA gross nameplate rating."</u></p>		
Public Service Electric and Gas Company		

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Organization	Yes or No	Question 6 Comments:
Central Lincoln	Yes	
SPP System Protection and Control Working Group	Yes	Please confirm whether this requirement is applicable for generating stations/ plants connected to BES above 100 kV.
<p><b>Response:</b> This was the intent of the requirement in the second posting. In response to comments the SDT has further revised the buses included in Requirement R4.4 to include generating units 20 MVA or greater and generating plants 75 MVA or greater directly connected at 60 kV and above based on data that indicates these criteria represent approximately 98 percent of the installed generating capacity in North America. The SDT believes that reliability of the UFLS program is supported by assessing the potential for this amount of generation to trip during events involving off-nominal frequency and voltage.</p>		
Long island power Authority	Yes	
Exelon	No	Don't agree with going into the generator over excitation equipment. This is an issue that is regional in nature and should be addressed at that level.
<p><b>Response:</b> It is appropriate to include this performance characteristic in this project because overexcitation that occurs as a direct result of UFLS operations must be considered when UFLS programs are designed. The SDT believes that excitation equipment and generator design and protection is sufficiently uniform across North America that a continent-wide performance requirement is appropriate.</p>		
ReliabilityFirst Corporation	Yes	
Arkansas Electric Cooperative Corporation		
System Protection & Control	Yes	
Duke Energy		
ReliabilityFirst	Yes	

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Organization	Yes or No	Question 6 Comments:
Illinois Municipal Electric Agency		
Hydro-Québec TransEnergie (HQT)	No	HQT agree with the intent of the change to focus the concern on buses where V/Hz protection may trip generators rather than broadly applying to all BES buses. However, reliability of underfrequency load shedding (UFLS) programs is dependent on assurance that the UFLS program will shed load prior to generation tripping in islanded conditions. The frequency response to generator tripping is primarily a function of the amount of generation tripped and is substantially independent of the location of the generator interconnection. Therefore, the standard should not specify a threshold on interconnection voltage or generating unit/plant nameplate MVA. We recommend that R6.4 apply to all generator buses and generator step-up (GSU) high-side buses similar to R7.1 and R7.2 applying to all generators that trip at particular frequency thresholds. See also our answer to Q8 in regards to frequency threshold.
<p><b>Response: The SDT agrees that the impact of generator tripping on system frequency is independent of the interconnection voltage. However, the SDT believes it is not necessary or practical to assess the potential for tripping of every generator unit. The SDT has further revised the buses included in Requirement R4.4 to include generating units 20 MVA or greater and generating plants 75 MVA or greater directly connected at 60 kV and above based on data that indicates these criteria represent approximately 98 percent of the installed generating capacity in North America. The SDT believes that reliability of the UFLS program is supported by assessing the potential for this amount of generation to trip during events involving off-nominal frequency and voltage.</b></p>		
AEP	Yes	
Ontario Power Generation	Yes	
We Energies	Yes	
PacifiCorp	Yes	PacifiCorp concurs with the decision of the SDT drafting team. V/Hz capability is generally associated with generating plants, not all buses within a system.
<b>Response: Thank you for your support.</b>		
NextEra Energy Resources, LLC		No comment.
American Transmission	No	Please provide the industry with the technical justification for this performance criteria. We are presently unaware of any

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Organization	Yes or No	Question 6 Comments:
Company		UFLS event where V/Hz 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.
Response:		<p><u>It is appropriate to include this performance characteristic in this project because overexcitation that occurs as a direct result of UFLS operations must be considered when UFLS programs are designed. The SDT notes that the subject of the cited IEEE and ANSI standards is design and protection of generators and transformers. The proposed Requirement R4.4 is a system performance requirement that is coordinated with these standards. If design verification studies demonstrate the potential for generator tripping, corrective measures must be applied to prevent further unnecessary outages or disturbances that would result from tripping the generator.</u></p> <p><u>The SDT acknowledges excitation models do not include V/Hz limiters; however, we also believe that meaningful results can be obtained from conservative simulations without the V/Hz limiter. If the simulated system response exceeds the V/Hz performance characteristics in the standard the group of Planning Coordinators would have the option of developing corrective actions as part of the UFLS program design or including additional modeling for generator units to demonstrate that the V/Hz limiter would prevent the overexcitation condition.</u></p>
Luminant Power	Yes	Luminant agrees with the direction of the UFLS SDT. Luminant further requests that the drafting team modify Requirement R6.4 to clarify that the per unit V/Hz limits modeled are 1.18 and 1.10 of Nominal transmission system voltage.
Response:		<p>Thank you for your support of the SDT direction on this requirement. However, the SDT has decided not to modify Requirement R4.4 to provide the V/Hz base. The SDT believes it is implicit that the V/Hz base is nominal system voltage divided by nominal system frequency, similar to voltage standards which typically refer to per unit voltage without explicitly stating the voltage base.</p>
Ameren	Yes	It is an improvement over the previous draft. However, there are still questions as to whether this requirement is needed. Please provide the technical justification for this performance criteria. We are presently unaware of any UFLS event where V/Hz tripped a unit. This requirement should not be included with this standard because it cannot be properly simulated because the voltage regulator V/Hz controls are not presently included in generator exciter/voltage regulator models that are used for stability simulation.
Response:		

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Organization	Yes or No	Question 6 Comments:
		<p><u>It is appropriate to include this performance characteristic in this project because overexcitation that occurs as a direct result of UFLS operations must be considered when UFLS programs are designed. If design verification studies demonstrate the potential for generator tripping, corrective measures must be applied to prevent further unnecessary outages or disturbances that would result from tripping the generator.</u></p> <p><u>The SDT acknowledges excitation models do not include V/Hz limiters; however, we also believe that meaningful results can be obtained from conservative simulations without the V/Hz limiter. If the simulated system response exceeds the V/Hz performance characteristics in the standard the group of Planning Coordinators would have the option of developing corrective actions as part of the UFLS program design or including additional modeling for generator units to demonstrate that the V/Hz limiter would prevent the overexcitation condition.</u></p>
FirstEnergy Corp	No	<p>The requirement has been devised to protect generators and step-up transformers from over-excitation based on traditional protection guidelines. However, other elements in the BES can also become over-excited. Dynamic simulations look at many quantities such as voltage and frequency but Volts/Frequency is not a common output that is reviewed. It is suggested that it would be better to require that bulk capacitors be tripped if system voltage exceeds equipment limits.</p>
		<p>Response: The SDT initially considered a requirement to trip capacitors when voltage exceeds equipment limits. However, in developing the requirement the SDT realized that the concern with high voltage during an underfrequency event is the potential for generating units to trip by overexcitation protection, potentially exacerbating the underfrequency condition and leading to a blackout. As such, the SDT believes it is important to focus <u>on the reliability impact on the BES and not how the impact should be addressed such as tripping bulk capacitors</u>. While the SDT agrees that V/Hz is not an output quantity commonly reviewed, the capability does exist to monitor this quantity.</p>
CenterPoint Energy		
Independent Electricity System Operator	No	<p>The 20 MVA/unit and 75 MVA per generating plant/facility thresholds are the same as those presented in PRC-024, on which we expressed a disagreement. In an islanded situation, each generator's status is critical to ensuring frequency decline is successfully arrested based on the assumption that all on-line generators would not trip within specific frequency bounds unless prior approval has been sought and granted to allow tripping. Not limiting the potential for overexcitation (V/Hz) at the smaller generators/plants exposes the island to a great uncertainty on the amount of generation that can be relied upon to arrest frequency excursion.</p>
		<p>Response: The SDT agrees with the premise of this comment. However, the SDT believes it is not necessary or practical to assess the potential for tripping of every generator unit. The SDT has further revised the buses included in Requirement R4.4 to include generating units 20 MVA or greater and generating plants 75 MVA or greater directly connected at 60 kV and above based on data that indicates these criteria represent approximately 98 percent of the installed generating capacity in North America. The SDT believes that reliability of the UFLS program is supported by assessing the potential for this amount of generation to trip during events involving off-nominal frequency and voltage.</p>

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Organization	Yes or No	Question 6 Comments:
Xcel Energy	No	No. Criteria in 6.4.1 and 6.4.2 looks like it is only measuring generators that are required to be registered. Yet, with increasing penetration of small generators (<20MVA, <75 MVA aggregate), we feel the scope is not large enough to consider a material impact on the BES by an aggregate of these small generators. (Same concern carries into R7)
<p>Response: The SDT has revised this requirement based on input from several commenters that share your concern. The SDT has further revised the buses included in Requirement R4.4 to include generating units 20 MVA or greater and generating plants 75 MVA or greater directly connected at 60 kV and above based on data that indicates these criteria represent approximately 98 percent of the installed generating capacity in North America. The SDT believes that reliability of the UFLS program is supported by assessing the potential for this amount of generation to trip during events involving off-nominal frequency and voltage. Add a note if we decide to change R7.</p>		

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**Standard Development Roadmap**

*This section is maintained by the drafting team during the development of the standard and will be removed when the standard becomes effective.*

**Development Steps Completed:**

1. The Standards Committee approved the SAR for posting on November 21, 2006
2. SAR posted for comments on November 29, 2006.
3. The Standards Committee appointed a SAR Drafting team on January 11, 2007.
4. SAR Drafting Team responds to comments, revises SAR and posts for comments on February 7, 2007.
5. SAR Drafting Team responds to comments on April 20, 2007.
6. Standards Committee approves development of Standard on April 10, 2007.
7. The Standards Committee appointed the Standard Drafting Team on April 10, 2007.
8. The Standards Drafting Team posted draft performance characteristics for comment on July 2, 2008.
9. Standards Drafting Team responds to comments, revises standard and posts for comments on April 15, 2009.

**Proposed Action Plan and Description of Current Draft:**

This is the second posting of the proposed standard (the first posting was proposed common continent-wide performance characteristics as a directive to the Regional Entities to develop regional standards) for a 30 day comment period, from April 15 – **May 14, 2009.**

**Future Development Plan:**

<b>Anticipated Actions</b>	<b>Anticipated Date</b>
1. Respond to comments on the second posting and post revised standard for a 30 day comment period.	July 7, 2009
2. Respond to comments on the draft of the proposed standard and implementation plan.	September 14, 2009
3. Obtain the Standards Committee’s approval to move the standard forward to balloting.	September 16, 2009
4. Post the standard and implementation plan for a 30-day pre-ballot review.	October 1, 2009
5. Conduct an initial ballot for ten days.	November 15, 2009
6. Respond to comments submitted with the initial ballot.	November 30, 2009
7. Conduct a recirculation ballot for ten days.	December 15, 2009
8. BOT adoption.	

A. Introduction

- 1. **Title:** Automatic Underfrequency Load Shedding
- 2. **Number:** PRC-006-01
- 3. **Purpose:** To establish design and documentation 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 Coordinators
  - 4.2. Distribution Providers that do not have an agreement with Transmission Owners to provide UFLS
  - 4.3. Transmission Owners that have an agreement with Distribution Providers to provide UFLS
- 5. **(Proposed) Effective Date:** TBD

B. Requirements

- R1.** Each Planning Coordinator shall join a group consisting of all the Planning Coordinators within the region for each of the regions in which it performs the Planning Coordinator function. [VRF: Medium][Time Horizon: Long-term Planning]
- R2.** Each group of Planning Coordinators shall develop and document criteria, including consideration of historical events and system studies, to select portions of the Bulk Electric System (BES), including portions of adjacent interconnected regions, that may form islands. [VRF: Medium][Time Horizon: Long-term Planning]
- R3.** Each group of Planning Coordinators shall identify an island(s) as a basis for designing a UFLS program, including: [VRF: Medium][Time Horizon: Long-term Planning]
  - 3.1.** Those islands selected by applying the criteria in Requirement R2, and
  - 3.2.** Any portions 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 (NOTE: as a result of comment made in Q8 by BPS) and
  - 3.3.** Any other islands necessary to ensure that all portions of the region's BES are included in at least one island.
- R4.** Each group of Planning Coordinators shall develop a underfrequency load shedding program with an implementation schedule for application across the region including technical design parameters required to meet the following performance characteristics in simulations of underfrequency conditions resulting from an imbalance scenario

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Comment [sm1]: Propose that R2 be merged with R6

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Comment [pjt2]: The SDT n ... [4]

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Comment [sm3]: 8/28 - Sub- ... [6]

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where an imbalance = [(load — actual generation output) / (load)] of up to 25 percent within the identified island(s): [VRF: High][Time Horizon: Long-term Planning]

- 4.1. Arrest frequency decline at no less than 58.0 Hz. – Variance for HydroQ, MRO
- 4.2. Frequency shall not remain below 58.2 Hz for greater than four seconds cumulatively per simulated event, and shall not remain below 58.5 Hz for greater than ten seconds cumulatively per simulated event, and shall not remain below 59.3 Hz for greater than 30 seconds, cumulatively per simulated event. Variance for MRO
- 4.3. Frequency overshoot resulting from operation of UFLS relays shall not exceed 61.8 Hz for any duration and shall not exceed 60.7 Hz for greater than 30 seconds, cumulatively per simulated event. Variance for MRO
- 4.4. Control voltage during and following UFLS operations such that the per unit Volts per Hz (V/Hz) does not exceed 1.18 for longer than two seconds cumulatively per simulated event, and does not exceed 1.10 for longer than 45 seconds cumulatively per simulated event at each generator bus and generator step-up transformer high-side bus associated with any: Variance for MRO and WECC
  - 4.4.1. Individual generating unit greater than 20 MVA (gross nameplate rating) and connected at 60 kV and above.
  - 4.4.2. Generating plant/facility greater than 75 MVA (gross aggregate nameplate rating) and directly connected at 60 kV and above or any facility consisting of one or more units that are directly connected at 60 kV and above at a common bus with total generation above 75 MVA gross nameplate rating.
- R5. Each group of Planning Coordinators shall conduct a UFLS assessment at least once every five years or within one year of an actuation of UFLS resulting in 500 MW or greater of loss of load that determines through dynamic simulation whether the UFLS program design meets the performance characteristics in Requirement R4. The simulation shall: [VRF: High][Time Horizon: Long-term Planning]
  - 5.1. Model the underfrequency trip settings of generators (same as generators in 4.4) that trip above the UFLS curve TBD.
  - 5.2. Model the overfrequency trip settings of generators (same as generators in 4.4) that trip at or below the UFLS curve TBD.
  - 5.3. Model any automatic load restoration that impacts frequency stabilization and operates within the duration of the simulations run for the assessment.
- R6. Each group of Planning Coordinators shall reach concurrence of assessment results with their adjacent region's group of Planning Coordinators of any islands identified by any one region's group of Planning Coordinators that straddle the respective interconnected regions. [VRF: High][Time Horizon: Long-term Planning]

- Comment [sm4]: if replaced by a curve (5.1) - Hydro would still require a Variance but WECC would be ok with what is proposed - MRO? if curve would replace 5.1, 5.2 ofc would replace 5.3
- Comment [sm5]: need to discuss responses to Question 6
- Comment [sm6]: 9/1 - the team conducted a poll and concluded that the team does not think that considering 90% of installed capacity is enough but should go beyond - the team needs to determine what voltage will provide appropriate "coverage" of installed capacity
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- Comment [pjt8]: We will in ... [12]
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- Deleted: 61.8 Hz.
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- R7.** Each group of Planning Coordinators shall specify the content, format and schedule to create a database and annually maintain the database containing information for use in event analyses and assessments of the UFLS program. [VRF: Lower][Time Horizon: Long-term Planning]
- R8.** Each Transmission Owner and Distribution Provider shall provide data to its group of Planning Coordinators according to the format and schedule specified by the group of Planning Coordinators to support maintenance of the database. [VRF: Lower][Time Horizon: Long-term Planning]
- R9.** Each Transmission Owner and Distribution Provider shall provide tripping of load in accordance with the UFLS program designed by the group of Planning Coordinators for each region in which it operates. [VRF: High][Time Horizon: Operations Planning]
- If program design changes are introduced by the group of Planning Coordinators as a result of assessment results, the PC's shall provide advance notice to the TO's and DPs prior to implementation of the new program design...(see addition to R4 added the term "implementation schedule")

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**Comment [sm9]:** stephanie thinks we need to delete this part of the requirement

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**Comment [pjt10]:** The VRF should be revisited after consideration of requirements in the present PRC-009 and if R7 is reconsidered as to whether the assessment if of the program design or the program implementation.

**Comment [sm11]:** 9/2 - the team identified the need to have an implementation transition time in this requirement to account for changes in the program

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C. **Measures (TO BE REVISED BASED ON CHANGES TO REQUIREMENTS)**

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- M1. The Planning Coordinator shall provide evidence that it joined a group consisting of all the Planning Coordinators within the region for each of the regions in which it performs the Planning Coordinator function such as roster of participants (including organization), meeting minutes with recorded attendees, agreements, etc.
- M2. The Planning Coordinator shall provide evidence that their group of Planning Coordinators designed an underfrequency load shedding program for application across the region such as documentation of technical design parameters. [including participation in development of, or consent to, the technical parameters]
- M3. The Planning Coordinator shall provide evidence that their group developed criteria as specified in Requirement R3.
- M4. The Planning Coordinator shall provide evidence that their group developed a procedure as specified in Requirement R4.
- M5. The Planning Coordinator shall provide evidence that their group identified islands as specified in Requirement R5.
- M6. The Planning Coordinator shall provide evidence that their group developed a UFLS program that specifies the technical design parameters required to meet the performance characteristics in simulations as specified in Requirement R6 of underfrequency conditions resulting from an imbalance scenario where an imbalance = [(load — actual generation output) / (load)] of up to 25 percent within the identified island(s). Evidence may include dynamic simulations, basis for load and generation capacity, including unit sizes and connection voltage.
- M7. The Planning Coordinator shall provide evidence that their group conducted a UFLS assessment as specified in Requirement R7 such as dynamic simulation input data, and dynamic simulation results.
- M8. The Planning Coordinator shall provide evidence that their group specified the content, created and annually maintained a UFLS database as specified in Requirement R8.
- M9. The Transmission Owner and Distribution Provider shall provide evidence that they provided data to their respective group of Planning Coordinators as specified in Requirement R9 such as transmittal document and associated data.
- M10. The Transmission Owner and Distribution Provider shall provide evidence of tripping of forecast load in accordance with the UFLS program designed by the group of Planning Coordinators for each region in which it operates such as relay records, setting sheets, and circuit forecast loading

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D. Compliance

- 1. **Compliance Monitoring Process**
  - 1.1. **Compliance Enforcement Authority**

Text
  - 1.2. **Compliance Monitoring Period and Reset Time Frame**

Not applicable.

**1.3. Data Retention**

Text

**1.4. Compliance Monitoring and Assessment Processes**

Text

**1.5. Additional Compliance Information**

Text

**2. Violation Severity Levels**

R #	Lower VSL	Moderate VSL	High VSL	Severe VSL

**E. Regional Variances**

None.

**F. Associated Documents**

**Version History**

Version	Date	Action	Change Tracking

Page 2: [1] Deleted	Stephanie Monzon	9/2/2009 8:25:00 AM
<p>group of Planning Coordinators shall develop criteria, considering historical events and system studies, to select portions of the Bulk Electric System (BES) that may form islands. [VRF: Medium][Time Horizon: Long-term Planning]</p>		
Page 2: [2] Deleted	Stephanie Monzon	9/2/2009 9:11:00 AM
<p>Each group of Planning Coordinators shall develop have a procedure for coordinating with groups of Planning Coordinators in neighboring regions within an interconnection to identify and reach agreement on islands between its region and neighboring regions within the interconnection. The procedure shall identify how the neighboring entities will assist in the UFLS assessments and document concurrence of assessment results.</p>		
Page 2: [3] Deleted	Stephanie Monzon	9/2/2009 9:27:00 AM
<p>[VRF: Lower][Time Horizon: Long-term Planning]</p>		
Page 2: [4] Comment [pjt2]	Tatro, Phil	9/2/2009 10:42:00 AM
<p>The SDT needs to consider whether these bullets should be numbered. - 9/2 - agreed that they should be AND statements and agreed to add "and" to each statement to clarify the intent (will make sure this is consistent across the standard)</p>		
Page 2: [5] Deleted	Stephanie Monzon	9/2/2009 9:27:00 AM
<p>[Substitute for R4 to be inserted after R7, removing R4 completely and also removing 3<sup>rd</sup> point under R5] The combined group of Planning Coordinators of adjacent interconnected regions shall conduct a UFLS assessment on any islands identified by any one region's group of Planning Coordinators that straddle the respective interconnected regions. The periodicity, objective, content and outcome of the assessment shall be in accordance with R7. [VRF: High][Time Horizon: Long-term Planning]</p>		
Page 2: [6] Comment [sm3]	Stephanie Monzon	9/2/2009 10:42:00 AM
<p>8/28 - Sub-team discussion that these should be numbers (AND statement) not bullets</p>		
Page 2: [7] Formatted	Stephanie Monzon	9/2/2009 10:15:00 AM
<p>Default Paragraph Font, Font: Times New Roman</p>		
Page 2: [8] Deleted	Stephanie Monzon	9/2/2009 9:17:00 AM
<p>Interregional islands agreed on by the Planning Coordinators.</p>		
Page 2: [9] Deleted	Stephanie Monzon	9/1/2009 4:22:00 PM
<p>of the underfrequency load shedding program</p>		
Page 3: [10] Formatted	Stephanie Monzon	9/8/2009 10:03:00 AM
<p>Font: (Default) Times New Roman, 12 pt, Not Bold, Font color: Auto</p>		
Page 3: [11] Comment [sm7]	Stephanie Monzon	9/2/2009 11:38:00 AM
<p>8/24 - suggest to move R7 before R6</p>		



9/2 - the team agreed to keep this order to avoid referencing the next requirement

**Page 3: [12] Comment [pjt8] Tatro, Phil 9/2/2009 10:42:00 AM**

We will include the proposed PRC-024 curve as the criterion for determining which generator protections must be modeled.

**Page 3: [13] Formatted Stephanie Monzon 9/2/2009 12:43:00 PM**

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