

Standard Development Timeline

This section is maintained by the drafting team during the development of the standard and will be removed when the standard is adopted by the NERC Board of Trustees (Board).

Description of Current Draft

Completed Actions	Date
Regional Standards Committee accepted the Regional Standard Authorization Request (RSAR)	August 9, 2023

Anticipated Actions	Date
1 st 45-day Formal Comment Period	April 14, 2025 – May 29, 2025
30-day Pre-ballot Period	
10-day ballot Period (Extended to achieve quorum)	
NPCC Board of Directors Approval	
NERC Board adoption	

A. Introduction

1. **Title:** Automatic Underfrequency Load Shedding
2. **Number:** PRC-006-NPCC-3
3. **Purpose:** The NPCC Automatic Underfrequency Load Shedding (UFLS) regional Reliability Standard establishes more stringent and specific NPCC UFLS program requirements than the NERC continent-wide PRC-006 standard. The program is designed such that declining frequency is arrested and recovered in accordance with established NPCC performance requirements stipulated in this document.
4. **Applicability:**
 - 4.1. **Functional Entities:**
 - 4.1.1. Generator Owner
 - 4.1.2. Planning Coordinator
 - 4.1.3. Distribution Providers that are responsible for the ownership, operation, or control of UFLS equipment as required by the UFLS program established by the Planning Coordinators
 - 4.1.4. Transmission Owners that are responsible for the ownership, operation, or control of UFLS equipment as required by the UFLS program established by the Planning Coordinators
5. **Effective Date:** See Implementation Plan.

B. Requirements and Measures

- R1.** Each Planning Coordinator in the Eastern Interconnection portion of NPCC shall design a UFLS program, pertaining to islands wholly within the NPCC Region, having performance characteristics that prevents the frequency from remaining below 59.5 Hz for more than 30 seconds in accordance with Figure 1. *[Violation Risk Factor: High]*
[Time Horizon: Long Term Planning]
- M1.** Each Planning Coordinator shall have evidence such as reports, system studies and/or real-time power flow data captured from actual system events and other dated documentation that demonstrates it meets Requirement R1.
- R2.** Each Planning Coordinator shall provide UFLS island boundaries, as identified per the NERC continent-wide PRC-006 standard on UFLS, to Distribution Providers, Generator Owners, and Transmission Owners within 30 calendar days of receipt of a request. *[Violation Risk Factor: Lower]* *[Time Horizon: Long Term Planning]*
- M2.** Each Planning Coordinator shall have evidence such as dated documentation that demonstrates that it meets requirement R2.

- R3.** Each Distribution Provider and Transmission Owner in the Eastern Interconnection portion of NPCC shall implement an automatic UFLS program, reflecting normal operating conditions, excluding outages. The automatic UFLS program shall be implemented on an island basis for each identified island per the NERC continent-wide PRC-006 standard on UFLS as follows: *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*
- The UFLS program shall be implemented by each Distribution Provider and Transmission Owner according to the frequency thresholds, nominal operating times, and load shedding amounts specified in Attachment C, Tables 1-3; or
 - The UFLS program shall be implemented collectively by multiple Distribution Providers or Transmission Owners, as long as they reside in the same UFLS island identified by the Planning Coordinator per Requirement R2. These multiple Distribution Providers or Transmission Owners, via mutual agreement, shall act as a single entity to provide an aggregated automatic UFLS program that sheds their coincident peak aggregated net Load according to the frequency thresholds, total nominal operating time, and load shedding amounts specified in Attachment C, Tables 1-3.
- M3.** Each Distribution Provider and Transmission Owner in the Eastern Interconnection portion of NPCC shall have evidence such as documentation or reports containing the location and amount of load to be tripped in their respective areas, and the corresponding frequency thresholds, on those circuits included in its UFLS program identified in Requirement R3. (Attachment C, Tables 1-3).
- R4.** Each Distribution Provider or Transmission Owner in the Eastern Interconnection portion of NPCC that does not meet the UFLS program parameters specified in Attachment C, Table 1-3, and each Distribution Provider or Transmission Owner in the Quebec Interconnection that does not meet the UFLS program parameters specified by its Planning Coordinator shall: *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*
- Within 30 calendar days of determining that it does not meet the specified parameters, notify its Planning Coordinator that it does not meet the UFLS program parameters; and
 - Within the following 180 calendar days from notification of the Planning Coordinator,
 - (1) develop a Corrective Action Plan and a schedule for implementation that is mutually agreed upon with its Planning Coordinator or
 - (2) provide its Planning Coordinator with a technical study that demonstrates that the deviations from the program parameters will not result in failure of UFLS performance criteria being met for any island. The technical study must be acceptable to the Planning Coordinator prior to implementing deviations from program parameters and shall demonstrate coordination with UFLS programs of all entities residing within the same island(s) identified by the Planning Coordinator in Requirement R2. The technical study shall also demonstrate coordination with other UFLS programs of adjoining Planning Coordinators, or

(3) provide its Planning Coordinator with an analysis demonstrating that no alternative load shedding solution is available that would allow the Distribution Provider or Transmission Owner to comply with UFLS Attachment C Table 2 or Attachment C Table 3.

- M4.** Each Distribution Provider or Transmission Owner shall have evidence such as reports analysis, system studies and dated documentation that demonstrates that it meets Requirement R4.
- R5.** Each Planning Coordinator shall develop and review settings for inhibit thresholds at least once per five calendar years (such as, but not limited to, voltage, current and time) to be utilized within its region’s UFLS program. *[Violation Risk Factor: Medium]*
[Time Horizon: Long Term Planning]
- M5.** Each Planning Coordinator shall have evidence such as reports, system studies or analysis that demonstrates that it meets Requirement R5.
- R6.** Each Planning Coordinator shall notify each Transmission Owner and Distribution Provider within its Planning Coordinator area of the applicable inhibit thresholds within 30 calendar days of any changes. *[Violation Risk Factor: Lower]* *[Time Horizon: Operations Planning]*
- M6.** Each Planning Coordinator shall provide evidence such as letters, emails or other dated documentation that demonstrates that it meets Requirement R6.
- R7.** Each Distribution Provider and Transmission Owner that receives a notification pursuant to Requirement R6 shall develop and submit an implementation plan with respect to inhibit thresholds for approval by the Planning Coordinator within 90 calendar days of the notification from the Planning Coordinator. *[Violation Risk Factor: Lower]* *[Time Horizon: Operations Planning]*
- M7.** Each Distribution Provider and Transmission Owner shall provide evidence such as letters, emails, or other dated documentation that demonstrates that it meets Requirement R7.
- R8.** Each Distribution Provider and Transmission Owner shall implement the inhibit thresholds provided by the Planning Coordinator in accordance with Requirement R6 and based on the Planning Coordinator approved implementation plan in accordance with R7. *[Violation Risk Factor: High]* *[Time Horizon: Operation Planning]*
- M8.** Each Distribution Provider and Transmission Owner shall provide evidence such as test reports, data sheets, completed work orders, or other documentation that demonstrates that it meets Requirement R8.
- R9.** Each Transmission Owner and Distribution Provider shall annually provide documentation, with no more than 15 calendar months between updates, to its Planning Coordinator of the actual net Load that would have been shed by the UFLS

relays at each UFLS stage. The actual net Load shall be coincident with the entity's integrated hourly peak net Load during the previous year, as determined by measuring or calculating Load through the switches that would disconnect load if triggered by the UFLS relays. If measured data is unavailable, then calculated data may be used. *[Violation Risk Factor: Lower] [Time Horizon: Long Term Planning]*

- M9.** Each Distribution Provider and Transmission Owner shall provide evidence such as reports, spreadsheets or other dated documentation submitted to its Planning Coordinator that indicates the net Load that would have been shed and the percentage of its peak Load at each stage of its UFLS program to demonstrate that it meets Requirement R9.

- R10.** Each Generator Owner shall set each generator underfrequency trip protections (either provided by relays or protective functions), if so equipped, on or below the appropriate generator underfrequency trip protection setting threshold curve in Figure 2, except as otherwise exempted in Requirements R13 and R16. *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*

- M10.** Each Generator Owner shall provide evidence such as reports, data sheets, spreadsheets or other documentation that demonstrates that it meets Requirement R10.

- R11.** Each Generator Owner shall transmit the generator underfrequency trip protection setting and time delay within 45 calendar days of the Planning Coordinator's request. *[Violation Risk Factor: Lower] [Time Horizon: Operations Planning]*

- M11.** Each Generator Owner shall provide evidence such as emails, letters or other dated documentation that demonstrates that it meets Requirement R11.

- R12.** Each Generator Owner with a new generating unit, or an existing generator increasing its net capability by greater than 10% shall: *[Violation Risk Factor: Medium] [Time Horizon: Long Term Planning]*
 - 12.1** Design measures to prevent the generating unit from tripping directly or indirectly for underfrequency conditions above the appropriate generator tripping threshold curve in Figure 2.
 - 12.2** Design auxiliary system(s) or devices used for the control and protection of auxiliary system(s), necessary for the generating unit operation such that they will not trip the generating unit during underfrequency conditions above the appropriate generator underfrequency trip protection setting threshold curve in Figure 2.

- M12.** Each Generator Owner shall provide evidence such as reports, data sheets, specifications, memorandum or other documentation that demonstrates that it meets Requirement R12.

- R13.** For existing non-nuclear units in service prior to July 1, 2015, that have underfrequency protections set to trip above the appropriate curve in Figure 2:

[Violation Risk Factor: High] [Time Horizon: Long Term Planning]

- 13.1** Each Generator Owner shall set the underfrequency protection to operate at the lowest frequency allowed by the plant design and licensing limitations.
- 13.2** Each Generator Owner shall transmit the existing underfrequency settings and any changes to the underfrequency settings along with the technical basis for the settings to the Planning Coordinator.
- 13.3** Each Planning Coordinator in Ontario, Québec and the Maritime Provinces shall arrange for compensatory load shedding, in accordance with Attachment A and as provided by a Distribution Provider or Transmission Owner, that is adequate to compensate for the loss of generator(s) due to early tripping that is within the UFLS island identified by the Planning Coordinator in Requirement R2.
- 13.4** Each Generator Owner in the ISO-NE Planning Coordinator area and in NYISO Planning Coordinator area shall arrange for compensatory load shedding, in accordance with Attachment B and as provided by a Distribution Provider or Transmission Owner, that is adequate to compensate for the loss of generator(s) due to early tripping that is within the UFLS island identified by the Planning Coordinator in Requirement R2.
- M13.** Each Generator Owner or Planning Coordinator in Ontario, Québec and the Maritime Provinces with existing non-nuclear units in service prior to July 1, 2015, which have underfrequency tripping that is not compliant with Requirement R10 shall provide evidence such as reports, spreadsheets, memorandum or dated documentation demonstrating that it meets Requirement R13.
- R14.** Each Planning Coordinator in Ontario, Quebec and the Maritime provinces shall apply the criteria described in Attachment A to determine the compensatory load shedding that is required in Requirement R13, Part 13.3 for generating units in its respective NPCC area. *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*
- M14.** Each Planning Coordinator in Ontario, Quebec and Maritime provinces shall provide evidence such as reports, memorandum or other documentation that demonstrates that it followed the methodology described in Attachment A and meets Requirement R14.
- R15.** Each Generator Owner, Distribution Provider or Transmission Owner within the ISO-NE Planning Coordinator Area and in NYISO Planning Coordinator Area shall apply the criteria described in Attachment B to determine the compensatory load shedding that is required in Requirement R13, Part 13.4 for generating units in its respective NPCC area. *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*
- M15.** Each Generator Owner, Distribution Provider or Transmission Owner within the Planning Coordinator area of ISO-NE or the NYISO shall provide evidence such as

reports, memorandum, or other documentation that demonstrates that it followed the methodology described in Attachment B and meets Requirement R15.

R16. Each Generator Owner of existing nuclear generating plants with units that have underfrequency trip protection threshold settings above the Eastern Interconnection generator tripping curve in Figure 2 based on their licensing design shall: *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*

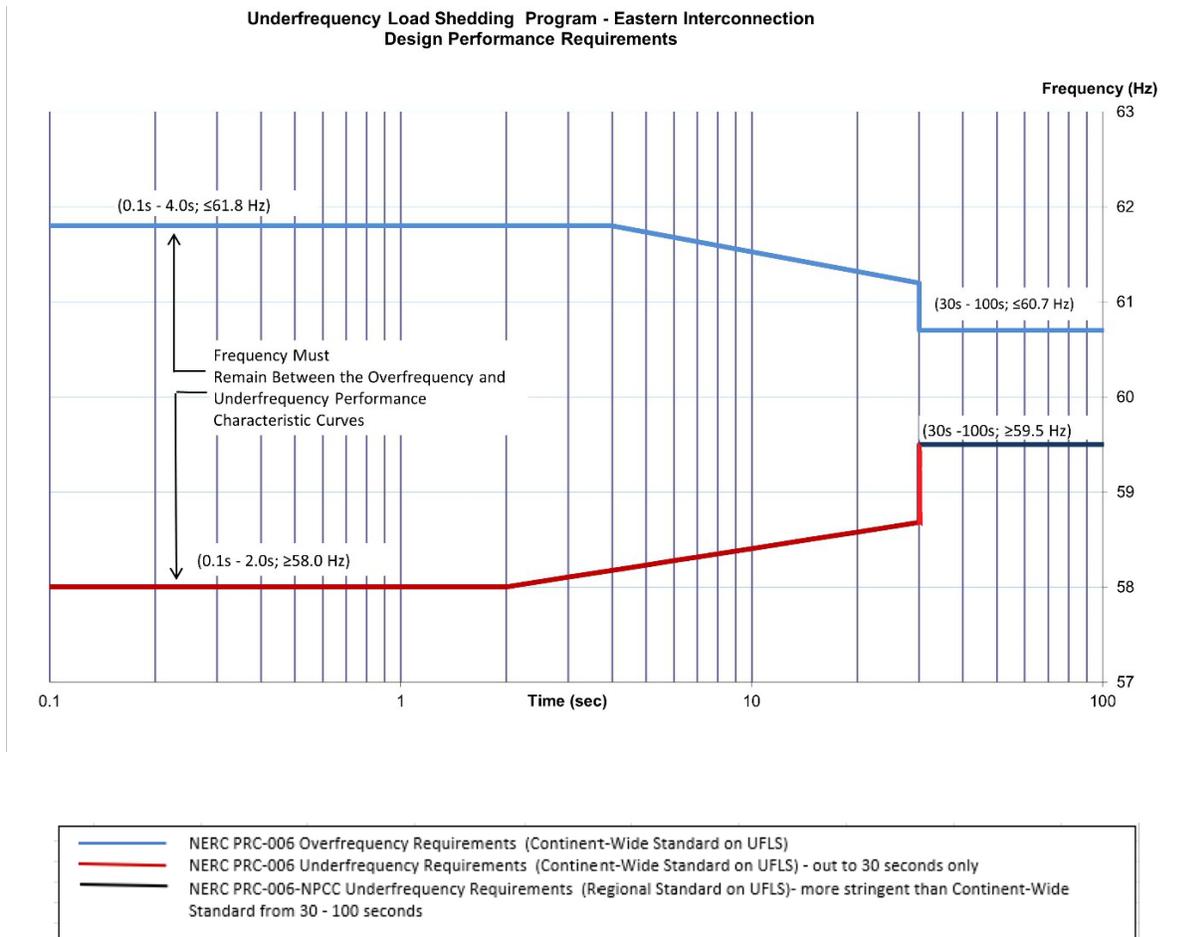
16.1 Set the underfrequency protection to operate at a frequency setting that is as low as possible in accordance with the plant design and licensing limitations but not greater than 57.8 Hz.

16.2 Set the frequency trip setting upper tolerance to no greater than + 0.1 Hz.

16.3 Transmit the initial frequency trip setting and any changes to the setting and the technical basis for the settings to the Planning Coordinator.

M16. Each Generator Owner of nuclear units that have generator trip settings above the generator trip curve in Figure 2 shall provide evidence such as letters, reports and dated documentation that demonstrates that it meets Requirement R16.

Figure 1

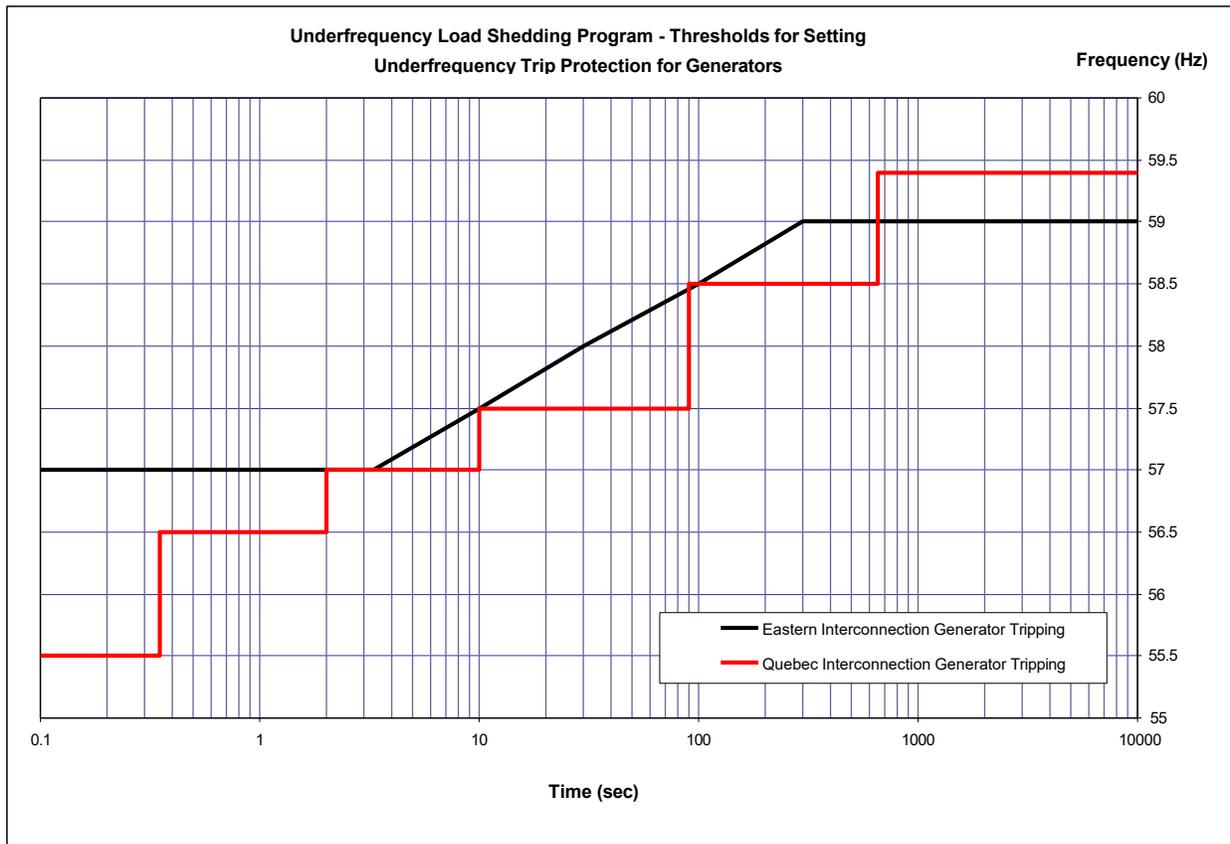


Curve Data:

Overfrequency Requirements		Source
Time (Sec)	Frequency (Hz)	
$t \leq 4$	$f = 61.8$	NERC PRC-006 (Continent-Wide Standard on UFLS)
$4 s < t \leq 30$	$f = -0.686\log(t) + 62.21$	
$t > 30$	$f = 60.7$	

Underfrequency Requirements		Source
Time (Sec)	Frequency (Hz)	
$t \leq 2$	$f = 58.0$	NERC PRC-006 (Continent-Wide Standard on UFLS)
$2 s < t \leq 30$	$f = 0.575\log(t) + 57.83$	
$t > 30$	$f = 59.5$	NERC PRC-006-NPCC (Regional Standard on UFLS)

Figure 2



Curve Data:

Eastern Interconnection:

Time (Sec)	Frequency (Hz)
$t \leq 3.3$	$f = 57.0$
$3.3 \leq t \leq 300$	$f = \log(t) + 56.5$
$t > 300$	$f = 59.0$

Quebec Interconnection:

Time (Sec)	Frequency (Hz)
$t \leq 0.35$	55.5
$0.35 < t \leq 2$	56.5
$2 < t \leq 10$	57.0
$10 < t \leq 90$	57.5
$90 < t \leq 660$	58.5
$t > 660$	59.4

C. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority:

Northeast Power Coordinating Council

1.2. Evidence Retention:

The Distribution Provider and Transmission Owner shall keep evidence for three calendar years for Measures 3, 4, 7, 8, and 9.

The Planning Coordinator shall keep evidence for three calendar years for Measures 1, 2, 5, 6, 13 and 14.

The Distribution Provider, Transmission Owner, and Generator Owner shall keep evidence for three calendar years for Measure 15.

The Generator Owner shall keep evidence for three calendar years for Measures 10, 11, 12, 13, and 16.

1.3. Compliance Monitoring and Enforcement Program:

Compliance Audit

Self-Certification

Spot Checking

Compliance Violation Investigation

Self-Reporting

Complaints

Violation Severity Levels

R #	Violation Severity Levels			
	Lower VSL	Moderate VSL	High VSL	Severe VSL
R1.	N/A	N/A	N/A	The Planning Coordinator failed to design a UFLS program having performance characteristics that prevent frequency from remaining below 59.5 Hz in accordance with Figure 1.
R2.	The Planning Coordinator provided its UFLS island boundaries, as identified per the NERC continent-wide PRC-006 standard on UFLS but did so more than 30 calendar days and up to and including 40 days following a request.	The Planning Coordinator provided its UFLS island boundaries, as identified per the NERC continent-wide PRC-006 standard on UFLS but did so more than 40 calendar days but less than and including 50 days following a request.	The Planning Coordinator provided its UFLS island boundaries, as identified per the NERC continent-wide PRC-006 standard on UFLS but did so more than 50 calendar days but less than and including 60 days following a request.	The Planning Coordinator failed to provide its UFLS island boundaries, as identified per the NERC continent-wide PRC-006 standard on UFLS within 60 calendar days following a request.
R3.	The Distribution Provider or Transmission Owner failed to apply appropriate settings on 20% or less of the relays identified as included in the UFLS program, or amount of load tripped is within 10% deviation from the required amount of Load required to be shed at each stage.	The Distribution Provider or Transmission Owner failed to apply appropriate settings on more than 20% but less than or equal to 40% of the relays identified as included in the UFLS program, or amount of load tripped is within 20% deviation from the required amount of Load required to be shed at each stage.	The Distribution Provider or Transmission Owner failed to apply appropriate settings on more than 40% but less than 60% of the relays identified as included in the UFLS program, or amount of load tripped is within 30% deviation from the required amount of Load required to be shed at each stage.	The Distribution Provider or Transmission Owner failed to apply appropriate settings on more than 60% of the relays identified as included in the UFLS program, or amount of load tripped has a > 30% deviation from the required amount of Load required to be shed at each stage.
R4.	The Distribution Provider or Transmission Owner that cannot meet the tolerances and/or number of stages and frequency set points specified in the UFLS Program fulfilled its obligations for	The Distribution Provider or Transmission Owner that cannot meet the tolerances and/or number of stages and frequency set points specified in the UFLS Program fulfilled its obligations for	The Distribution Provider or Transmission Owner that cannot meet the tolerances and/or number of stages and frequency set points specified in the UFLS Program fulfilled its obligations but exceeded the permissible	The Distribution Provider or Transmission Owner that cannot meet the tolerances and/or number of stages and frequency set points specified in the UFLS Program failed to meet all of Requirement R4 within 60

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	Requirement R4 but exceeded the permissible time frame(s) by a period of up to 10 calendar days but less than or equal to 20 calendar days.	Requirement R4 but exceeded the permissible time frame(s) within a time greater than 20 calendar days but less than or equal to 30 calendar days.	time frame(s) within a time greater than 30 calendar days but less than or equal to 60 calendar days.	calendar days of permissible time for each item.
R5.	The Planning Coordinator developed or reviewed settings for inhibit thresholds at least once per five calendar years, for less than 100% but more than (and including) 95% of relays within its region’s UFLS program.	The Planning Coordinator developed or reviewed settings for inhibit thresholds at least once per five calendar years, for less than 95% but more than (and including) 90% of relays within its region’s UFLS program.	The Planning Coordinator developed or reviewed settings for inhibit thresholds at least once per five calendar years, for less than 90% but more than (and including) 85% of relays within its region’s UFLS program.	The Planning Coordinator developed or reviewed settings for inhibit thresholds at least once per five calendar years, for less than 85% of relays within its region’s UFLS program.
R6.	The Planning Coordinator provided to a Transmission Owner or Distribution Provider within its Planning Coordinator area the applicable inhibit thresholds more than 30 calendar days and up to and including 40 calendar days of any changes.	The Planning Coordinator provided to a Transmission Owner or Distribution Provider within its Planning Coordinator area the applicable inhibit thresholds more than 40 calendar days but less than and including 50 calendar days of any changes.	The Planning Coordinator provided to a Transmission Owner or Distribution Provider within its Planning Coordinator area the applicable inhibit thresholds more than 50 calendar days but less than and including 60 calendar days of any changes.	The Planning Coordinator failed to provide to a Transmission Owner or Distribution Provider within its Planning Coordinator area the applicable inhibit thresholds within 60 calendar days after any changes
R7.	The Distribution Provider or Transmission Owner developed and submitted its implementation plan more than 90 calendar days and up to and including 100 calendar days following the notification.	The Distribution Provider or Transmission Owner developed and submitted its implementation plan more than 100 calendar days and up to and including 110 calendar days following the notification.	The Distribution Provider or Transmission Owner developed and submitted its implementation plan more than 110 calendar days and up to and including 120 calendar days following the notification.	The Distribution Provider or Transmission Owner failed to develop and submit its implementation plan within 120 days following the notification.
R8.	The Distribution Provider or Transmission Owner implemented the inhibit threshold settings provided by the Planning Coordinator in accordance with the Planning Coordinator	The Distribution Provider or Transmission Owner implemented the inhibit threshold settings provided by the Planning Coordinator in accordance with the Planning Coordinator	The Distribution Provider or Transmission Owner implemented the inhibit threshold settings provided by the Planning Coordinator in accordance with the Planning Coordinator	The Distribution Provider or Transmission Owner implemented the inhibit threshold settings provided by the Planning Coordinator in accordance with the Planning Coordinator

	approved implementation plan for less than 100% but more than (and including) 95% of UFLS relays.	approved implementation plan for less than 95% but more than (and including) 90% of UFLS relays.	approved implementation plan for less than 90% but more than (and including) 85% of UFLS relays.	approved implementation plan for less than 85% of UFLS relays.
R9.	The Distribution Provider or Transmission Owner provided to its Planning Coordinator documentation of the actual net Load that would have been shed by the UFLS relays at each UFLS stage as described in Requirement R9 more than 15 calendar months but less than (and including) 16 calendar months since last update.	The Distribution Provider or Transmission Owner provided to its Planning Coordinator documentation of the actual net Load that would have been shed by the UFLS relays at each UFLS stage as described in Requirement R9 more than 16 calendar months but less than (and including) 17 calendar months since last update.	The Distribution Provider or Transmission Owner provided to its Planning Coordinator documentation of the actual net Load that would have been shed by the UFLS relays at each UFLS stage as described in Requirement R9 more than 17 calendar months but less than (and including) 18 calendar months since last update.	The Distribution Provider or Transmission Owner failed to provide to its Planning Coordinator documentation of the actual net Load that would have been shed by the UFLS relays at each UFLS stage as described in Requirement R9 within 18 calendar months since last update.
R10.	N/A	N/A	N/A	The Generator Owner did not set each generator underfrequency trip protection, if so equipped, on or below the appropriate generator underfrequency trip protection settings threshold curve in Figure 2, except as otherwise exempted.
R11.	The Generator Owner transmitted the generator underfrequency trip protection setting and time delay more than 45 calendar days and less than (and including) 55 calendar days of the Planning Coordinator’s request.	The Generator Owner transmitted the generator underfrequency trip protection setting and time delay more than 55 calendar days and less than (and including) 65 calendar days of the Planning Coordinator’s request.	The Generator Owner transmitted the generator underfrequency trip protection setting and time delay more than 65 calendar days and less than (and including) 75 calendar days of the Planning Coordinator’s request.	The Generator Owner failed to transmit the generator underfrequency trip protection setting and time delay within 75 calendar days of the Planning Coordinator’s request.
R12.	N/A	N/A	The Generator Owner with a new generating unit, or an existing generator increasing its net capability by greater than 10%:	The Generator Owner with a new generating unit, or an existing generator increasing its net capability by greater than 10%, did not fulfill the obligations of

			<p>Did not fulfill the obligation of Requirement R12; Part 12.1</p> <p>OR</p> <p>Did not fulfill the obligation of Requirement R12, Part 12.2.</p>	<p>Requirement R12, Part 12.1 and Part 12.2.</p>
R13.	N/A	<p>The Generator Owner failed to transmit the existing underfrequency settings and any changes to the underfrequency settings along with the technical basis for the settings to the Planning Coordinator as specified in Requirement R13, Part 13.2.</p>	<p>The Generator Owner failed to set the underfrequency protection to operate at the lowest frequency allowed by the plant design and licensing limitations as specified in Requirement 13, Part 13.1</p>	<p>The Planning Coordinator in Ontario, Québec and the Maritime Provinces or the Generator Owner within the ISO-NE and in NYISO Planning Coordinator areas failed to arrange for compensatory load shedding as specified in Requirement R13, Part 13.3 and 13.4.</p>
R14.	N/A	N/A	N/A	<p>The Planning Coordinator did not apply the criteria described in Attachment A to determine the compensatory load shedding that is required.</p>
R15.	N/A	N/A	N/A	<p>The Generator Owner, Distribution Provider, or Transmission Owner did not apply the criteria described in Attachment B to determine the compensatory load shedding that is required.</p>
R16.	N/A	<p>The Generator Owner failed to transmit the initial frequency trip setting and any changes to the setting and the technical basis for the settings to the Planning Coordinator as specified in Requirement R16, Part 16.3.</p>	<p>The Generator Owner:</p> <p>Failed to set the underfrequency setting as specified in Requirement R16; Part 16.1</p> <p>OR</p> <p>Failed to set the frequency trip setting upper tolerance as</p>	<p>The Generator Owner did not fulfill the obligations of Requirement R16, Part 16.1 and Part 16.2.</p>

			specified in Requirement R16, Part 16.2.	
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D. Regional Variances

PRC-006-5 Automatic Underfrequency Load Shedding Regional Quebec Variance

E. Associated Documents

Technical Rationale

Version History

Version	Date	Action	Change Tracking
1	2-9-2012	Adopted by Board of Trustees	
2	6-23-2015	RSAR Submitted	
2	11-5-2019	Adopted by the NERC Board of Trustees	
2	2-18-2020	FERC issued letter order approving PRC-006-NPCC-2. Docket No. RD20-1-000	
3	3-7-2023	RSAR Submitted	

Standard Attachments

PRC-006-NPCC-3 Attachment A

Compensatory Load Shedding Criteria for Ontario, Quebec, and the Maritime Provinces:

The Planning Coordinator in Ontario, Quebec and the Maritime provinces is responsible for establishing the compensatory load shedding requirements for all existing non-nuclear units in its NPCC area with underfrequency protections set to trip above the appropriate curve in Figure 2. In addition, it is the Planning Coordinator's responsibility to communicate these requirements to the appropriate Distribution Provider or Transmission Owner and to ensure that adequate compensatory load shedding is provided in all UFLS islands in which the unit may operate.

The methodology below provides a set of criteria for the Planning Coordinator to follow for determining compensatory load shedding requirements as part of its UFLS Assessment based on the NERC continent-wide PRC standard on UFLS:

1. The Planning Coordinator shall identify, compile and maintain a list of all existing non-nuclear generating units in their Planning Coordinator area that were in service prior to the effective date of the Regional Standard (July 1, 2015, PRC-006-NPCC-1). The list must indicate generating units, if any, that have their underfrequency protections set to trip above the appropriate curve in Figure 2. Generating units not appearing on the list as of the effective date of Version 1 of the Regional Standard, as shown above, must have their underfrequency protections set to trip on or below the appropriate curve in Figure 2. The list shall include the following information for each unit:
 - 1.1 Generator name and generating capacity.
 - 1.2 Underfrequency protection trip settings, including frequency trip set points and time delays.
 - 1.3 Physical and electrical location of the unit
 - 1.4 All islands within which the unit may operate.
2. For each generating unit identified in (1) above, the Planning Coordinator shall establish the requirements for compensatory load shedding based on criteria outlined below:
 - 2.1 Arrange for a Distribution Provider or Transmission Owner that owns UFLS relays within the island(s) identified by the Planning Coordinator within which the generator may operate to provide compensatory load shedding.
 - 2.2 In Ontario and in the Maritime provinces, the compensatory load shedding that is provided by the Distribution Provider or Transmission Owner shall be in addition to the amount that the Distribution Provider or Transmission Owner is required to shed as specified in Requirement R3.

2.3 The compensatory load shedding shall be provided at the UFLS program stage (or threshold stage for Quebec) with a frequency threshold setting that corresponds to the highest frequency at which the subject generator will trip above the appropriate curve in Figure 2 during an underfrequency event. If the highest frequency at which the subject generator will trip above the appropriate curve in Figure 2 does not correspond to a specific UFLS program stage threshold setting, the compensatory load shedding shall be provided at the UFLS program stage with a frequency threshold setting that is higher than the highest frequency at which the subject generator will trip above the appropriate curve in Figure 2.

2.4 The amount of compensatory load shedding shall be equivalent ($\pm 5\%$) to the average net generator megawatt output for the prior two calendar years, as specified by the Planning Coordinator, plus expected station loads to be transferred to the system upon loss of the facility. The net generation output should only include those hours when the unit was a net generator to the electric system.

In the specific instance of a generating unit that has been interconnected to the electric system for less than two calendar years, the amount of compensatory load shedding shall be equivalent ($\pm 5\%$) to the maximum claimed seasonal capability of the generator over two calendar years, plus expected station loads to be transferred to the system upon loss of the facility.

PRC-006-NPCC-3 Attachment B

Compensatory Load Shedding Criteria for ISO-NE and NYISO:

The Generator Owner in the New England states or New York State are responsible for establishing a compensatory load shedding program for all existing non-nuclear units with underfrequency protection set to trip above the appropriate curve in Figure 2 of this standard. The Generator Owner shall follow the methodology below to determine compensatory load shedding requirements:

1. The Generator Owner shall identify, compile, and maintain a list of all of its existing non-nuclear generating units that were in service prior to the effective date of the Regional Standard (July 1, 2015, PRC-006-NPCC-1). The list must indicate the Generator Owner's generating units, if any, which have their underfrequency protections set to trip above the appropriate curve in Figure 2. Generating units not appearing on the list as of the effective date of Version 1 of the Regional Standard, as shown above, must have their underfrequency protections set to trip on or below the appropriate curve in Figure 2. The list shall include the following information associated with each unit:
 - 1.1 Generator name and generating capacity.
 - 1.2 Underfrequency protection trip settings, including frequency trip set points and time delays.
 - 1.3 Physical and electrical location of the unit
 - 1.4 Smallest island within which the unit may operate as identified by the Planning Coordinator in Requirement R1 of this standard.
2. For each generating unit identified in (1) above, the Generator Owner shall establish the requirements for compensatory load shedding based on criteria outlined below:
 - 2.1 In cases where a Distribution Provider or Transmission Owner has coordinated protection settings with the Generator Owner to cause the generator to trip above the appropriate curve in Figure 2, the Distribution Provider or Transmission Owner is responsible to provide the appropriate amount of compensatory load to be shed within the same and smallest island identified by the Planning Coordinator in Requirement R1 of this standard.
 - 2.2 In cases where a Generator Owner has a generator that cannot physically meet the set points defined by the appropriate curve in Figure 2, the Generator Owner shall arrange for a Distribution Provider or Transmission Owner to provide the appropriate amount of compensatory load to be shed within the same and smallest island identified by the Planning Coordinator in Requirement R1 of this standard.

- 2.3 The compensatory load shedding that is provided by the Distribution Provider or Transmission Owner shall be in addition to the amount that the Distribution Provider or Transmission Owner is required to shed as specified in Requirement R3.
- 2.4 The compensatory load shedding shall be provided at the UFLS program stage with the frequency threshold setting at or closest to but above the frequency at which the subject generator will trip.
- 2.5 The amount of compensatory load shedding shall be equivalent ($\pm 5\%$) to the average net generator megawatt output for the prior two calendar years, as specified by the Planning Coordinator, plus expected station loads to be transferred to the system upon loss of the facility. The net generation output should only include those hours when the unit was a net generator to the electric system.

In the specific instance of a generating unit that has been interconnected to the electric system for less than two calendar years, the amount of compensatory load shedding shall be equivalent ($\pm 5\%$) to the maximum claimed seasonal capability of the generator over two calendar years, plus expected station loads to be transferred to the system upon loss of the facility.

PRC-006-NPCC-3 Attachment C

UFLS Table 1: Eastern Interconnection					
Distribution Providers and Transmission Owners with 100 MW ² or more of peak net Load shall implement a UFLS program with the following attributes:					
UFLS Stage	Frequency Threshold (Hz)	Minimum Relay Time Delay (s)	Total Nominal Operating Time (s) ¹	Load Shed at Stage as % of TO or DP Load	Minimum Cumulative Load Shed as % of TO or DP Load
1	59.5	0.10	0.30	6.5 – 7.5	6.5
2	59.3	0.10	0.30	6.5 – 7.5	13.5
3	59.1	0.10	0.30	6.5 – 7.5	20.5
4	58.9	0.10	0.30	6.5 – 7.5	27.5
5	59.5	0.10	10.0	2 - 3	29.5

UFLS Table 2: Eastern Interconnection					
Distribution Providers and Transmission Owners with 50 MW ² or more and less than 100 MW ² of peak net Load shall implement a UFLS program with the following attributes:					
UFLS Stage	Frequency Threshold (Hz)	Minimum Relay Time Delay (s)	Total Nominal Operating Time (s) ¹	Load Shed at Stage as % of TO or DP Load	Minimum Cumulative Load Shed as % of TO or DP Load
1	59.5	0.10	0.30	14 – 25	14
2	59.1	0.10	0.30	14 – 25	28

1. The total nominal operating time includes the underfrequency relay operating time plus any interposing auxiliary relay operating times, communication times, and the breaker interrupting time (measured or rated), with maximum deviation for any load limited to ±50 ms for each UFLS Stage 1 to UFLS Stage 4, and ±350 ms for UFLS Stage 5. For the study purposes, the total nominal operating times are used to simulate load interruption for the entire Balancing Authority Area UFLS program and assume the sum of all individual load deviations will have minimal net impact. The underfrequency relay operating time is measured from the time when frequency passes through the frequency threshold setpoint, using a test rate of frequency decay of 0.2 Hz per second. If the relay operating time is dependent on the rate of frequency decay, the underfrequency relay operating time and any subsequent testing of the UFLS relays shall utilize a test rate of linear frequency decay of 0.2 Hz per second.
2. Peak net load shall be calculated as an average of the peak net load from the previous 3 years, excluding the current year.

UFLS Table 3: Eastern Interconnection Distribution Providers and Transmission Owners with 25 MW ² or more and less than 50 MW ² of peak net Load shall implement a UFLS program with the following attributes:					
UFLS Stage	Frequency Threshold (Hz)	Minimum Relay Time Delay (s)	Total Nominal Operating Time (s) ¹	Load Shed at Stage as % of TO or DP Load	Minimum Cumulative Load Shed as % of TO or DP Load
1	59.5	0.10	0.30	28 – 50	28

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1. The total nominal operating time includes the underfrequency relay operating time plus any interposing auxiliary relay operating times, communication times, and the breaker interrupting time (measured or rated), with maximum deviation for any load limited to ±50 ms for each UFLS Stage 1 to UFLS Stage 4, and ±350 ms for UFLS Stage 5. For the study purposes, the total nominal operating times are used to simulate load interruption for the entire Balancing Authority Area UFLS program and assume the sum of all individual load deviations will have minimum net impact. The underfrequency relay operating time is measured from the time when frequency passes through the frequency threshold setpoint, using a test rate of frequency decay of 0.2 Hz per second. If the relay operating time is dependent on the rate of frequency decay, the underfrequency relay operating time and any subsequent testing of the UFLS relays shall utilize a test rate of linear frequency decay of 0.2 Hz per second.
 2. Peak net load shall be calculated as an average of the peak net load from the previous 3 years, excluding the current year.

Rationale Box:

Standard PRC-006-3, R4 requires the Planning Coordinator to conduct a UFLS assessment at least once every five years. However, aside from a UFLS islanding event, it does not prescribe other factors or events which could warrant a new UFLS assessment in less than the five years timeframe.

PRC-006-NPCC-2 contained requirements if changes to load distribution impacted UFLS program performance (R21) but did not consider many other factors. The drafting team recommends retiring these requirements (R21, R22, R23) and replacing them with the following guidance. Significant variations in the following factors could require a Planning Coordinator to conduct a new assessment:

- Changes to the BES that could modify the creation of islands or the severity of events such as new transmission topologies, revised protection schemes or new or revised RAS.
- Unforeseen islanding event
- Real and reactive load distribution (including changes to location of compensatory load shedding)
- Transmission Owner or Distribution Provider's inability to implement the UFLS program within the stated tolerances
- Load characteristics in particular frequency responsive load
- Automatic load restoration
- Generation geographical distribution
- Generator trip settings
- Generation mix in particular non-BES generation that may not be subject to frequency ride-through criteria
- Generator dynamic modeling
- Dynamic VAR device modeling
- HVDC dynamic modeling

Rationale for Requirement R1: Figure 1 of this document shows the NPCC underfrequency criteria for the Eastern Interconnection portion of NPCC. Figure 1 also shows the NERC criteria as defined in the NERC continent-wide PRC-006 standard on UFLS.

Rationale for Requirement R5: An inhibit function provides supervisory control over a UFLS relay. For example, an undervoltage inhibit feature prevents UFLS relay operation if the sensed voltage decreases below an adjustable setting. An undervoltage inhibit function is intended to prevent operation of a UFLS relay when the transmission supply is lost to distribution station feeding many induction motors. Following loss of the transmission supply, motors may support the voltage while the motors coast down in speed. The motors coasting down (ringing down) will look like an underfrequency event to the relay. The inhibit setting is set to a voltage above which the motor load is expected to sustain. This prevents the underfrequency relay from

tripping and locking out distribution feeder breakers supplying the motor load, between the time the transmission supply line trips and the time when the line recloses to restore the load. Voltages sustained by motors that are coasting down (e.g. 0.70 pu) are typically much lower than voltages at which the UFLS relays are required to operate to meet UFLS performance criteria. However, motor loads supplied by cable networks typically have higher ring down voltages because of cable charging. Therefore, care must be taken so that the voltage inhibit setting is not higher than the voltage at which UFLS relays are required to operate to meet UFLS performance criteria.

Rationale for Requirement R9: Ideally, the amount of load to be shed in each stage of the UFLS program for every entity should perfectly match that prescribed in this standard, for all phases of the load cycle, i.e., seasonal (summer vs. winter), weekly (weekday vs. weekend vs. holidays), daily (morning, noon, and night), etc. for all of the identified islands. Practically, however, this is obviously not possible because the load cycles of the various areas and sub-areas within any given island do not perfectly track the load cycle of the overall island. The UFLS program, on the other hand, is designed based on peak conditions for the overall island. The percentages of actual load shedding that would occur for any conditions other than peak, therefore, can only approximate that prescribed in the standard. To that end, Requirement R9 requires entities to document measured loads in the UFLS program coincident with their own annual peak, whether or not that peak occurs at the same time or in the same season as the peak of the identified island in which their load resides. Using individual entity peaks vs. overall island peaks provides a consistent approach for accounting purposes among the very entities that are responsible for designing and maintaining their UFLS programs.