

A. Introduction

1. **Title:** Automatic Underfrequency Load Shedding Requirements
2. **Number:** **PRC-006-MRO-01**
3. **Purpose:** The purpose of this standard is to develop, coordinate, implement and document Automatic Underfrequency Load Shedding (UFLS) requirements to provide last resort system preservation measures to mitigate unwanted low frequency conditions.
4. **Applicability:**
 - 4.1. Planning Coordinator (PC)
 - 4.2. Distribution Provider (DP)
 - 4.3. Transmission Owner (TO)
 - 4.4. Generator Owner (GO)
5. **Effective Date:** 1st day of the 1st quarter one year following last appropriate Regulatory Approval, financial sanctions will become effective.

B. Requirements

- R1.** Each Planning Coordinator shall develop and maintain a documented methodology to determine areas of credible islanding within its area. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
The methodology shall consider the following:
 - Historical islanding events
 - Historical severe disturbance events
 - Any network islanding scheme
 - Identity of the connecting elements for credible islands
 - Identity of exempt critical loads within each credible island
 - Identity of exempt credible islands
 - How the registered entities and stakeholders, including adjacent entities, will assist in the UFLS development, including studies and analyses, and provide concurrence
- R2.** A Planning Coordinator shall make its methodology available to MRO or NERC within 15 business days of a request. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
- R3.** Each Planning Coordinator shall use its methodology to determine credible islands within its area of responsibility and identify the credible islands that must have UFLS programs. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

- R3.1.** Each Planning Coordinator shall evaluate and confirm credible islanding within their area of responsibility every calendar-year and within 15 months of the last evaluation ~~annually~~.
- R3.2.** Each Planning Coordinator shall provide its credible island determination to the TOs and DPs that are within its area of responsibility, and to adjacent PCs, within 30 days of the determination.

R4. Each Planning Coordinator shall have a documented methodology for design and performance of its UFLS program. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

The methodology shall include the following elements:

- **Frequency** set points and timing delays Comment [LLE1]: Severe vsI
- **A** minimum of 30% percent of its total connected forecasted annual peak hour Load assigned to trip in each designated island Comment [LLE2]: Severe vsI
- **Frequency** decline shall be arrested at no less than 58.0 Hz. The frequency shall not remain below 58.5 Hz for greater than 30 seconds, cumulatively, and shall not remain below 59.5 Hz for greater than 30 seconds, cumulatively. Comment [LLE3]: Moderate vsI
- **Frequency** overshoot resulting from operation of UFLS relays shall not exceed 61.0 Hz for any duration and shall not exceed 60.5 Hz for greater than 30 seconds, cumulatively. Comment [LLE4]: Moderate vsI
- **Bulk** Electric System voltage during and following UFLS operations shall be controlled such that the per unit Volts per Hz (V/Hz) will not exceed 1.18 for longer than 2 seconds, cumulatively, and will not exceed 1.10 for longer than 45 seconds, cumulatively. Comment [LLE5]: Moderate vsI
- **Undervoltage** inhibit shall not be greater than 75 percent of nominal voltage Comment [LLE6]: Moderate vsI
- ~~Maximum breaker interrupting times~~
- **Evaluate** and discuss any network islanding schemes, automatic load restoration schemes, network tie tripping schemes, generating unit frequency excursion protection tripping scheme, and other methods of load and resource balancing, including any recognized potential effects on adjacent Planning Coordinators. Comment [LLE7]: Moderate vsI
- **Evaluate** applicable reactive power device tripping scheme designs for proper coordination with the proposed UFLS Program designs to avoid excessive BES bus voltage during automatic UFLS events. Comment [LLE8]: Moderate vsI
- **Exemption** criteria Comment [LLE9]: Lower vsI
- **Off**-nominal frequency relay types used Comment [LLE10]: Lower vsI
- **Simulation** methods used Comment [LLE11]: Lower vsI

- ~~Maximum~~ breaker interrupting times

Comment [LLE12]: Lower vsI

R5. Each Distribution Provider shall review, and if necessary make revisions to, its portion of the UFLS program ~~annually~~ each calendar year and within 15 months of the last evaluation to agree with the overall UFLS program. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

The ~~annual~~ review shall include the following:

- Collect information as needed regarding the characteristics and criticality of the end use Load that is in each island and connected to its facilities from the associated Load Serving Entities.
- Update the UFLS program load data in each island ~~annually~~ to reflect next year's projected peak hour Loads.

Comment [LLE13]: Define in the reference document?

R6. Each Planning Coordinator shall review its UFLS program each calendar year and within 15 months of the last review ~~annually~~ and if the updated UFLS program in any island does not agree with the design methodology, then the UFLS program shall be revised to agree with the design methodology. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

R7. Each Planning Coordinator shall periodically perform an assessment of the expected performance of UFLS program design changes in each island in its footprint and provide an assessment report to the entities associated with each island. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

R7.1. Perform an assessment of the expected performance of the UFLS program, reactive power device tripping scheme, any related protective schemes or balancing methods in each island at least every five calendar years.

R7.2. Prepare a report of the assessment results and provide the report to the entities associated with each UFLS program, reactive power device tripping scheme, related protective scheme, or balancing method within 30 days. The entities may include Distribution Providers, Transmission Owners, Generator Owners, Transmission Planners, Planning Coordinators, adjacent Planning Coordinators, the MRO, ~~and or~~ NERC.

R8. Each Distribution Provider or Transmission Owner that owns UFLS relay(s) shall ~~annually~~ provide new and updated UFLS data to its Planning Coordinator(s) ~~upon request, every calendar year and within 15 months of the last submittal~~ in the MRO approved format. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

This information shall include:

- Point where each load, as a part of the UFLS program, is ultimately interconnected to the transmission system
 - Percentage of peak load tripped at the transmission interconnection location for each load step
 - Frequency trip points for each UFLS step
 - Relay operating time delay for each UFLS step
 - Nominal circuit breaker operating time
 - UFLS relay undervoltage-inhibit voltage level
- R9.** Each Distribution Provider or Transmission Owner with reactive power devices, system protection schemes, or load and resource balancing methods that may impact the UFLS programs in the MRO footprint shall provide the device or protection scheme data to its Planning Coordinator in the MRO approved format. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
- R9.1.** Provide the following data on any applicable new reactive power device before it is placed in service and any existing reactive power device. Also provide any change in the device data within 60 days.
- R9.2.** Provide data on any applicable system protection scheme or load and resource balancing method before it is placed in service and provide any change in the scheme or method within 60 days.
- R10.** Each Generator Owner shall provide the off-nominal frequency capability limits of its generating units and any frequency excursion protection system data that may affect the UFLS program(s) in the MRO footprint to its Planning Coordinator in the MRO approved format. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
- R10.1.** Provide the off-nominal frequency response capability limits of each new generation unit before it is placed in service, and for each existing unit. Also provide any changes in data within 60 days.
- R10.2.** Provide the settings and time delays of any frequency excursion for each new protection relays before they are placed in service, and for each existing relay. Also provide any changes in the relay data within 60 days.
- R10.3.** Provide information documenting any other new schemes that may impact the UFLS programs in the MRO footprint before it is placed in service, and for each existing scheme. Also provide any changes in the scheme data within 60 days.

- R11.** Each Generator Owner with automatic underfrequency protection relays installed in the MRO footprint shall have relay trip settings that are slower than the minimum tripping time delays in the following table: *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

Table 1	
Frequency (Hz)	Minimum Time Delay (Sec)
≥ 59.5	Automatic Tripping Not Permitted
≤59.5 to > 59.3	2,700
≤59.3 to > 59.0	300
<59.0 to > 58.4	80
≤58.4 to > 58.0	30
≤58.0 to > 57.6	7.5
≤58.2	0

If a generator must be tripped for its own protection outside the specifications in the above Table 1, then GO may become compliant by arranging for Load shedding to be installed by mutual agreement, in addition to that required of DP or TO with end-use Load connected to their Facilities in R8.

This additional Load shedding shall be equal to or greater than the generator MW dispatch, instituted at the same frequency and time as the generator would be expected to trip within the same credible island.

- R12.** Each Distribution Provider, Transmission Owner, and Generation Owner shall implement its portion of the UFLS Program or related protective scheme prior to the next projected peak season. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*
- R13.** Each Planning Coordinator shall update its UFLS program database in the MRO approved format every calendar year and within 15 months of the last update annually. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

The database shall include:

- Credible islands
- UFLS program information (location, size, setting, time duration)
- Applicable generation unit frequency information (e.g. performance limits, inertia and frequency excursion protection scheme information)
- Applicable reactive power device information as listed in R9
- The tripping schemes

- R14.** The Planning Coordinator shall provide the UFLS database to applicable entities, MRO ~~and~~or NERC within 30 calendar days of a request.
[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]

C. Measures

M1.

M2.

D. Compliance

1. Compliance Monitoring Process

- 1.1. Compliance Enforcement Authority**
- 1.2. Compliance Monitoring Period and Reset Time Frame**
- 1.3. Data Retention**
- 1.4. Compliance Monitoring and Assessment Processes**
- 1.5. Additional Compliance Information**

2. Violation Severity Levels

<u>R #</u>	<u>Lower VSL</u>	<u>Moderate VSL</u>	<u>High VSL</u>	<u>Severe VSL</u>
<u>1</u>	<u>The Planning Coordinator did not consider 1 of the criteria in its methodology.</u>	<u>The Planning Coordinator did not consider 2 of the criteria in its methodology.</u>	<u>The Planning Coordinator did not consider 3 or 4 of the criteria in its methodology.</u>	<u>The Planning Coordinator did not consider 5 or more of the criteria in its methodology.</u> <u>OR</u> <u>The Planning Coordinator did not develop a methodology to determine areas of credible islanding.</u>
<u>2</u>	<u>The Planning Coordinator made its methodology available within 16 – 30 days of a request.</u>	<u>The Planning Coordinator made its methodology available within 31 – 45 days of a request.</u>	<u>The Planning Coordinator made its methodology available within 46 – 60 days of a request.</u>	<u>The Planning Coordinator made its methodology available more than 60 days after a request.</u>

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<p><u>3</u></p>	<p><u>The Planning Coordinator provided credible island determinations to the Transmission Owners and Distribution Providers 31 – 45 days after determination as described in R3.2.</u></p>	<p><u>The Planning Coordinator provided credible island determinations to the Transmission Owners and Distribution Providers 46 – 60 days after determination as described in R3.2.</u></p>	<p><u>The Planning Coordinator provided credible island determinations to the Transmission Owners and Distribution Providers 61 - 75 days after determination as described in R3.2.</u></p>	<p><u>The Planning Coordinator did not evaluate and confirm credible islanding more than 15 months from the last evaluation as required in R3.1.</u></p> <p>OR</p> <p><u>The Planning Coordinator provided credible island determinations to the Transmission Owners and Distribution Providers more than 61 days after determination as described in R3.2.</u></p>
<p><u>4</u></p>	<p><u>The Planning Coordinator’s methodology did not include exemption criteria, Off-nominal frequency relay types, simulation methods used, and/or maximum breaker interrupting times.</u></p>	<p><u>The Planning Coordinator’s methodology did not include the frequency and/or voltage characteristics, and/or evaluations of other schemes and potential effect on adjacent Planning Coordinators.</u></p>		<p><u>The Planning Coordinator’s methodology did not include frequency set points and timing delays and/or did not meet the 30% load shed.</u></p> <p>OR</p> <p><u>The Planning Coordinator does not have a</u></p>

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				<u>documented methodology for design and performance of its UFLS program.</u>
<u>5</u>		<u>The Distribution Provider did not collect characteristics data or criticality of End-use Load from the Load Serving Entities.</u>		<u>The Distribution Provider did not review and update its UFLS program more than 15 months from the last evaluation</u>
<u>6</u>				<u>The Planning Coordinator did not review its UFLS program, and update it as needed, within 15 months of the last review.</u>
<u>7</u>	<u>The Planning Coordinator performed the assessment but didn't include 1 of the performance elements as required in R7.1.</u> <u>OR</u> <u>The Planning Coordinator provided the assessment report to the associated</u>	<u>The Planning Coordinator performed the assessment but didn't include 2 of the performance elements as required in R7.1.</u> <u>OR</u> <u>The Planning Coordinator provided the assessment report to the associated</u>	<u>The Planning Coordinator performed the assessment but didn't include more than 2 of the performance elements as required in R7.1.</u> <u>OR</u> <u>The Planning Coordinator provided the assessment report to the associated</u>	<u>The Planning Coordinator did not perform a periodic assessment of the expected performance of the UFLS program at least every 5 calendar years as required in R7.1.</u> <u>OR</u> <u>The Planning Coordinator provided the</u>

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	<u>entities in 31 - 45 days as required in R7.2.</u>	<u>entities in 46 - 60 days as required in R7.2.</u>	<u>entities in 61 - 75 days as required in R7.2.</u>	<u>assessment report to the associated entities more than 75 days from the request as required in R7.2.</u>
8	<u>The Distribution Provider or Transmission Owner did not provide 1 or 2 of the elements.</u> OR <u>The data was not submitted in the MRO approved format.</u>	<u>The Distribution Provider or Transmission Owner did not provide 3 or 4 of the elements.</u>	<u>The Distribution Provider or Transmission Owner did not provide 5 of the elements.</u>	<u>The Planning Coordinator did not provide the data within 15 months of the last submittal.</u>
9	<u>The Distribution Provider or Transmission Owner provided the data 61 – 75 days from the date of change.</u> OR <u>The data was not submitted in the MRO approved format.</u>	<u>The Distribution Provider or Transmission Owner provided the data 76 – 90 days from the date of change.</u>	<u>The Distribution Provider or Transmission Owner provided the data 90 – 105 days from the date of change.</u>	<u>The Distribution Provider or Transmission Owner provided the data more than 105 days from the date of change.</u> OR <u>The Distribution Provider did not supply information on reactive power devices, system protection schemes, or</u>

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				<u>load and resource balancing methods prior to their in-service dates.</u>
<u>10</u>	<u>The Distribution Provider or Transmission Owner provided the information 61 – 75 days from the date of change.</u> <u>OR</u> <u>The data was not submitted in the MRO approved format.</u>	<u>The Distribution Provider or Transmission Owner provided the information 76 – 90 days from the date of change.</u>	<u>The Distribution Provider or Transmission Owner provided the information 90 – 105 days from the date of change.</u>	<u>The Distribution Provider or Transmission Owner provided the information more than 105 days from the date of change.</u>
<u>11</u>	<u>The Generator Owner did not meet 1 of the criteria listed in Table 1 and did not arrange for additional load shedding.</u>	<u>The GO did not meet 2 of the criteria listed in Table 1 and did not arrange for additional load shedding.</u>	<u>The GO did not meet more than 3 of the criteria listed in Table 1 and did not arrange for additional load shedding.</u>	<u>The GO did not meet the criteria listed in Table 1 and did not arrange for additional load shedding.</u>
<u>12</u>				<u>The Distribution Provider, Transmission Owner, and Generation Owner did not implement its portion of the UFLS program prior to peak season.</u>
<u>13</u>	<u>The Planning Coordinator did</u>	<u>The Planning Coordinator did</u>	<u>The Planning Coordinator did</u>	<u>The Planning Coordinator did</u>

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	<p><u>not include 1 or 2 of the criteria in its UFLS database.</u></p> <p><u>OR</u></p> <p><u>The data was not submitted in the MRO approved format.</u></p>	<p><u>not include 3 or 4 of the criteria in its UFLS database.</u></p>	<p><u>not include the criteria in its UFLS database.</u></p>	<p><u>not update its UFLS database.</u></p>
<u>14</u>	<p><u>The Planning Coordinator provided its database 31 – 45 days after a request.</u></p>	<p><u>The Planning Coordinator provided its database 46 – 60 days after a request.</u></p>	<p><u>The Planning Coordinator provided its database 60 – 75 days after a request.</u></p>	<p><u>The Planning Coordinator provided its database more than 75 days after a request.</u></p>

Version History

Version	Date	Action	Change Tracking