Information Document
Alberta Underfrequency Load Shedding Program
ID #2021-002

Information documents are generally not authoritative. Information documents are normally for information purposes only and are intended to provide guidance. In the event of any discrepancy between an information document and any authoritative document[1] in effect, the authoritative document governs.

1 Purpose

This information document relates to the following authoritative document:

- reliability standard PRC-006-AB-3, *Automatic Underfrequency Load Shedding* ("PRC-006")

The purpose of this information document is to provide market participants with the Alberta underfrequency load shedding program referred to in PRC-006. This document is likely of most interest to market participants that have responsibilities related to the Alberta underfrequency load shedding program.

2 Background

The AESO is responsible for the design of the underfrequency load shedding program for Alberta, and for ensuring that the program meets the applicable requirements of the NERC and the WECC. As required by requirement RD.B.3 of PRC-006, the AESO has adopted a modified version of the WECC "1a the Coordinated Plan" in the *WECC Off-Nominal Frequency Load Shedding Plan* dated May 24, 2011[2], taking into account that:

(a) the interconnected electric system is planned with controlled separation schemes from the Western Interconnection;

(b) sufficient load will be available to protect the system against the simultaneous loss of 1201L at maximum import plus the largest two-unit generating plant in Alberta; and

(c) off-nominal frequency tripping of generators is coordinated with the underfrequency load shedding program.

For clarity, the Alberta underfrequency load shedding program is the only one that applies in Alberta.

3 Alberta Underfrequency Load Shed Program

In accordance with requirement RD.B.3, the AESO has adopted an underfrequency load shedding program with the design set out below in this subsection 3 and in the following subsection 4.

(a) The Alberta underfrequency load shedding program load block requirements include:

(i) a minimum of 31.1% of the connected load will be available for instantaneous shedding in accordance with WECC requirements to correct underfrequency decay. These 5 instantaneous load blocks and the corresponding frequency and amount of load to be dropped are listed in Table 1;

(ii) a minimum of 14% of the additional connected load will be available for instantaneous shedding for interconnected electric system reliability. These 2 instantaneous load blocks are identified in Table 1 as "AIES Security 1" and "AIES Security 2" respectively;

(iii) a minimum of 6% of the additional connected load will be available for time-delayed shedding in accordance with WECC requirements to correct underfrequency stalling. The 3 blocks assigned for time-delayed shedding are identified in Table 1 as D1, D2 and D3; and

[1] "Authoritative document" is the general name given by the AESO to categories of documents made by the AESO under the authority of the *Electric Utilities Act* and associated regulations, and that contain binding legal requirements for either market participants or the AESO, or both. Authoritative documents include the ISO rules, the reliability standards, and the ISO tariff.

[2] https://www.wecc.org/Reliability/Off-Nominal%20Frequency%20Load%20Shedding%20Plan.pdf

(iv) a minimum of 5.1% of the connected load will be available from the 59.1 Hz load shed block for automatic restoration in accordance with WECC requirements to correct frequency overshoot. The load blocks assigned for this purpose, with the associated pickup frequencies and delays, are listed in Table 2.

(b) Load shedding devices must meet the following requirements:

(i) for instantaneous load shedding, total time delay to interrupt load will not exceed 14 cycles. This time delay includes underfrequency relay operating time and circuit breaker operating time; and

(ii) all load shed blocks will be equipped with solid-state or microprocessor-based relays.

(c) The "delayed automatic load restoration" used in this document refers to automatic load restoration following the operation of underfrequency load shedding load blocks listed in Table 1 and Table 2 of this document. The "delayed automatic load restoration", where used, will meet the following requirements:

(i) delayed automatic load restoration must not begin until the system frequency reaches at least 59.95 Hz and maintains at least 59.95 Hz for a minimum of 30 minutes; and

(ii) load will be automatically restored in blocks no greater than 2% of customer load, provided the system frequency is stable at 59.95 Hz or greater. Each restoration block will be delayed for a minimum of 5 minutes following restoration of the previous block.

(d) In reference to requirement R10 of PRC-006, the AESO does not currently require automatic switching of capacitor banks, transmission lines or reactors to control over-voltage as a result of underfrequency load shedding.

(e) The AESO conducts a review of the Alberta underfrequency load shedding program once each calendar year.

(f) The requirements for generator off-nominal frequency protective relay settings in Section 502.1 of the ISO rules, *Aggregated Generating Facilities Technical Requirements* and 502.5 of the ISO rules, *Generating Unit Technical Requirements* are developed considering the Alberta underfrequency load shedding program coordination.

Table 1 – Load shed blocks

Load Block	% of Customer Load Shed	Pickup (Hz)	Intentional Delay (seconds)
1	5.3	59.1	N/A
2	5.9	58.9	N/A
3	6.5	58.7	N/A
4	6.7	58.5	N/A
5	6.7	58.3	N/A
AIES security 1	7	58.1	N/A
AIES security 2	7	58.0	N/A
D1	2.3	59.3	15*
D2	1.7	59.5	30*
D3	2.0	59.5	60*

Note:* A load used in a "D1", "D2" or "D3" load block can also be included in "AIES security 1" or "AIES security 2" load block.

Table 2 – Load available for automatic restoration to correct frequency overshoot

% of Customer Load Restoration	Pickup (Hz)	Intentional Delay (seconds)
1.1	60.5	30
1.7	60.7	5
2.3	60.9	0.25

4 Responsibilities of a Legal Owner of an Electric Distribution System

4.1 Data Requirements

Further to the data requirements set out in requirement R8, each legal owner of an electric distribution system is responsible for:

(a) annually reviewing the *underfrequency load shedding program* for their facilities and providing data to the AESO by April 15 of each year, using the excel sheet posted on the PRC-006 landing page on the AESO's website. Note that the review will be based on the Alberta system peak load the AESO specifies;

(b) providing other underfrequency load shedding data information, such as the system light load condition the AESO specifies in order to assist the AESO in determining the overall underfrequency load shedding program effectiveness and facilitating future underfrequency load shedding program design; and

(c) if the AESO requests, providing underfrequency load shedding data for program review at any time outside the normal review process described in (a) above.

4.2 Automatic Tripping of Load

Further to the requirement set out in requirement R9 to provide automatic tripping of load in accordance with the underfrequency load shedding program design, each legal owner of an electric distribution system is responsible for:

(a) contributing proportionally to the load block requirements as a condition of connection to the interconnected electric system, at the frequencies the AESO assigns in subsection 3(a) above;

(b) actively managing underfrequency blocks within their respective supply area, and advising the AESO of any changes to the underfrequency load shedding program settings in a timely manner;

(c) determining the specific loads which to apply underfrequency load shedding, and where possible, avoid using intermittent load or feeders with high variability for load shedding in order to maintain load availability;

(d) ensuring that its load shedding devices conform to the requirements of subsection 3(b) above;

(e) using "delayed automatic load restoration" at its discretion. However, each legal owner of an electric distribution system must be able to disable it or reduce an equivalent amount of load elsewhere if directed by the AESO System Controller. "Delayed automatic load restoration" will meet the requirements of subsection 3(c) above;

(f) implementing the latest underfrequency load shedding settings by July 1st of each year unless the AESO specifies a later date

5 Appendices

Appendix 1 – Underfrequency Load Shedding Data Reporting Template

Revision History

Posting Date	Description of Changes
2021-12-22	Initial release

Appendix 1

PRC-006-AB-3 Underfrequency Load Shedding Criterion
UFLS Entity Data Submittals Requirements

Compliance with the Alberta Underfrequency Load Shedding Program

Category:	Generator	UFLS Entity

Company Name:
Respondent's Name:
Position/Title:
E-mail:
Phone Number:
Fax Number:
Address:

Submittal Date:

Are you an applicable entity per PRC-006-AB-3? YES (YES, NO)

Notes:
1. Market Participants do not need to enter info. for greyed out areas;
2. This page is for System Peak Condition.
3. For clarity on the "reset freq. (Hz)": this depends on detailed relay setting, especially for the time delayed uderfrequency load shed blocks. For example, when frequency goes down to the triggering frequency (e.g. below 59.5Hz of the D2 block), the D2 block timer starts. But before D2 timer reaches the 30 sec threshold, system frequency recovers to or above the reset frequency, it will reset the D2 block timer. This parameter is not modelled in uderfrequency load shed model used for WECC/AESO system studies, but the information is required by WECC.
4. For clarity on the "Manual Restore Delay Time (Min)": manual restoration of tripped breakers is coordinated with the AESO System Controllers. If entities have plan to manually restore load, WECC/AESO needs to know the delay time. Otherwise, N/A may be acceptable too.
5. The question below regarding whether frequency relays operate above 80% of nominal is for information purpose only.

UNDER FREQUENCY LOAD SHED
UFLS SCHEDULE (2022) _____

DFO Total load ___ MW at system peak
Total System Peak in (Year): _____ MW

UF Block #	Substation (Element Tripped)	Breaker Number(s)	Substation Name or Line From		Line To		WECC Zone	WECC Area	Trip Freq. (Hz)	Reset Freq. (Hz)	Trip Time Delay (sec)	Breaker Time (cycles)	Total Tripping Time	Manual Restore Delay Time (Min)	Load Shed MW	AESO requirements	
			WECC Bus Name	WECC Bus #	WECC Bus Name	WECC Bus #										Measurement Point	% Measurement Point
1									59.1								
1									59.1								
1									59.1								
1									59.1								
1									59.1								
1									59.1								
			Req. MW Load Shed for Block #1								Block #1 Total MW Load Shed						
			Req. % Load Shed for Block #1								Block #1 % Load Shed						
Note:																	
2									58.9								
2									58.9								
2									58.9								
2									58.9								
2									58.9								
2									58.9								
			Req. MW Load Shed for Block #2								Block #2 Total MW Load Shed						
			Req. % Load Shed for Block #2								Block #2 % Load Shed						
Note:																	
3									58.7								
3									58.7								
3									58.7								
3									58.7								
3									58.7								
			Req. MW Load Shed for Block #3								Block #3 Total MW Load Shed						
			Req. % Load Shed for Block #3								Block #3 % Load Shed						
Note:																	
4									58.5								
4									58.5								

4									58.5								
4									58.5								
4									58.5								
			Req. MW Load Shed for Block #4								Block #4 Total MW Load Shed						
			Req. % Load Shed for Block #4								Block #4 % Load Shed						

Note:

5									58.3								
5									58.3								
5									58.3								
5									58.3								
5									58.3								
			Req. MW Load Shed for Block #5								Block #5 Total MW Load Shed						
			Req. % Load Shed for Block #5								Block #5 % Load Shed						

Note:

AIES security 1									58.1								
AIES security 1									58.1								
AIES security 1									58.1								
AIES security 1									58.1								
AIES security 1									58.1								
			Req. MW Load Shed for AIES security 1								AIES security 1 Total MW Load Shed						
			Req. % Load Shed for AIES security 1								AIES security 1 % Load Shed						

Note:

AIES security 2									58								
AIES security 2									58								
AIES security 2									58								
AIES security 2									58								
AIES security 2									58								
			Req. MW Load Shed for AIES security 2								AIES security 2 Total MW Load Shed						
			Req. % Load Shed for AIES security 2								AIES security 2 % Load Shed						

Note:

UNDER FREQUENCY LOAD SHED

UFLS SCHEDULE (2022) _____

UF Block #	Substation (Element Tripped)	Breaker Number(s)	Substation Name or Line From		Line To		WECC Zone	WECC Area	Trip Freq. (Hz)	Reset Freq. (Hz)	Trip Time Delay (sec)	Breaker Time (cycles)	Total Tripping Time	Manual Restore Delay Time (Min)	Load Shed MW	AESO requirements	
			WECC Bus Name	WECC Bus #	WECC Bus Name	WECC Bus #										Measurement Point	% Measurement Point
D1									59.3								
D1									59.3								
D1									59.3								
D1									59.3								
D1									59.3								
			Req. MW Load Shed for D1								D1 Total MW Load Shed						
			Req. % Load Shed for D1								D1 % Load Shed						

Note:

D2									59.5								
D2									59.5								
D2									59.5								
D2									59.5								
D2									59.5								
D2									59.5								
			Req. MW Load Shed for D2								D2 Total MW Load Shed						
			Req. % Load Shed for D2								D2 % Load Shed						

Note:

D3									59.5								
D3									59.5								
D3									59.5								
D3									59.5								
D3									59.5								
D3									59.5								
			Req. MW Load Shed for D3								D3 Total MW Load Shed						
			Req. % Load Shed for D3								D3 % Load Shed						

Note:

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UNDER FREQUENCY LOAD SHED

UFLS SCHEDULE (2022) _____

Load automatically restored to correct for frequency overshoot.

Auto Reset Block #	Substation (Element Tripped)	Breaker Number(s)	Substation Name or Line From		Line To		WECC Zone	WECC Area	Over Freq. (Hz)	Reset Freq. (Hz)	Automatic Restoration Time Delay (sec)	Load Restore MW	AESO requirements	
			WECC Bus Name	WECC Bus #	WECC Bus Name	WECC Bus #							Measurement Point	% Measurement Point
AR1									60.5					
AR1									60.5					
			Req. MW Load Restore for AR1								Total MW Load Restore			
			Req. % Load Restore for AR1								% Load Restore for this Block			

Note:

AR2									60.7					
AR2									60.7					
AR2									60.7					
			Req. MW Load Restore for AR2								Total MW Load Restore			
			Req. % Load Restore for AR2								% Load Restore for this Block			

Note:

AR3									60.9					
AR3									60.9					
AR3									60.9					
			Req. MW Load Restore for AR3								Total MW Load Restore			
			Req. % Load Restore for AR3								% Load Restore for this Block			

Note:

Does your company use only solid state and/or microprocessor underfrequency relays to comply with the Alberta Uderfrequency Load Shed Program? ____ Yes ____ No

If No, please explain here:

Will your company's frequency relays use define time characteristics and operate within any voltage above 80% of nominal? ____ Yes ____ No

If No, please explain here:

Are there any other exceptions to the Alberta Uderfrequency Load Shed Program? ____ Yes ____ No

If Yes, please explain here:

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use same format with Tab 2, but for System Light

#	Tasks/Actions	Date	Comments
1	Initial Release	12/22/2021	This form is based on the PRC-006-WECC-CRT-3 Attachment A Reporting Form, and revised for PRC-006-AB-3 and the Uderfrequency Load Shed program in Alberta.