Attachment 1
(Frequency No Trip Boundaries by Interconnection[9])

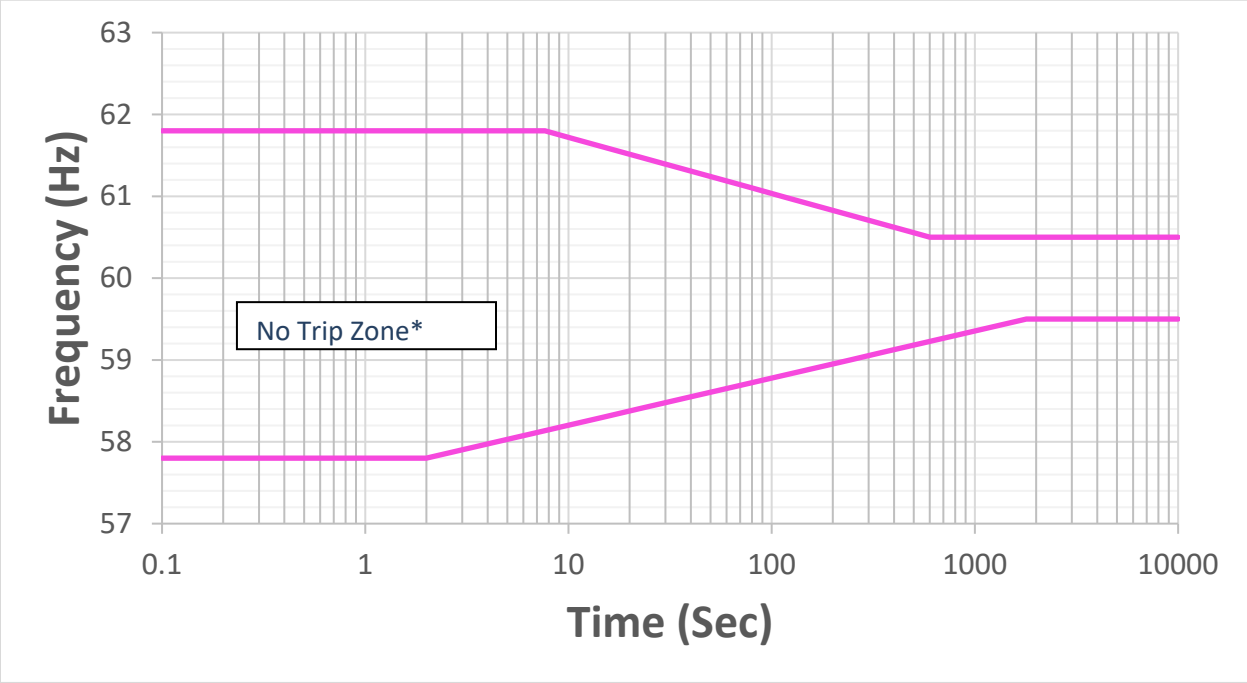


Figure 1: Eastern Interconnection Boundaries

**** The area outside the "No Trip Zone" is not a "Must Trip Zone."***

Table 1: Frequency Boundary Data Points - Eastern Interconnection

High Frequency Duration		Low Frequency Duration	
Frequency (Hz)	Minimum Time (Sec)	Frequency (Hz)	Minimum Time (sec)
≥61.8	Instantaneous[10]	≤57.8	Instantaneous[11]
≥60.5	$10^{(90.935-1.45713*f)}$	≤59.5	$10^{(1.7373*f-100.116)}$
<60.5	Continuous operation	> 59.5	Continuous operation

[9] The figures do not visually represent the "no trip zone" boundaries before 0.1 seconds and after 10,000 seconds. The Frequency Boundary Data Points Table defines the entirety of the "no trip zone" boundaries.

[10] Frequency is calculated over a window of time. While the frequency boundaries include the option to trip instantaneously for frequencies outside the specified range, this calculation should occur over a time window. Typical window/filtering lengths are three to six cycles (50 – 100 milliseconds). Instantaneous trip settings based on instantaneously calculated frequency measurement is not permissible.

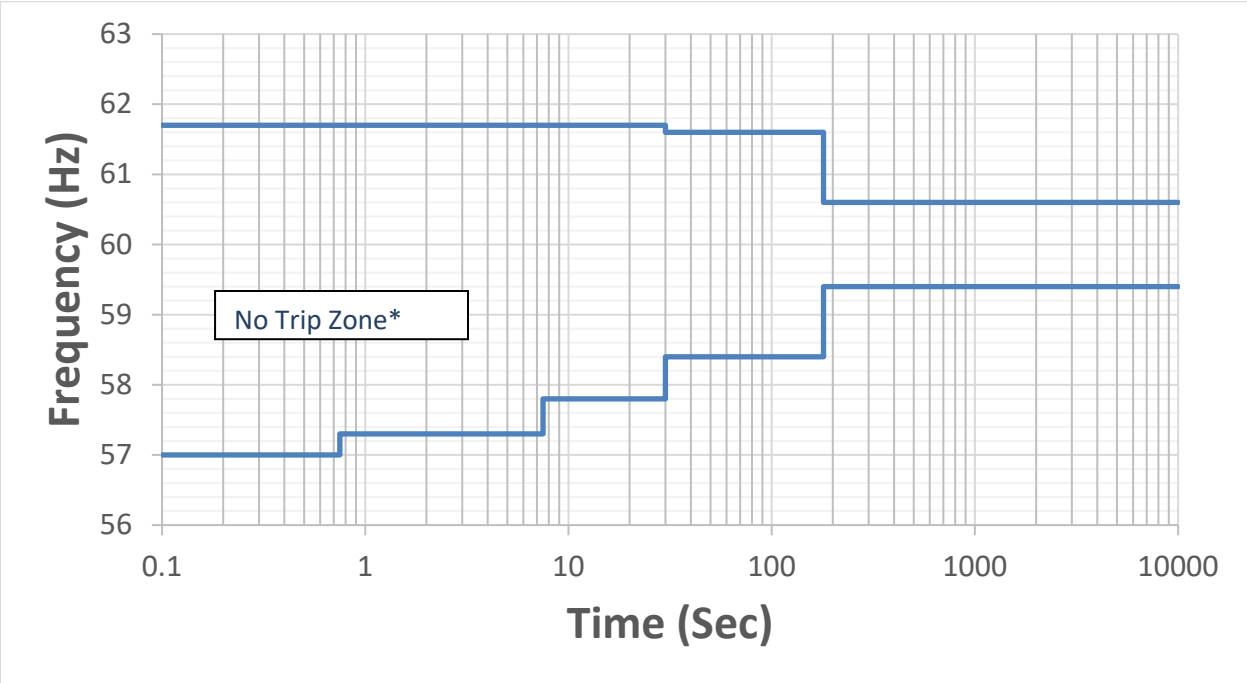


Figure 2: Western Interconnection Boundaries

**** The area outside the "No Trip Zone" is not a "Must Trip Zone."***

Table 2: Frequency Boundary Data Points – Western Interconnection

High Frequency Duration		Low Frequency Duration	
Frequency (Hz)	Minimum Time (Sec)	Frequency (Hz)	Minimum Time (sec)
≥61.7	Instantaneous[11]	≤57.0	Instantaneous[11]
≥61.6	30	≤57.3	0.75
≥60.6	180	≤57.8	7.5
<60.6	Continuous operation	≤58.4	30
		≤59.4	180
		>59.4	Continuous operation

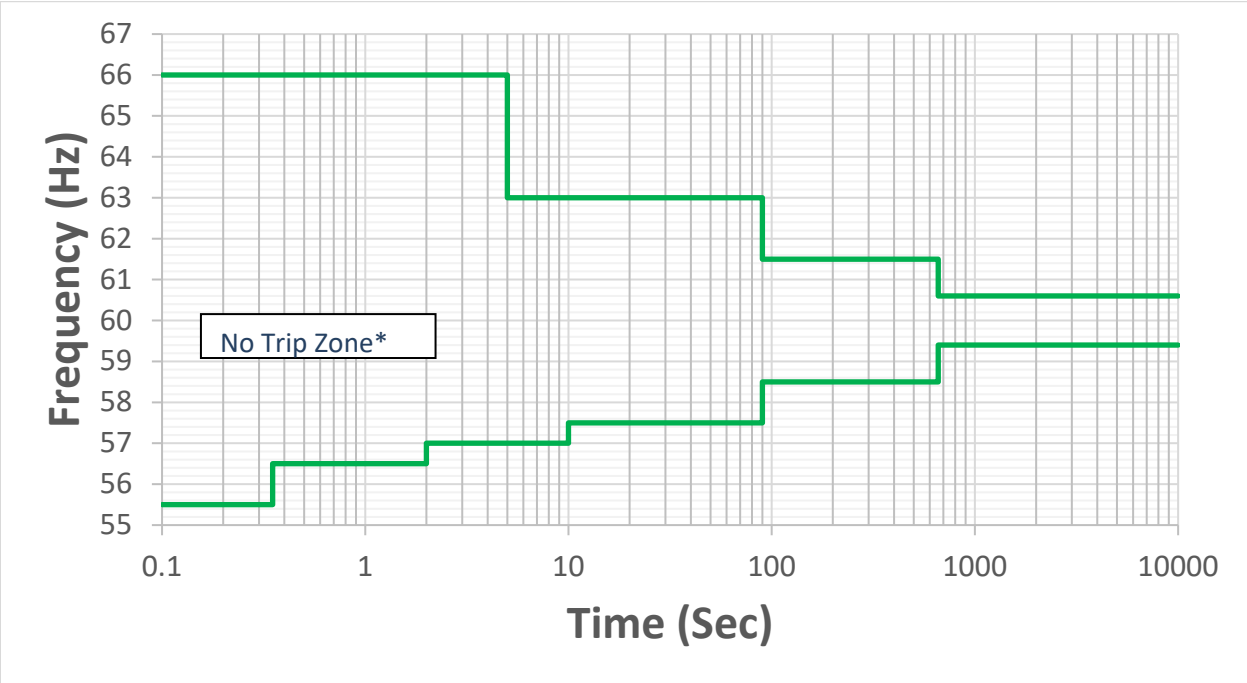


Figure 3: Quebec Interconnection Boundaries

**** The area outside the "No Trip Zone" is not a "Must Trip Zone."***

Table 3: Frequency Boundary Data Points – Quebec Interconnection

High Frequency Duration		Low Frequency Duration	
Frequency (Hz)	Minimum Time (Sec)	Frequency (Hz)	Minimum Time (Sec)
>66.0	Instantaneous[11]	<55.5	Instantaneous[11]
≥63.0	5	≤56.5	0.35
≥61.5	90	≤57.0	2
≥60.6	660	≤57.5	10
<60.6	Continuous operation	≤58.5	90
		≤59.4	660
		>59.4	Continuous operation

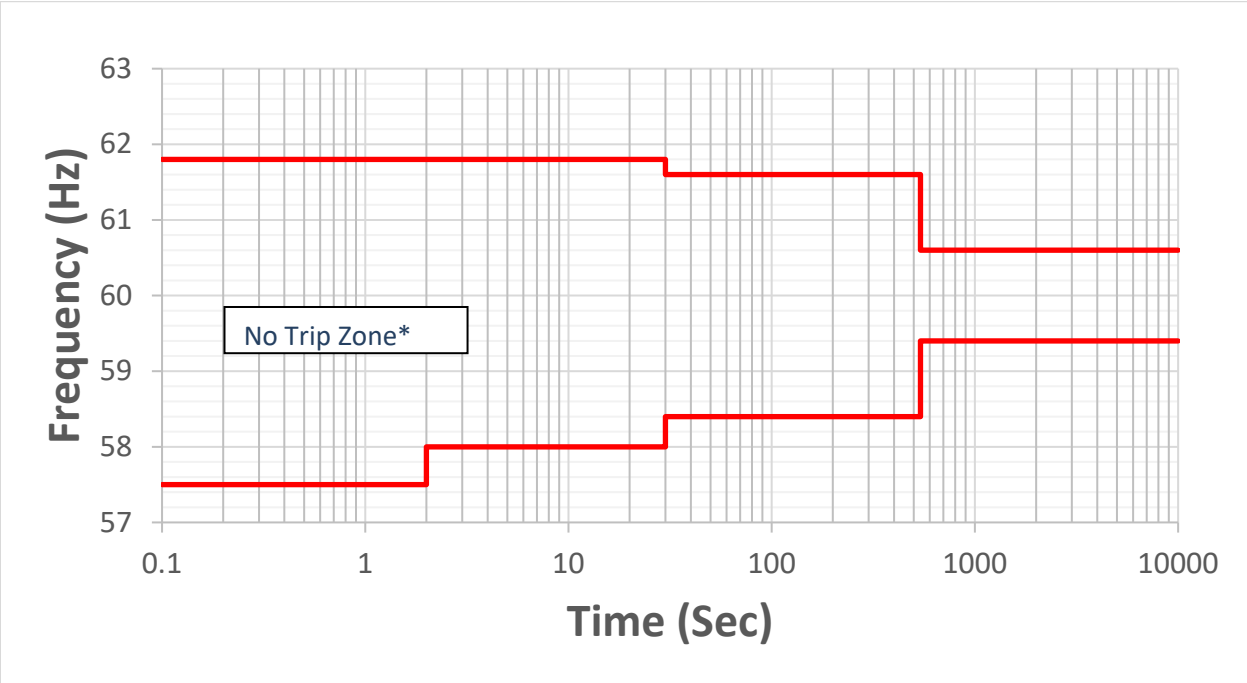


Figure 4: ERCOT Interconnection Boundaries

**** The area outside the "No Trip Zone" is not a "Must Trip Zone."***

Table 4: Frequency Boundary Data Points – ERCOT Interconnection

High Frequency Duration		Low Frequency Duration	
Frequency (Hz)	Minimum Time (Sec)	Frequency (Hz)	Minimum Time (sec)
≥61.8	Instantaneous[11]	≤57.5	Instantaneous[11]
≥61.6	30	≤58.0	2
≥60.6	540	≤58.4	30
<60.6	Continuous operation	≤59.4	540
		>59.4	Continuous operation

PRC-024 — Attachment 2

(Voltage No-Trip Boundaries – Eastern, Western, and ERCOT Interconnections)

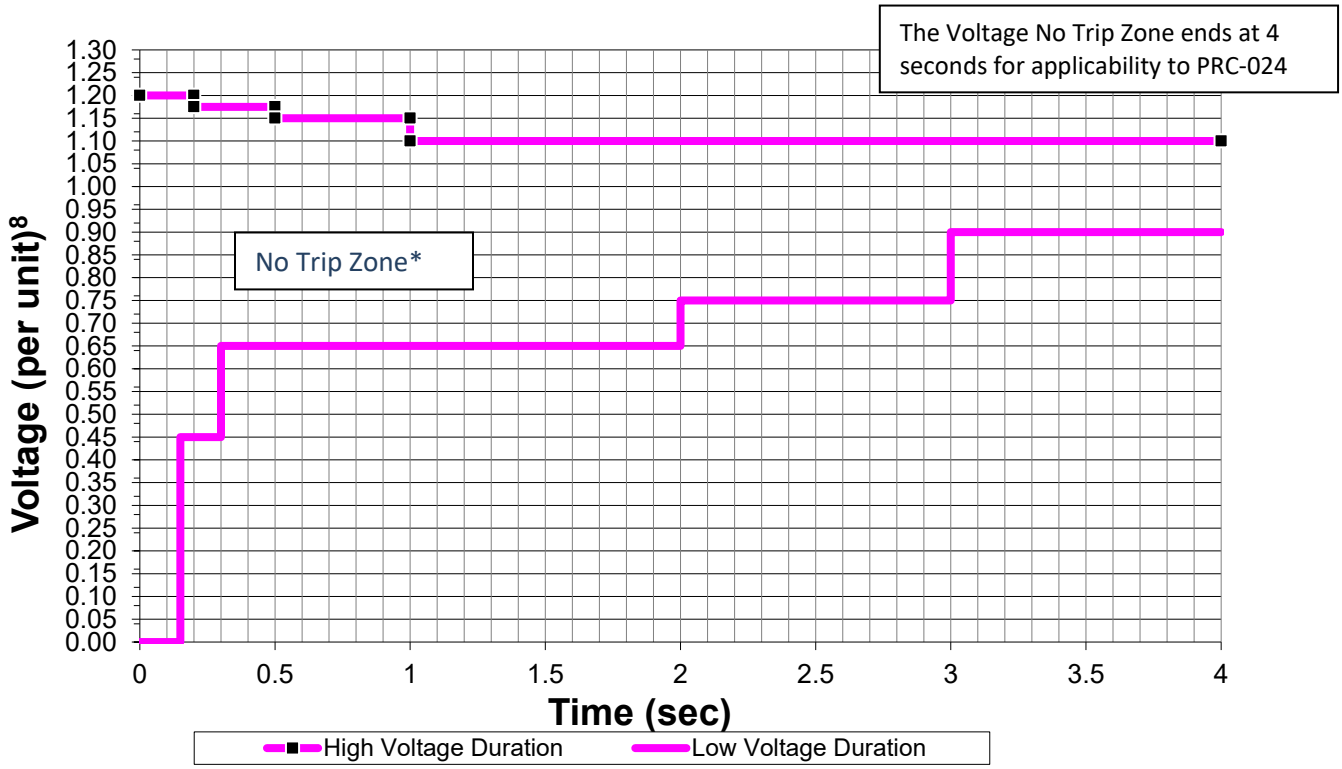


Figure 5: Voltage No-Trip Boundaries – Eastern, Western, and ERCOT Interconnections

**** The area outside the "No Trip Zone" is not a "Must Trip Zone."***

Table 5: Voltage Boundary Data Points

High Voltage Duration		Low Voltage Duration	
Voltage (per unit)	Minimum Time (sec)	Voltage (per unit)	Minimum Time (sec)
≥1.200	0.00	<0.45	0.15
≥1.175	0.20	<0.65	0.30
≥1.15	0.50	<0.75	2.00
≥1.10	1.00	<0.90	3.00
<1.10	4.00	≥ 0.90	4.00

Attachment 2: Voltage Boundary Clarifications – Eastern, Western, and ERCOT Interconnections

Boundary Details:

1. Unless otherwise specified by the Transmission Planner, the per unit voltage base for these boundaries is the nominal transmission system voltage (e.g., 100 kV, 115 kV, 138 kV, 161 kV, 230 kV, 345 kV, 400 kV, 500 kV, 765 kV, etc.).
2. The values in the table represent the minimum time durations allowed for specified voltage excursion thresholds.
3. When evaluating volts per hertz protection, either assume a system frequency of 60 Hertz or the magnitude of the high voltage boundary can be adjusted in proportion to deviations of frequency below 60 Hertz.
4. Voltages in the boundaries assume RMS fundamental frequency phase-to-ground or phase-to-phase per unit voltage.
5. For applicability to PRC-024, the “no trip zone” ends at 4 seconds.

Evaluating Protection Settings:

The voltage values in the Attachment 2 voltage boundaries are voltages at the high-side of the GSU/MPT. For resources with multiple stages of step up to reach interconnecting voltage, this is the high-side of the transformer with a low side below 100kV and a high-side 100kV or above**.** When evaluating protection settings, consider the voltage differences between where the protection is measuring voltage and the high-side of the GSU/MPT. A steady state calculation or dynamic simulation may be used.

If using a steady state calculation or dynamic simulation, use the following conditions when evaluating protection settings:

a. The most probable real and reactive loading conditions for the synchronous generator, type 1 or 2 wind resources, or synchronous condenser under study.

b. All installed wind resource reactive support (e.g., static VAR compensators, synchronous condensers, capacitors) equipment is available and operating normally.

c. Account for the actual tap settings of transformers between the generator terminals or the collector station and the high-side of the GSU/MPT.

d. For dynamic simulations, the synchronous generator or condenser automatic voltage regulator is in automatic voltage control mode with associated limiters in service.

PRC-024— Attachment 2A
(Voltage No-Trip Boundaries – Quebec Interconnection)

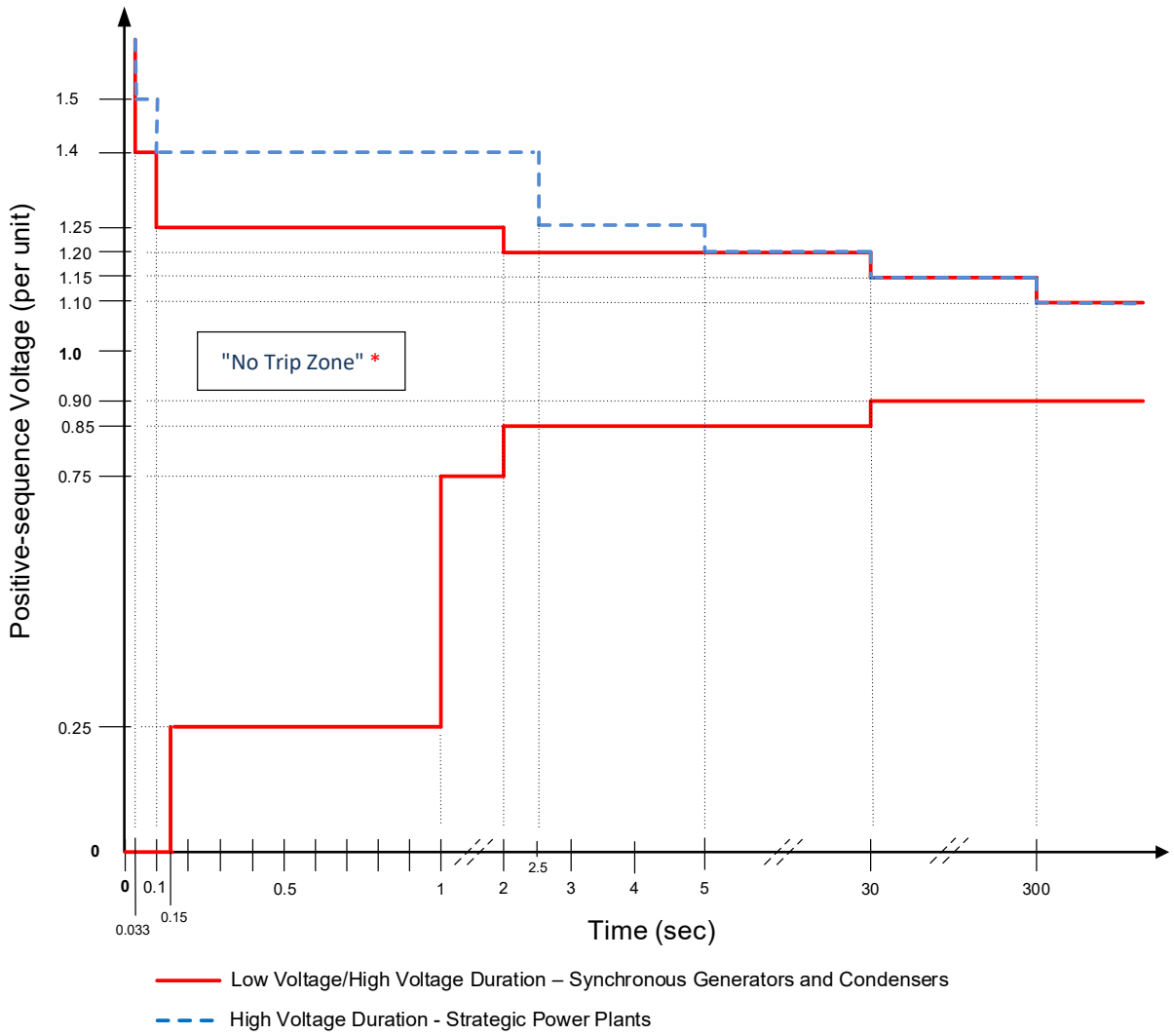


Figure 6: Voltage No-Trip Boundaries – Quebec Interconnection

**** The area outside the "No Trip Zone" is not a "Must Trip Zone."***

Table 6: High Voltage Boundary Data Points – Quebec Interconnection

High Voltage Duration for all Synchronous Generators and Condensers		High Voltage Duration for strategic Power Plants	
Voltage (per unit)	Minimum Time (sec)	Voltage (per unit)	Minimum Time (sec)
---	---	>1.50	0.033
>1.40	0.033	>1.40	0.10
>1.25	0.10	>1.25	2.50
>1.20	2.00	>1.20	5.00
>1.15	30	>1.15	30
>1.10	300	>1.10	300
≤1.10	continuous	≤1.10	continuous

Table 7: Low Voltage Boundary Data Points – Quebec Interconnection

Low Voltage Duration for all Synchronous Generators and Condensers	
Voltage (per unit)	Minimum Time (sec)
<0.25	0.15
<0.75	1.00
<0.85	2.00
<0.90	30
≥0.90	continuous

Attachment 2A: Voltage Boundary Clarifications – Quebec Interconnection

Boundary Details:

1. The per unit voltage base for these boundaries is the nominal operating voltage (e.g., 120 kV, 161 kV, 230 kV, 315 kV, 735 kV, etc.).
2. The values in the table represent the minimum time durations allowed for specified voltage excursion thresholds.
3. When evaluating volts per hertz protection, either assume a system frequency of 60 Hertz or the magnitude of the high voltage boundary can be adjusted in proportion to deviations of frequency below 60 Hertz.
4. Voltages in the Quebec Interconnection boundaries assume positive-sequence values.

Evaluating Protection Settings:

The voltage values in the Attachment 2A voltage boundaries are voltages at the high-side of the GSU/MPT. For resources with multiple stages of step up to reach interconnecting voltage, this is the high-side of the transformer that connects to the interconnecting voltage. When evaluating protection settings, consider the voltage differences between where the protection is measuring voltage and the high-side of the GSU/MPT. A steady state calculation or dynamic simulation may be used.

If using a steady state calculation or dynamic simulation, use the following conditions when evaluating protection settings:

a. The most probable real and reactive loading conditions for the unit under study.
b. All installed generating plant reactive support (e.g., static VAR compensators, synchronous condensers, capacitors) equipment is available and operating normally.
c. Account for the actual tap settings of transformers between the generator terminals and the high-side of the GSU/MPT.
d. For dynamic simulations, the automatic voltage regulator is in automatic voltage control mode with associated limiters in service.