

Summary of Planning Limits for Low and Medium Voltage Networks

Section & Reference Standards		Definition	Planning Limits					
Q2-01	Voltage Interruptions	An event is classified as a voltage interruption when the voltage falls below 10% of nominal voltage.	No planning limits apply.					
Q2-02	Voltage Frequency CAN/CSA-C61000-2-2 CAN/CSA-C61000-2-12	The rate at which the voltage sine wave oscillates per second, measured in Hertz (Hz).	Integrated Networks		Non-Integrated Networks			
			59.40 to 60.60 Hz		59.10 to 60.90 Hz			
Q2-03	Steady-State Voltage CAN-3-C235-83	State of average r.m.s. voltage which is maintained after all transient effects have subsided.	LV	Extreme Range				
				Voltage (V)	Normal Range		Max	
					Min	Min		Max
				120/240	106/212 V (-11.7%)	110/220 V (-8.3%)	125/250 V (+4.2%)	127/254 V (+5.8%)
				120/208	110/190 V (-8.3/-8.6%)	112/194 V (-6.7%)	125/216 V (+4.2/+3.8%)	127/220 V (+5.8%)
			277/480	245/424 V (-11.7%)	254/440 V (-8.3%)	288/500 V (+4.0/+4.2%)	293/508 V (+5.8%)	
			347/600	306/530 V (-11.8/-11.7%)	318/550 V (-8.4/-8.3%)	360/625 V (+3.7/+4.2%)	367/635 V (+5.8%)	
			MV	MV connections require ± 6% of network nominal voltage				
				Voltage (V)	Min		Max	
				2400/4160	2256/3910		2544/4410	
7200/12470	6768/11722			7632/13218				
14400/24940	13536/23444			15264/26436				
19920/34500	18725/32430		21115/36570					
Q2-04	Rapid Voltage Changes CAN/CSA-C61000-2-2 CAN/CSA-C61000-3-7	Changes in fundamental frequency r.m.s. voltages lasting between 1 and 60 cycles and having magnitudes less than the sag/swell threshold. (±10%) Notes: [1] Only allowed for transformer energizations controlled by operating orders. [2] Only allowed for motor starts controlled by operating orders.	Number of changes (n)		Voltage Change ΔU (%)			
			n ≤ 4 per year ^[1]		8 < ΔU ≤ 10			
			n ≤ 8 per year ^[2]		6 < ΔU ≤ 8			
			n ≤ 4 per day		4 < ΔU ≤ 6			
			n ≤ 2 per hour		3 < ΔU ≤ 4			
			n ≤ 6 per hour		2 < ΔU ≤ 3			
			restricted by flicker limits (Q2-05)		0 < ΔU ≤ 2			

Q2-05	Voltage Flicker CAN/CSA-C61000-2-2 CAN/CSA-C61000-2-12 CAN/CSA-C61000-3-7	When voltage changes occur in rapid succession having magnitudes large enough to cause lighting level variations which are noticeable or annoying to human beings, the effect is called flicker.	LV	Flicker Index		Limit		
				Short term (10 min) P_{st}		0.9		
				Long term (2 hr) P_{lt}		0.7		
			MV	Flicker Index		Limit		
				Short term (10 min) P_{st}		0.8		
				Long term (2 hr) P_{lt}		0.6		
Q2-07	Voltage Unbalance CAN/CSA-C61000-2-2 CAN/CSA-C61000-2-12	A condition in a polyphase system in which the r.m.s. values of the line-to-line voltages (fundamental component), or the phase angles between consecutive line voltages, are not all equal. The degree of the inequality is expressed as the ratio of the negative sequence component to the positive sequence component.	Negative Sequence Unbalance (U_{unb2}) Limits (%)					
			Standard Networks			Rural Networks		
			2.0			3.0		
			Rural Substations					
			AFT	CKY	GLS	LBH	PEM	STO
			AHM	CLN	GRR	LBY	PHR	STW
			APL	CLW	GVL	LU2	PHY	SVA
			ARM	CMS	HFY	MAS	PML	SZM
			ASK	CNL	HLD	MCA	PPS	TCK
			ATL	COM	HMH	MCK	PSN	TLR
			AVO	CRO	HUS	MEZ	PTO	TSV
			AYH	CWD	HZN	MFE	PVW	TXB
			BAB	DIL	ILL	MON	RDM	TXL
			BAR	DLK	IPR	MTE	SAL	UFR
BBR	EDD	JOR	MWN	SAM	VBY			
BEL	END	JUL	MYE	SBR	VDF			

<p>Q2-08</p>	<p>Voltage Sags and Swells CAN//CSA-C61000-2-8</p>	<p>A voltage sag, also known as a dip, is a sudden reduction of voltage below a defined threshold, followed by a recovery to, or near, the reference voltage.</p> <p>A voltage swell, also known as a surge, is a sudden increase of voltage above a defined threshold, followed by a recovery to, or near, the reference voltage.</p> <p>BC Hydro defines the change threshold for both sags and swells at 10% of nominal voltage.</p>	<p>There are no planning limits for occurrence of unavoidable sags and swells due to electrical faults caused by uncontrolled events, and</p> <p>No voltage sag or swell events shall be allowed to occur on the distribution network that arises from the normal operation of customer equipment.</p>																																																																																																
<p>Q2-09</p>	<p>Voltage Harmonics CAN/CSA-C61000-2-2 CAN/CSA-C61000-2-12 CAN/CSA-C61000-3-6</p>	<p>Harmonics are frequency components of a periodic waveform having integer multiples of the fundamental frequency; they exist in both voltage and current waveforms.</p>	<table border="1"> <thead> <tr> <th colspan="6">Voltage Total Harmonic Distortion Limits (THDu)</th> </tr> <tr> <th colspan="3">Evaluation Period</th> <th colspan="3">THDu (%)</th> </tr> </thead> <tbody> <tr> <td colspan="3">Long-term (≥ 10 min)</td> <td colspan="3">6.5</td> </tr> <tr> <td colspan="3">Very short-term (≤ 3 sec)</td> <td colspan="3">9.0</td> </tr> <tr> <th colspan="6">Individual Harmonic Limits (Long-term ≥ 10 min)</th> </tr> <tr> <th colspan="4">Odd Ordered Harmonics</th> <th colspan="2">Even Ordered Harmonics</th> </tr> <tr> <th colspan="2">Non-Multiples of 3</th> <th colspan="2">Multiples of 3</th> <th colspan="2"></th> </tr> <tr> <th>Harmonic Order h</th> <th>Harmonic Voltage (%)</th> <th>Harmonic Order h</th> <th>Harmonic Voltage (%)</th> <th>Harmonic Order h</th> <th>Harmonic Voltage (%)</th> </tr> <tr> <td>5</td> <td>5</td> <td>3</td> <td>4</td> <td>2</td> <td>1.8</td> </tr> <tr> <td>7</td> <td>4</td> <td>9</td> <td>1.2</td> <td>4</td> <td>1</td> </tr> <tr> <td>11</td> <td>3</td> <td>15</td> <td>0.3</td> <td>6</td> <td>0.5</td> </tr> <tr> <td>13</td> <td>2.5</td> <td>21</td> <td>0.2</td> <td>8</td> <td>0.5</td> </tr> <tr> <td>17 ≤ h ≤ 49</td> <td>$\frac{32.3}{h} - 0.2$</td> <td>21 ≤ h ≤ 45</td> <td>0.2</td> <td>10 ≤ h ≤ 50</td> <td>$\frac{2.5}{h} + 0.22$</td> </tr> <tr> <th colspan="6">Individual Harmonic Limits (Very short-term ≤ 3 sec)</th> </tr> <tr> <td colspan="6">Long-term limits from the table above are multiplied by a factor k_{hvs}</td> </tr> <tr> <td colspan="6" style="text-align: center;"> $k_{hvs} = 1.3 + \frac{0.7}{45} (h - 5)$ </td> </tr> </tbody> </table>	Voltage Total Harmonic Distortion Limits (THDu)						Evaluation Period			THDu (%)			Long-term (≥ 10 min)			6.5			Very short-term (≤ 3 sec)			9.0			Individual Harmonic Limits (Long-term ≥ 10 min)						Odd Ordered Harmonics				Even Ordered Harmonics		Non-Multiples of 3		Multiples of 3				Harmonic Order h	Harmonic Voltage (%)	Harmonic Order h	Harmonic Voltage (%)	Harmonic Order h	Harmonic Voltage (%)	5	5	3	4	2	1.8	7	4	9	1.2	4	1	11	3	15	0.3	6	0.5	13	2.5	21	0.2	8	0.5	17 ≤ h ≤ 49	$\frac{32.3}{h} - 0.2$	21 ≤ h ≤ 45	0.2	10 ≤ h ≤ 50	$\frac{2.5}{h} + 0.22$	Individual Harmonic Limits (Very short-term ≤ 3 sec)						Long-term limits from the table above are multiplied by a factor k_{hvs}						$k_{hvs} = 1.3 + \frac{0.7}{45} (h - 5)$					
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Q2-10	Voltage Interharmonics CAN/CSA-C61000-2-2 CAN/CSA-C61000-2-12 CAN/CSA-C61000-3-6	Interharmonics are current and voltage components having frequencies that are non-integer multiples of the fundamental 60 Hz.	Voltage Interharmonic Limits from 0-120Hz			
			Difference from Fundamental		Planning Limits (% of fundamental)	
			0.1 to 2.3 Hz		0.50	
			2.4 to 4.7 Hz		0.27	
			4.8 to 7.1 Hz		0.18	
			7.2 to 14.3 Hz		0.16	
			14.4 to 16.7 Hz		0.27	
			16.8 to 19.1 Hz		0.34	
			19.2 to 21.5 Hz		0.43	
			21.6 to 23.9 Hz		0.52	
			24.0 to 60.0 Hz		0.62	
			Voltage Interharmonic Limits > 120Hz			
			Frequency Range		Planning Limits (% of fundamental)	
121 to 2500 Hz		0.45				
2501 to 5000 Hz		0.27				
Q2-11	Telephone Interference CAN/CSA C22.3 No.3 IEEE 776 IEEE 519	Conducted or radiated noise which interferes with the quality of signal transmission via telephone. Telephone interference can affect both voice and data communications.	LV	Planning limits only apply to MV networks		
			MV	I-T Product Planning Limits (Direct measured)		
				Balanced I-T product	10 000	
				Residual I-T product	1 000	
				I-T Product Planning Limits (Probe Wire measured)		
				Recommended	< 500	
				Marginal	500 – 1000	
				Unacceptable	> 1000	
			Longitudinal Induction Planning Limits			
50 V						
Q2-12	Neutral-to-Earth Voltage CSA C22.3 No.1 CSA C22.3 No.3	The voltage which exists between a grounded system's neutral or grounding conductor and remote earth.	Operating Conditions	NEV Limits	Parallel Network Impedance Limits	
			Normal	8 V	4.8 Ω	
			Extreme	10 V	6 Ω	