Power Quality Standards for Electric Service

Effective January 1, 2024

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Entergy Power Quality Standards

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Section 1 Foreword, General Information, and Terms

1.1 Purpose

The information contained in this document is presented for customer connections to the Entergy power lines. Current power quality requirements, adopted by the Entergy companies to assure economical and satisfactory service to Customers, consistent with the most recent versions of the IEEE Standards, are set forth and discussed herein. Specific information regarding requirements that are different or are available only in specific areas can be found at the end of the document.

1.2 Service Standards Availability and Revisions

The current Edition Power Quality Service Standards are issued in an electronic format which can be accessed at Entergy's website at www.entergy.com. Under "for customers" click on your State. On your State webpage, under "your business", click on Builder Standards.

These Power Quality Service Standards will be revised from time to time as new methods and improved equipment become available. This document may be re-issued or updated on January 1 every year. Changes of policy made after the publication date, will be in effect despite the fact that they will not be in the document. These changes of policy will be available upon request. If the issue date is not the current year, contact the Company or go to the website to determine if yours is the current edition or to obtain supplementary information. To acquire the Power Quality Service Standards in a book go to the Entergy website or contact the Company.

1.3 How to Interpret and Apply the Standards

When reading the standard, check out the key words (verbs):

Shall: Any rule using the word "shall" is strictly enforced

Should: Any rule using "should" carries the idea that options exist, but that the rule contains the best engineering expertise as written. This rule could be less strictly enforced than the "shall" rule.

Recommend: Any rule using "recommend" has several options, but the Company would like for the customer to use the one given.

May: Any rule using "may" is allowed by the Company. It's the customer's option.

1.4 Terms Used in Power Quality Service Standards

Agreement for Service: See "Application".

Ampere: The unit of measurement of the rate of flow of electricity. It is the unit of current produced in a circuit by one volt acting through a resistance of one ohm.

Application (or Agreement for Service or Contract): The agreement between the Company and the Customer under which service is taken. Until a written agreement for service has been signed, service rendered by the Company is subject to the provisions of the Company's Service Regulations and applicable rate schedule. The provisions of the Company's standard application for service will be presumed to apply. The supplying and taking of such service shall constitute an Agreement for Service.

Authorities (having jurisdiction) (AHJ): The organization, office, or individual responsible for approving equipment, materials, an installation, or a procedure. The basic role of an AHJ is to verify that an installation complies with the National Electric Code.

Company: Entergy Corporation, its operating subsidiaries, officers, agents or employees.

Contract: See "Application".

Current: The rate of flow of electricity usually measured in amperes. The Company supplies alternating current (AC) and will not supply direct current (DC).

Customer: An individual, firm, partnership, association, corporation, organization, or governmental agency who is taking service as defined by regulatory authorities.

Customer's Installation: In general, all the wires, appliances, devices or apparatus of any kind or character on the Customer's side of the point of delivery except the meters, metering devices and facilities of the Company that may be located on the Customer's side of the point of delivery. The Customer's wiring and electrical equipment within or on the premises shall be installed and maintained in accordance with all effective building and wiring codes, and local laws and ordinances.

Demand: The kW or kVA, as shown or computed from the readings of the Company's demand meter installation, for the interval of the customer's greatest use between readings. (This is also known as maximum demand.)

Electric Service: See "Service".

Energy: The total work done as distinguished from the rate of doing work (power), usually measured in kilowatt-hours. Its amount depends upon the power and the time that the power is taken. For instance, a power rate of one kilowatt maintained for one hour is one kilowatt-hour of energy.

Hertz: Unit of frequency in Cycles per second For example, the Company furnishes 60 Hertz alternating current.

Kilovolt-ampere: (kVA) 1,000 volt amperes, the unit of apparent power, volts times amperes, which is comprised of both real and reactive power.

Kilowatt: (kW) 1,000 watts.

Load: The amount of electric power delivered or required at any specified point or points on a system.

Meter: A device or devices together with auxiliary equipment used for measuring any of the following: apparent, real, and reactive power and/or energy, which are supplied to any customer at a single point of delivery.

Number of Phases: See "Phase".

Ohm: The unit of measurement of electrical resistance or impedance. It is that resistance through which one volt will produce a current of one ampere.

Phase (or Number of Phases): Term which designates characteristics of alternating current. It is a term used in the electric industry relating to the characteristics of the electrical service available or supplied at a given location or required for the operation of a given electrical device. Single phase is normally supplied for residences and small power customers and three phase is supplied for larger power customers.

Point of Delivery: (also called “Point of Common Coupling) The physical location where the Customer's service terminals or wires are joined to the Company's facilities or such other point specifically designated by written agreement.

Power: The time rate of doing work, generating, transferring, or using electric energy, usually expressed in kilowatts (kW).

Power Factor: The ratio of real power (kW) to apparent power (kVA) for any given load and time. Normally, power factor is expressed as a ratio and stated as a percentage.

Reactive-kilovolt-amperes: (kVAR) (rkVA) (kilovar) The product of the applied voltage and the magnetizing or charging current, divided by 1,000. Reactive-kilovolt-amperes do no work but must be supplied to magnetic equipment, such as motors. Generators or capacitors supply it.

Sag (Voltage sag): A decrease in RMS voltage at the power frequency for duration of 0.5 cycles to 1 minute. Typical values are 0.1 to 0.9 per unit.

Service (or Electric Service): The availability of electric power and energy to the Customer, regardless of whether any power and energy is actually used. Supplying of service by the Company consists of its maintaining at the point of delivery the approximate nominal voltage and frequency by means of facilities adequate for supplying the Customer's contracted load.

Shall: The highest degree of requirement, no other options exist when shall is used. (also see 1.4)

Volt / Voltage: A unit of electrical pressure or potential or electromotive force which if applied to a load of one ohm resistance will cause a current of one ampere to flow. Primary distribution and transmission voltages are usually designated in kilovolts (kV). One kilovolt is equal to 1,000 volts.

Watt: An electrical unit of power. Electrical appliances and lamps are rated in watts to indicate their capacity or rate of using power for doing work. A 100 watt lamp used 10 hours will use one kilowatt-hour (kWh) of energy (1,000 watt-hours). Likewise a household iron rated at 1,000 watts will use one kilowatt-hour in one hour.

Section 2 Information for Providing Electric Service

2.1 Pre-Installation Information

The Company can expedite service connection and minimize cost to both the Customer and the Company if the Customer consults the Company before the design phase of the installation has begun. The Company is not responsible for the cost of replacing any of the Customer’s facilities that do not meet the requirements for service. Connection to the Company's electric system is not available prior to approval by the Company. The approval process may include the acquisition of permits and/or inspections by the authorities having jurisdiction. Consult the Customer Installation Standards for more information.

2.2 Alterations to Existing Service

The Company's facilities, including meters, transformers, and other equipment, are sized and installed to satisfy the Customer's requirements at the time the service is initiated and is based on information supplied by the Customer. Consulting with the Company regarding any change in the Customer’s requirements is recommended. It is essential that the Customer give notice to the Company of any substantial additional load (e.g., a large motor or generator) that is to be connected to the electric system. The Customer should not proceed to make these additions until after the Company has notified them that it can either supply the increased load or the conditions under which the increased load can be served. The Company is not liable for any damages incurred by the Customer connecting additional equipment without notice to the Company.

2.3 Required Information for New Service or Alteration to Service

The Customer **shall** furnish the following information to Company for any new service, or alterations to existing service, desired by the Customer:

1. Total motor load (to include size(s) of largest motor(s), starting current(s), NEMA letter or code) and rated voltage.
2. General characteristics of equipment to be driven by motors.
3. Date new electric service or alterations to existing service are needed.
4. Any highly fluctuating loads such as welders, X-ray machines, and motors with unusual or frequent starting requirements

The Company reserves the right to refuse to connect its service if the Customer's installation does not meet the Company’s requirements in this document. In some instances, the most practical solution to these problems may be the installation of additional facilities to serve the Customer. Should the Company need to install such additional facilities, the Customer will be required to pay for them.

Section 3 Power Quality Parameters for Customer Equipment Specifications

3.1 General Comments

This Section provides general guidelines on the quality of power a Customer can expect to receive at the point of electrical service. Additionally, this Section lists the restrictions the Company places upon the electrical distortion allowed on the power system that is caused by a Customer's equipment. This is to ensure that the Company's and other Customers' equipment will not be adversely impacted by a new Customer's facilities or an existing Customer's planned expansion.

The Company should be consulted early in the design phase for new installations and load additions to address specific installation requirements for new facilities and planned expansions.

Applicable Standards are:
ANSI C84.1 Electric Power Systems and Equipment
ANSI MG-1 Motors and Generators
ANSI C62.92.4-1991 IEEE Guide for the Application of Neutral Grounding in Electrical Utility Systems, Part IV-Distribution
IEEE 141-1993 IEEE Recommended Practices For Electric Power Distribution For Industrial Plant Systems
IEEE 519-1992 IEEE Recommended Practices And Requirements For Harmonic Control In Electrical Power Systems
IEEE 1159-1995 IEEE Recommended Practice For Monitoring Electric Power Quality

3.2 Steady State Voltage to Customer

The steady state voltage is the voltage a Customer can expect to receive under normal operating conditions. Since the loads on a utility system are constantly changing, it is impossible to maintain a completely constant voltage. Thus the Company will provide voltage regulation to keep the steady state voltage within the ranges shown in Tables 3.1 as indicated by ANSI standard C84.1.

Table 3.1 ANSI C84.1 Voltage Limits (Service Voltage)

Standard Nominal System Voltages and Voltage Ranges (Preferred system voltages in boldface type)

VOLTAGE CLASS	Nominal System Voltage (Note a)			Nominal Utilization Voltage (Note h)	Voltage Range A (Note b)			Voltage Range B (Note b)		
					Maximum	Minimum		Maximum	Minimum	
	2-wire	3-wire	4-wire	2-wire 3-wire 4-wire	Utilization and Service Voltage (Note c)	Service Voltage	Utilization Voltage	Utilization and Service Voltage	Service Voltage	Utilization Voltage
	Single-Phase Systems									
Low Voltage	**120**	**120/240**		**115** **115/230**	**126** **126/252**	**114** **114/228**	**108** **108/216**	**127** **127/254**	**110** **110/220**	**104** **104/208**
	Three-Phase Systems									
Low Voltage		240 **480** 600 (Note e)	**208Y/120** (Note d) **240/120** **480Y/277** 690Y/400	**200** **230/115** **230** **460Y/266** **460** 575 660	**218Y/126** **252/126** **252** **504Y/291** **504** 630 (Note e) 720	**197Y/114** **228/114** 228 **456Y/263** **456** 570 655	**187Y/108** **216/108** 216 **432Y/249** **432** 540 630	**220Y/127** **254/127** 254 **508Y/293** **508** 635 (Note e) 725	**191Y/110** (Note i) **220/110** 220 **440Y/254** **440** 550 635	**180Y/104** (Note i) **208/104** 208 **416Y/240** **416** 520 610
Medium Voltage		2400 **4160** 4800 **6900** **13800** 23000 34500	4160Y/2400 8320Y/4800 12000Y/6930 **12470Y/7200** **13200Y/7620** **13800Y/7970** 20780Y/12000 22860Y/13200 **24940Y/14400** **34500Y/19920**		2520 4370/2520 **4370** 5040 **7240** 8730Y/5040 12600Y/7270 **13090Y/7560** **13860Y/8000** **14490Y/8370** **14490** 21820Y/12600 24000Y/13860 24150 **26190Y/15120** **36230Y/20920** 36230	2340 4050Y/2340 **4050** 4680 **6730** 8110Y/4680 11700Y/6760 **12160Y/7020** **12870Y/7430** **13460Y/7770** **13460** 20260Y/11700 22290Y/12870 22430 **24320Y/14040** **33640Y/19420** 33640	2160 3740Y/2160 **3740** 4320 **6210** (Note f) **12420** (Note f)	2540 4400Y/2540 **4400** 5080 **7260** 8800Y/5080 12700Y/7330 **13200Y/7620** **13970Y/8070** **14520Y/8380** **14520** 22000Y/12700 24200Y/13970 24340 **26400Y/15240** **36510Y/21080** 36510	2280 3950Y/2280 **3950** 4560 **6560** 7900Y/4560 11400Y/6580 **11850Y/6840** **12540Y/7240** **13110Y/7570** **13110** 19740Y/11400 21720Y/12540 21850 **23690Y/13680** **32780Y/18930** 32780	2080 3600Y/2080 **3600** 4160 **5940** (Note f) **11880** (Note f)
					Maximum Voltage (Note g)					
		46000 **69000**			48300 **72500**					

1. **Service voltage** is measured at the point of common coupling between Customer and Company. Jurisdictional Public Service Commissions may specify other voltage limits.
2. Voltage limits in % deviation from nominal
3. For circuits with no lighting equipment
4. **Range A** applies to normal operations
5. **Range B** applies for short duration and/or abnormal conditions on the utility system (excluding fault conditions and transients).
6. **Utilization Voltage** is measured at the equipment using the electricity.

When abnormal conditions occur (such as the loss of a major transmission line, generator, etc.), corrective measures shall be taken by the Company within a reasonable time to improve voltages to meet Range A guidelines. The Company will follow these guidelines for service voltages.

It is the responsibility of the Customer to design their electrical system to ensure the utilization voltage guidelines in ANSI standard C84.1 are met. Table 3.2 lists the guidelines for the Customer's utilization equipment.

The Company's transmission grid (above 34.5 kV) is designed to operate at steady state voltage levels between 95% and 105% during normal conditions and between 92% and 105% during contingency situations. Accordingly, Customers fed from the transmission grid should have a means of regulating the step-down transformer(s) low-side voltage to ensure the appropriate voltage levels are maintained at the Customer's utilization equipment.

3.3 Voltage Unbalance

3.3.1 Voltage Unbalance at Service Entrance

The voltage Unbalance at the service entrance under **no-load** conditions should be limited to 3% or less per ANSI standard C84.1. The Company's facilities will be designed to meet this guideline.

$$\text{Percent voltage unbalance} = \frac{\text{V max dif} - \text{Vav 3 ph}}{\text{Vav 3 ph}} \times 100\ \%$$

Where:
Vmax dif = the phase voltage most different from the average of three phases
Vav 3 ph = the average voltage of three phases

For voltage imbalance greater than 1% at a Customer's motor terminals, the motor should be derated; ANSI Standard MG-1 provides guidelines for motor derating to avoid excessive motor heating. Additionally, excessive current imbalance due to supply voltage imbalance can cause nuisance tripping of motor protective devices. The Customer is responsible for balancing the loads in their facility to ensure adequate levels of balance are maintained during all loading conditions.

3.3.2 Loss of Power

An extreme case of phase imbalance is single phasing, which can occur on both the utility side and the Customer side of the point of common coupling. It is the responsibility of the Customer to protect utilization equipment from single-phasing events on the power system. Compliance with the NEC does not ensure adequate protection from single phasing. Also see Section 14.7.3 and NEC 430.

3.4 Voltage Swells

Voltage swells are characterized as RMS (root mean square) voltage variations exceeding 110% of nominal voltage for less than one minute. Faults to ground on power systems may cause voltage swells on the unfaulted phases, which last for the duration of the fault. The magnitude of the swell depends upon the circuit grounding configuration and the relation of the zero-sequence impedance to the positive sequence impedance of the system. Additionally, system voltage regulation shall be considered when determining the maximum over voltage seen by the equipment. This may result in the maximum prefault operating voltage being 5% above the nominal for some customers.

The order of magnitude of over voltage during ground faults is shown in Table 3.2 for various types of distribution systems (34.5 kV and below).

Table 3.2 Voltage Swell Maximum During Ground Faults

System	**Over Voltage Maximum** *(per ANSI C62.92.4)*
Ungrounded	1.82 X nominal line-ground voltage
Four-wire multigrounded (cable system)	1.5 X nominal line-ground voltage
Three- or Four-wire ungrounded	1.4 X nominal line-ground voltage
Four-wire multigrounded (open wire system)	1.25 X nominal line-ground voltage

As an example, the voltage to ground on the unfaulted phases of a loaded four-wire multi-grounded neutral system can increase by as much as 20%, the exact amount depending upon the location of the fault. In selection of the maximum overvoltage seen by equipment; however, system voltage regulation must be considered, which results in maximum prefault operating voltage being 5% above the nominal voltage. Consequently, the maximum overvoltage factor for this system is approximately 1.25 (1.2 × 1.05).

Similarly, for spacer-cable systems, a factor not exceeding 1.58 is specified in ANSI C62.92.4 - 1991 as the maximum value of overvoltage on the unfaulted phases of a three-phase circuit during single phase-to-ground faults. Taking into account connected distribution transformers, the factor reduces to 1.46. Thus, for spacer-cable systems, the duty cycle voltage rating of arresters should be based on the nominal line-to-neutral voltage multiplied by the product of the Range A factor 1.05 and 1.46. This is equivalent to 1.5 times nominal line-to-neutral system voltage.

It is the Customer's responsibility to protect sensitive equipment from these voltage swells by using fast acting voltage regulators or power conditioners.

3.5 Voltage Sags

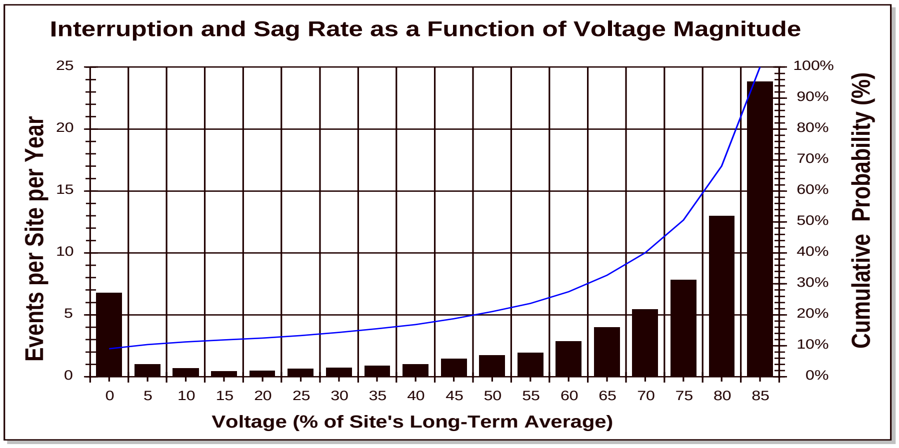
Voltage sags are RMS voltage variations between 10% and 90% of nominal voltage for less than one minute. Voltage sags typically are caused by a fault condition somewhere on the power system. The actual sag seen by the Customer depends upon a number of factors such as service voltage level, fault location, fault type, the number of delta-wye or wye-delta transformations between the fault and the Customer, etc.

An Electric Power Research Institute (EPRI) national survey performed on electrical distribution systems found that 40% of the sag events resulted in a voltage of less than 70% of nominal (see Figure 1). Additionally, only 16% of the events resulted in a voltage of less than 40%. ***Performance at a specific location may be significantly better or worse depending on many factors*.**

Due to protective device coordination and other factors, voltage sags on distribution systems can last for two or more seconds.

Figure 1

Typical Distribution System Voltage Sag Frequency
(based on actual measurements from the Electric Power Research Institute Distribution Power Quality Project)



Customers fed directly from the transmission system (above 34.5 kV) generally will experience the effects of fewer sags than a distribution fed Customer as well as experience faster fault clearing times. A voltage sag on the transmission system due to a fault will generally last from 5 to 12 cycles. Customers on distribution systems may experience the effects of a voltage sag occurring on the transmission system. Performance at a specific location varies widely depending on the service voltage level, circuit configuration, the location of the fault and many other factors.

Accordingly, Customers served from all voltage levels should provide conditioned power for sensitive controls and equipment and ride-through circuitry for critical motors to mitigate the impact of voltage sags.

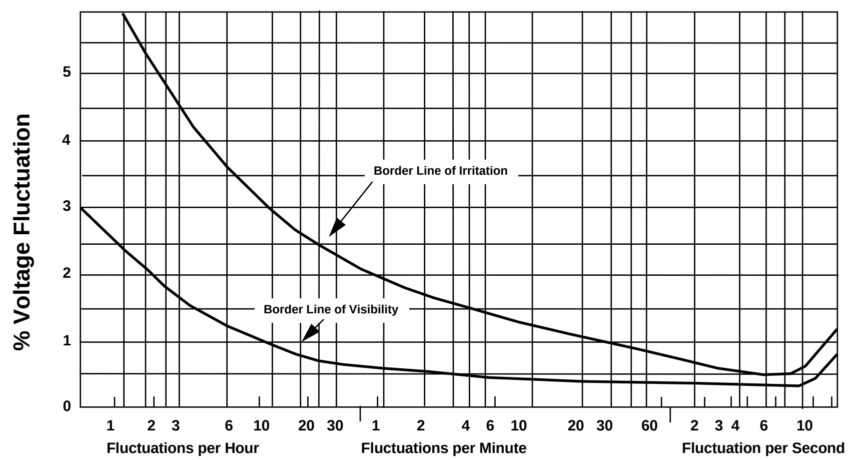
3.6 Voltage Fluctuations Caused By Customer

Voltage fluctuations are systematic variations of the voltage envelope or a series of random voltage changes, the magnitude of which does not normally exceed the steady state voltage ranges prescribed in ANSI C84.1. Voltage fluctuations are often referred to as flicker due to their impact on lighting intensity. The Company requires certain restrictions of Customers with fluctuating loads to mitigate the impact of voltage fluctuations on the rest of the Customers on the utility system. The GE Flicker Limit Curve (Figure 2) is used as a guideline for voltage fluctuations, as modified by the limits in the following paragraphs.

For customers with loads causing voltage fluctuations in the frequency range of 1 to 25 Hz, voltage flicker levels are unacceptable if either one of the following conditions exist: (a) the cumulative RMS voltage flicker at the point of common coupling exceeds 0.30% for 1.0% of a representative time period, or (b) the instantaneous voltage flicker level regularly exceeds 0.45% at the point of common coupling (this is approximately equal to a cumulative RMS voltage flicker of 0.45% for 0.01% of a representative time period). It is the Customer's responsibility to install corrective equipment to reduce the voltage flicker to acceptable levels.

Regardless of the frequency of occurrence, Customer switched loads shall not result in a voltage step change greater than 4% on the Company's distribution system or 2.5% on the transmission system (above 34.5 kV). The Customer is responsible for installing reduced voltage starting or other equipment to meet these restrictions.

Figure 2
Voltage Fluctuation Limits Allowed by Customers
(taken from the GE Flicker Limit Curve)



Composite curves of voltage flicker studies by General Electric Company, General Electric Review, August 1925

(IEEE 141-1993, Figure 3.8, page 94)

The allowable maximum voltage drop at a motor's terminals or on the Customer's own distribution system depends upon the Customer's requirements. It is the Customer's responsibility to ensure that the starting of their motor does not result in an unacceptable voltage drop within their facility.

3.7 Harmonic Distortion

Harmonics are voltages or currents at frequencies that are integer multiples of the fundamental 60 Hz frequency (120 Hz, 180 Hz, 240 Hz, etc.). Harmonics combine with the fundamental voltage or current and produce a distorted waveform. Harmonic distortion exists due to the nonlinear characteristics of devices and loads on the power system. The IEEE standard 519 provides harmonic distortion limits for both voltage and current at the point of common coupling (PCC). The point of common coupling, when measuring for harmonic distortion, is defined as a point of metering or any point where both the Company and the Customer can access the point for direct measurement of the harmonic indices meaningful to both. Generally the PCC will be the high side of the transformer supplying a single industrial or commercial Customer. The Company is responsible for maintaining the quality of the utility system voltage waveform to all Customers The Customer is responsible for limiting harmonic currents injected into the power system.

The voltage distortion limits followed by the Company are shown in Table 3.3. In order to conform to the above listed constraints, the Company requires the Customer to follow the IEEE standard 519 harmonic current injection limits. These limits, measured at the point of common coupling, are shown below:

Table 3.3 Harmonic Voltage Limits, IEEE STD 519
(Paragraph 10.4.1 + Table 11.1, page 59)

Utility Bus Voltage	Maximum Individual Harmonic Component (%)	Maximum THD (%)
≤ 69 kV	3.0%	5.0%

(Note: THD = Total Harmonic Distortion

Table 3.4 Harmonic Current Distortion Limits (I_h IN PERCENT OF I_L)
Service Voltage ≤ 69 kV(IEEE519, page 78 Table 10.3)

SCR= I_{SC}/I_L	h<11	11≤h<17	17≤h<23	23 ≤h< 35	35 ≤h	TDD
<20	4.0	2.0	1.5	0.6	0.3	5.0
20-50	7.0	3.5	2.5	1.0	0.5	8.0
50-100	10.0	4.5	4.0	1.5	0.7	12.0
100-1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

NOTES

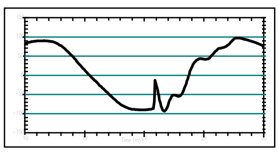
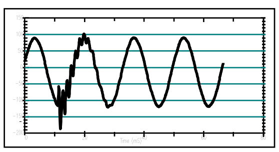
1. Values shown for the current distortion limits are in percent of “average maximum demand load current”
2. SCR = short circuit ratio (utility short circuit current at point of common coupling divided by the Customer average maximum demand load)
3. h = harmonic number,
4. I_{SC}= Utility short circuit at the point of common coupling,
5. I_L= Customer average demand load,
6. TDD = Total Demand Distortion

3.8 Transients

Transients are deviations from the AC sine wave having a very short duration, typically from a fraction of a microsecond to a very few milliseconds. Transients can be broken into two sub-categories: oscillatory transients and impulsive transients (see Figure 3). Most transients on the power system, which are within the Customer's facilities, are oscillatory in nature.

Figure 3

Transients

Example Waveshape or RMS variation	Power Quality Variation Category	Method of Characterizing	Typical Causes
	Impulsive Transients	Peak magnitude, Rise time, Duration	Lightning, Electro-Static Discharge, Switching Capacitor
	Oscillatory Transients	Waveforms, Peak Magnitude, Frequency Components	Line/Cable Switching, Capacitor Switching, Load Switching

Capacitor switching is the most common cause of an oscillatory transient on the power system. Although the voltage magnitude can approach two times the peak voltage, usually system damping causes the voltage to be less than 1.6 per unit (1.0 per unit = 100% of nominal). These transients can occur on a daily basis. It is the Customer's responsibility to ensure that the sensitive drives and equipment have enough input line reactance (via a suitably designed choke or filter) to avoid nuisance tripping.

Lightning is the most common cause of impulsive transients. Voltage transients caused by lightning can be much higher in magnitude than capacitor switching but are much shorter in duration and have lower energy levels. Customers should apply surge suppression equipment at the service entrance and at sensitive equipment to protect against damage and misoperation due to lightning and other high frequency transients. (See NEC Article 285.)

3.9 Frequency

During normal operations, the frequency should not vary more than 0.05 Hertz from 60 Hertz. Southeastern Electric Reliability Council generating unit spinning reserves will be used to maintain the frequency. However, a major disturbance among the interconnected bulk electric system may result in certain areas becoming isolated and experiencing abnormally low frequency. If such a disturbance occurs, the Company will automatically shed Customer load as required to restore system frequency. Under certain conditions, the presence of Customers' distributed generation may also cause frequency abnormalities if the distributed generation produces energy while it is separated from the power system.

3.10 Electrical Noise

Electrical noise is unwanted electrical signals with broadband spectral content lower than 200 kHz superimposed upon the phase or neutral conductors or signal lines. Power electronic devices, control circuits, arcing equipment, loads with solid-state rectifiers, and switching power supplies can cause noise in power systems. Noise problems are often made worse by improper grounding. (See NEC Article 250 for proper grounding techniques.) Non-conducted environmental factors such as electromagnetic interference (EMI) and radio frequency interference (RFI) can also have an effect on load equipment.

It is the Customer's responsibility to employ proper grounding techniques and to install filters, isolation transformers, and line conditioners to mitigate the impact of electrical noise. Additionally, the Customer should ensure that proper separation of data and power lines are maintained, shielded twisted pair instrumentation and data cables are used, and suitable distances are maintained between sensitive electronic equipment and sources of large electromagnetic interference.