Comments on Draft Specification Framework ENERGY STAR Uninterruptible Power Supply Specification Framework - dated February 16, 2010

GE Digital Energy commends the effort by the EPA to establish a framework for ENERGY STAR requirements for Uninterruptible Power Supplies, issued February 16, 2010. GE Digital Energy has a broad range of products and technology that delivers highly reliable and energy efficient power quality for mission critical and data center facilities. We help ensure that mission critical equipment and processes are protected and uninterrupted by power system anomalies. GE has been a supporter of the EPA Energy Star program thru other programs for products ranging from lighting to appliances. GE believes the EPA Energy Star brand and processes provide the UPS industry with the best opportunity to improve the energy efficiency of UPS.

Since 2005, GE's Ecomagination business initiative helps meet customers' demand for cleaner and more energy-efficient products. Ecomagination also reflects GE's commitment to invest in a future that creates innovative solutions to environmental challenges and delivers valuable products and services to customers. GE believes that energy efficiency products delivers benefits to customers thru energy savings and the environment by reducing the green house gases normally required to generate the electricity. In addition to improving GE product efficiency, the GE Ecomagination effort also focuses on improving the energy efficiency of GE facilities including data centers.

Response #	Page #	Section #	Topic	GE Comment(s)
1	2	Building Block#1 Definitions c. Preliminary List of Definitions a. Uninterruptible Power Supply (UPS)	"maintain continuity of power to electrical loads"	GE recommends the EPA define the "maintain continuity of power" and "conditioning the power" section in first paragraph. GE recommends adoption of a power tolerance standard like ITI (CBEMA) curve to define the primary mission of the UPS.

2	2	Building Block#1 Definitions c. Preliminary List of Definitions a. Uninterruptible Power Supply (UPS)	"electrical loads"	GE recommends the EPA define the term "electrical loads". Studies published from a variety of independent organizations (Frost & Sullivan, EPRI, etc) have concluded most UPS systems are applied to protect IT and computer equipment loads. By defining IT, servers and computer equipment as the primary load for the UPS this will allow adoption of tolerance standards like ITI (CBEMA) curve thus creating a significant opportunity to optimize UPS energy efficiency.
3	2	Building Block#1 Definitions c. Preliminary List of Definitions b. System Topology	Multiple or parallel UPS operation	GE recommends the EPA include parallel operation of UPS in system topology definitions. The basic building blocks for UPS are single modules and GE assumes this EPA effort will focus on single UPS module efficiency. However, many data centers will deploy multiple UPS modules operating in parallel configurations for reliability (N+1, N+N, etc.) and evaluating UPS efficiency in redundant configurations will be important essential.
4	3	Building Block #1 Definitions c. Preliminary List of Definitions e. UPS Operational States 1. Normal State	Double Conversion in Eco Mode	GE agrees with this general definition of operating states and these definitions are consistent with the IEC-62040 standard. GE recommends the EPA to add a fourth Normal Operating State titled and defined as, "4.) Double Conversion in Eco Mode: This operating state can reduce UPS energy losses by up to 85%, provides for operational flexibility, and provides the greatest opportunity for UPS efficiency improvement without compromising reliability." While this operating state uses Double Conversion UPS as basic topology, the historical treatment of Eco Mode as an abnormal operating state has created perceived risk and significantly hurt the market adoption of this high efficiency operating state. Double Conversion in Eco mode should be defined and added as a Normal Operating State to accelerate market adoption of this high efficiency operating state.

5	3	Building Block #1 Definitions d. Questions for Discussions question #1	Sources	GE encourages EPA to use the IEC 62040 standard for definitions. However, this standard does not completely address the opportunity to establish or improve UPS efficiency. A key element for establishing and optimizing UPS efficiency is to clearly define the primary mission of the UPS – to provide reliable power within tolerance to the IT/computer load. The definition of this "reliable power within tolerance to the IT/computer load" is critical to evaluating and optimizing UPS efficiency. GE encourages EPA to establish the ITI (CBEMA)[1] curve as the specific output tolerance criteria for UPS achieve. [1] The ITI (CBEMA) Curve was published by Technical Committee 3 (TC3) of the Information Technology Industry Council (formerly known as the Computer & Business Equipment Manufacturer's Association). The ITI (CBEMA) curve was last updated in 2000 with support from EPRI but has not been formally adopted by national standard body. A voltage tolerance curve very similar to an older version of the ITI (CBEMA) curve is referenced in IEEE standard 446-1995 (page 54).

6	3	Building Block #1 Definitions d. Questions for Discussions question #2	Alternate version of operational states	As stated above in our Response #4, GE recommends the EPA add a fourth Normal Operating State titled "4.) Double Conversion in Eco Mode". A traditional Double Conversion UPS is continuously converting utility power that is normally within tolerance for the IT/server device. A UPS only needs to operate in Double Conversion operating mode when the utility power quality deviates from the ITI (CBEMA) curve compliance required for IT/server equipment loads. Some analogies of energy efficiency operating modes already deployed in data centers are diesel gens (turn on when needed), VFD drives in cooling equipment, compressors for cooling systems (turn off on cool days) and IT/servers with power save features (turn off server when not needed). The UPS should only be consuming energy and converting power when the utility power is outside of ITI (CBEMA) curve tolerance.
7	3	Building Block #1 Definitions d. Questions for Discussions question #3	"eco-mode"	GE recommends that the EPA adopt Eco Mode as a Normal Operating State for UPS. This normal operating state has the largest percent improvement potential for UPS energy efficiency. The perceived risk of reliability can be addressed by adopting ITI (CBEMA) curve as performance standard for IT/server equipment (i.e. add check box to identity compliance on the server/IT equipment data sheet). The 3rd party testing agencies (i.e. EPRI) being considered for UPS energy efficiency certification could perform ITIC (CBEMA) curve certification testing and reporting specifications for both IT/server equipment and UPS equipment. GE recommends the EPA differentiate between Line Interactive and Double Conversion in Eco Mode. While there are some similarities, there are differences in both the topology and operating states that need to be defined.

8	3	Building Block #1 Definitions d. Questions for Discussions question #4	Load conditions	The UPS industry currently does not have an industry standard for publishing and evaluating energy efficiency across the operating load conditions. While every customer site will have different operating load conditions, UPS operating between 25% and 75% load is the most common. For larger data centers with N+N redundancy, the operating load condition just below 50% is common. For higher power applications (>200 kVA), GE recommends publishing efficiency at 25%, 50%, 75% and 100% load points on the data sheets. UPS efficiency curves should be plotted at 5% load increments. The 100% operating point is the least important because a UPS rarely operates at 100% load. Operating load data from GE customers, GE data centers and from industry sources confirms these operating conditions between 25%, 50% and 75% are most common. Part of this question appears truncated – please complete the question sentence, "What load conditions are data center operators".....?

9	4	Building Block #1 Definitions d. Questions for Discussions question #5	Power conditioning and industry tolerances	GE recommends the EPA pursue this relationship between UPS power conditioning and energy efficiency. As previous responses stated, establishing the ITI (CBEMA) curve as the required power conditioning for the UPS and adding the ITI (CBEMA) curve compliance to the IT/server manufacturer public data sheets will create significant opportunity for improving UPS efficiency without compromising the mission of the UPS. The UPS mission is to provide highly reliable power within acceptable tolerance to the IT/server loads. The data center industry is evaluating and adopting similar "tolerances" for cooling. The data center industry is establishing higher operating temperature tolerance of the IT/server equipment and these higher temperature tolerances will result in more efficient data centers. The higher temperature tolerance for IT/cooling equipment is a good analogy for the power tolerance – a wider voltage tolerance on the IT/cooling equipment will allow more efficient operating modes for the UPS.
10	4	Building Block #1 Definitions d. Questions for Discussions question #6	Energy storage	GE is aware of the environmental impact of battery production and disposal, but GE does not see any significant impact on operating energy efficiency of a UPS based on the energy storage technology (battery, flywheel, etc). GE recommends the environmental impact of battery be considered under separate rules and regulations, not this EPA ENERGY STAR UPS specification.

11	4	Building Block #2 Eligible Product Categories b. Initial Approach	Market scope and segments	GE recommends the EPA consider the following UPS groups in the following order of priority: 1) Three-phase > 200 kVA 2) Three-phase < 200 kVA 3) Single-phase 1) The largest opportunity for adoption of ENERGY STAR UPS with significant improvements in UPS efficiency is in the 3 Phase > 200 kVA because of faster growth in large data centers, the efficiency improvement potential in this range and the speed of market adoption of other data center efficiency standards (i.e. PUE, Energy Star data centers) by the large data center market. This segment has the most informed end users and engineering consultants for adopting energy efficiency standards and using these standards for real improvement in data center efficiency. 2) After addressing Three-phase > 200 kVA, then efficiency standards could be deployed on <200 kVA – while this is a large market, this segment is very fragmented and end users do not currently evaluate efficiency as much as 3 Phase > 200 kVA large UPS. 3) A majority of the Single Phase market is comprised of Passive Standby and Line Interactive topologies, which are fairly efficient, and the opportunity for significant improvement in Single-phase UPS energy efficiencies may be limited.
12	5	Building Block #2 Eligible Product Categories d. Questions for Discussion question #1	Market segments	As stated in GE response #11, GE recommends the EPA consider the following segments: 1) Three-phase > 200 kVA 2) Three-phase < 200 kVA 3) Single-phase

13	5	Building Block #2 Eligible Product Categories d. Questions for Discussion question #2	Opportunity for energy savings	GE views the Three-phase >200 kVA market as having a high growth rate and best opportunity for UPS energy savings based on availability of improved UPS technology. This market has a knowledgeable UPS customer base motivated to evaluate and improve the efficiency of their data centers. These larger data centers have higher loads and higher energy bills, thus upper management of these large data center facilities may be quicker to adopt ENERGY STAR rated UPS as a standard criteria.
14	5	Building Block #2 Eligible Product Categories d. Questions for Discussion question #2	Technology and product types	GE recommends the EPA include Double Conversion in Eco Mode as a Normal Operating State.
15	5	Building Block #3 Energy Efficiency Criteria and Test Procedures a. Purpose	3rd party testing	GE recommends EPA require the use of EPS approved 3rd party testing agencies (such as EPRI) for testing energy efficiency and power conditioning (ITI (CBEMA) curve) performance based on this ENERGY STAR specification. GE would not be in favor of self-certification based on potential inconsistency in testing methods and accuracy.
16	5	Building Block #3 Energy Efficiency Criteria and Test Procedures a. Purpose	Notes on Value Added Resellers (VAR)	GE recognizes the important role that VARs provide in this UPS market and believe the VAR sales channel can be instrumental in implementing plans to improve UPS energy efficiency.

17	5	Building Block #3 Energy Efficiency Criteria and Test Procedures a. Purpose Initial Approach	Normal State	GE supports EPA comment to use existing test procedures and to evaluate efficiency across the UPS load range. GE also agrees that UPSs operate a majority of the time in "Normal State" and this "Normal State" will need some guidelines on expected annual operating hours (i.e. 90% of the year) to ensure impact on annual energy savings. GE recommends Double Conversion in Eco Mode be considered as a "Normal State" since a majority of the time utility power is within an acceptable tolerance of the IT/server load equipment. GE recommends the EPA add ITI (CBEMA) testing and test reporting for UPS to ensure the UPS operates within IT/Server load accepted tolerance.
18	5	Building Block #3 Energy Efficiency Criteria and Test Procedures b. Existing Test Procedures for Reference	IEC 62040-3	GE recommends the use of IEC 62040-3 based on the broad global adoption of this standard by UPS industry. However, this standard does not address all of the considerations for energy efficiency testing and improvements will be needed in efficiency criteria and testing.
19	5	Building Block #3 Energy Efficiency Criteria and Test Procedures c. Questions for Discussions question #1	Operational states	The Normal operating States should be the primary criteria for the ENERGY STAR program based on the high number of annual operating hours. Operating states such as Bypass and Stored Energy will have limited operating hours and limited impact on annual energy savings. GE recommends that Double Conversion in Eco Mode be considered as a Normal operating State based on opportunity to operate over 95% of time in this high efficiency mode and the opportunity for significant improvement in annual energy savings in UPS

20	6	Building Block #3 Energy Efficiency Criteria and Test Procedures c. Questions for Discussions question #2	Efficiency and Operating hours by state	The efficiency of Double Conversion UPS in normal operating state averages between 90-94% depending on the kVA size and the load condition of the UPS. The efficiency of Double Conversion in Eco Mode UPS in Normal operating State averages between 97-99% efficiency depending on the kVA size and the percent-operating load of the UPS. A Double Conversion UPS in Normal operating State will transfer to Bypass State or Storage State infrequently, so its reasonable to assume >99% annual operating hours will be in Double Conversion mode. Considering reliability data for the US utility grid, GE estimates that a Double Conversion UPS can operate in Eco Mode around 95-99% of the time and only 1-5% of the time in Double Conversion Mode. Bypass mode and stored energy mode operating hours would be relatively insignificant.
21	6	Building Block #3 Energy Efficiency Criteria and Test Procedures c. Questions for Discussions question #3	Over sizing and part load	GE recommends the EPA avoid criteria on "over sizing" and focus ENERGY STAR on the energy efficiency across the load range (25% to 100%) for both single module and multi-module redundant configurations. By providing efficiency across load range allows end user to make informed decision on impact of redundancy (N, N+1, N+N, etc.) on the UPS efficiency. The UPS systems for mission critical applications usually operate in multiple modules with N+1, N+N configurations for redundancy and high reliability. These N+1, N+N configurations require the UPS modules to share the load, thus the UPS modules are normally operating at partial loads. In the mission critical industry, this redundant system configuration is often required and is not considered "over sizing". The additional "over sizing" is frequently a conscious end user decision for redundancy and high reliability.

22	6	Building Block #3 Energy Efficiency Criteria and Test Procedures c. Questions for Discussions question #4	Modularity and scalability	GE recommends the EPA evaluate efficiency in both single module and multi-module systems with UPS modules operating in parallel for reliability, modularity or scalability. Any additional effort to define modularity and scalability does not appear to impact energy efficiency and should not be considered part of this specification.
23	6	Building Block #3 Energy Efficiency Criteria and Test Procedures c. Questions for Discussions question #6	Efficiency test procedure	The existing UPS testing standards like IEC 62040-3 may not adequately address all considerations for UPS energy efficiency testing and procedures. Additional efficiency test procedures may be required.
24	6	Building Block #3 Energy Efficiency Criteria and Test Procedures c. Questions for Discussions question #7	Load Ranges and Redundant Operation	GE recommends EPA define "categories" in first question. GE recommends certification of both single module and multi-module systems to account for any potential differences in hardware or software that could impact energy efficiency. Redundant operation typically uses similar hardware as single module, but differences in hardware or software for redundant operation could impact efficiency.
25	6	Building Block #3 Energy Efficiency Criteria and Test Procedures c. Questions for Discussions question #8	Value Added Resellers (VAR) role	GE recognizes the important role that VARs provide in this UPS market and believe the VAR sales channel can be instrumental in implementing plans to improve UPS energy efficiency. VARs could be instrumental in assisting end user on understanding power conditioning standards (ITI (CBEMA) curve) and the opportunity to apply a high efficient UPS system to meet these standards.
26	7	Building Block #4 Information and Management Requirements a. Purpose Standard Information Reporting	Reporting and measurement tools	The IEC 62040-3 standardized reporting format for UPS product data sheets is a good reference for energy efficiency data sheet formatting. GE recommends the EPA consider additional data sheet details such as, part load conditions, parallel vs. single modules, ITI (CBEMA) curve compliance, etc. be added.

27	7	Building Block #4 Information and Management Requirements a. Purpose	PUE and data centers	GE supports the use of PUE for data center efficiency metric for non-IT infrastructure.
28	7	Building Block #4 Information and Management Requirements b. Initial Approach Standard Information Reporting	Data Sheets	GE recommends compliance with output performance standard (ITI (CBEMA)) is included on the data sheet.
29	8	Building Block #4 Information and Management Requirements b. Initial Approach Standard Information Reporting	Reporting requirements	GE recommends that various alternatives internal and external to the UPS be evaluated for measuring power consumption, inlet air temperature and utilization data. Also accuracy of the measurement devices will need to be established.
30	8	Building Block #4 Information and Management Requirements c. Questions for Discussion question #1	Server data sheet	GE is evaluating the server data sheet and will provide specific comments at later date. GE recommends the EPA add power tolerance compliance (ITI (CBEMA)) to the server data sheet.
30	8	Building Block #4 Information and Management Requirements c. Questions for Discussion question #2	UPS reporting capability	GE recommends both that energy efficiency measurement and reporting systems internal and external to the UPS be evaluated. The data reporting capability and accuracy for individual UPS may vary significantly. Many data centers and UPS may have limited capability to measure efficiency accurately, and may require external high-accuracy measurement devices be added.
31	8	Building Block #4 Information and Management Requirements c. Questions for Discussion question #3	Power and Performance data sheet	GE recommends the EPA including compliance to power tolerance or conditioning standard (ITI (CBEMA)). Reporting guidelines noted in IEC 62040 may be helpful to establish this definition.
32	8	Building Block #4 Information and Management Requirements c. Questions for Discussion question #4	Efficiency measurement	See GE response #30.

33	8	Building Block #4 Information and Management Requirements c. Questions for Discussion question #5	Utilization and operating information	Utilization and operating information based on this question should provide end users with operating state (Normal, Stored Energy, Bypass) and provide instantaneous and cumulative data on % operating load, efficiency (output kW/input kW) and output power tolerance compliance.

-- End --

ITI (CBEMA) CURVE APPLICATION NOTE

The ITI (CBEMA) Curve, included within this Application Note, was published by Technical Committee 3 (TC3) of the Information Technology Industry Council (ITI, formerly known as the Computer & Business Equipment Manufacturer's Association).

1) SCOPE

The ITI (CBEMA) Curve and this Application Note describe an AC input voltage envelope which typically can be tolerated (no interruption in function) by most Information Technology Equipment (ITE). The Curve and this Application Note comprise a single document and are not to be considered separately from each other. They are not intended to serve as a design specification for products or AC distribution systems. The Curve and this Application Note describe both steady-state and transitory conditions.

2) APPLICABILITY

The Curve and this Application Note are applicable to 120V nominal voltages obtained from 120V, 208Y/120V, and 120/240V 60Hz systems. Other nominal voltages and frequencies are not specifically considered and it is the responsibility of the user to determine the applicability of these documents for such conditions.

3) DISCUSSION

This section provides a brief description of the individual conditions which are considered in the Curve. For all conditions, the term "nominal voltage" implies an ideal condition of 120V RMS, 60Hz.

Seven types of events are described in this composite envelope. Each event is briefly described in the following sections, with two similar line voltage sags being described under a single heading. Two regions outside the envelope are also noted. All conditions are assumed to be mutually exclusive at any point in time, and with the exception of steady-state tolerances, are assumed to commence from the nominal voltage. The timing between transients is assumed to be such that the ITE returns to equilibrium (electrical, mechanical, and thermal) prior to commencement of the next transient.

3.1) Steady-State Tolerances

The steady-state range describes an RMS voltage which is either very slowly varying or is constant. The subject range is +/- 10% from the nominal voltage. Any voltages in this range may be present for an indefinite period, and are a function of normal loadings and losses in the distribution system.

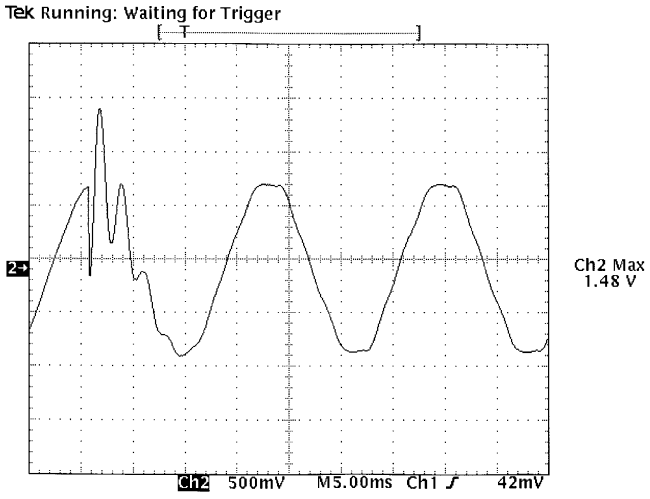
3.2) Line Voltage Swell

This region describes a voltage swell having an RMS amplitude of up to 120% of the RMS nominal voltage, with a duration of up to 0.5 seconds. This transient may occur when large loads are removed from the system or when voltage is supplied from sources other than the electric utility.

3.3) Low-Frequency Decaying Ringwave

This region describes a decaying ringwave transient which typically results from the connection of power-factor-correction capacitors to an AC distribution system. The frequency of this transient may range from 200Hz to 5KHz, depending upon the resonant frequency of the AC distribution system. The magnitude of the transient is expressed as a percentage of the peak 60Hz nominal voltage (not the RMS value). The transient is assumed to be completely decayed by the end of the half-cycle in which it occurs. The transient is assumed to occur near the peak of the nominal voltage waveform. The amplitude of the transient varies from 140% for 200Hz ringwaves to 200% for 5KHz ringwaves, with a linear increase in amplitude with increasing frequency. Refer to Figure 1 for an example of a typical waveform.

FIGURE 1



TYPICAL LOW FREQUENCY DECAYING RINGWAVE

3.4) High-Frequency Impulse and Ringwave

This region describes the transients which typically occur as a result of lightning strikes. Wave shapes applicable to this transient and general test conditions are described in ANSI/IEEE C62.41-1991. This region of the curve deals with both amplitude and duration (energy), rather than RMS amplitude. The intent is to provide an 80 Joule minimum transient immunity.

3.5) Voltage Sags

Two different RMS voltage sags are described. Generally, these transients result from application of heavy loads, as well as fault conditions, at various points in the AC distribution system. Sags to 80% of nominal (maximum deviation of 20%) are assumed to have a typical duration of up to 10 seconds, and sags to 70% of nominal (maximum deviation of 30%) are assumed to have a duration of up to 0.5 seconds.

3.6) Dropout

A voltage dropout includes both severe RMS voltage sags and complete interruptions of the applied voltage, followed by immediate re-application of the nominal voltage. The interruption may last up to 20 milliseconds. This transient typically results from the occurrence and subsequent clearing of faults in the AC distribution system.

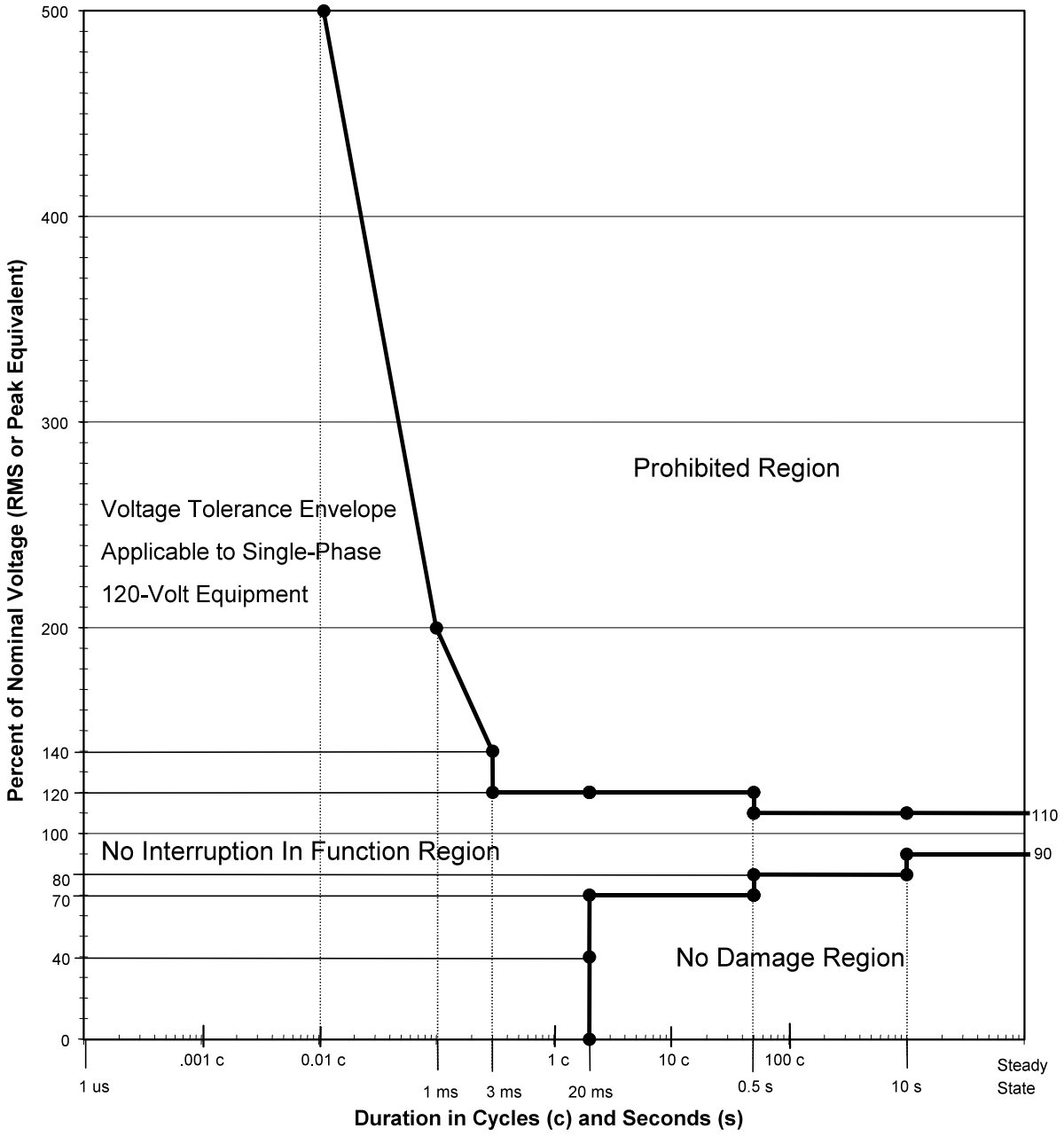
3.7) No Damage Region

Events in this region include sags and dropouts which are more severe than those specified in the preceding paragraphs, and continuously applied voltages which are less than the lower limit of the steady-state tolerance range. The normal functional state of the ITE is not typically expected during these conditions, but no damage to the ITE should result.

3.8) Prohibited Region

This region includes any surge or swell which exceeds the upper limit of the envelope. If ITE is subjected to such conditions, damage to the ITE may result.

ITI (CBEMA) Curve
(Revised 2000)



Published by:

Information Technology Industry Council (ITI)
1101 K Street NW, Suite 610, Washington DC 20005
(202) 737-8888
http://www.itic.org