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UNIVERSITI TEKNOLOGI MALAYSIA
Centre of Electrical Energy Systems (CEES)

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PQ STAKEHOLDER WORKSHOP

PWTC

22nd OCTOBER 2012

-:OVERVIEW OF THE PQ BASELINE STUDY:-

POWER QUALITY BASELINE STUDY FOR PENINSULAR MALAYSIA

Suruhanjaya Tenaga

KeTTHA
KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

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Introduction

Definition of Power Quality

- Power quality or conducted Electromagnetic Compatibility (EMC) is defined by IEC as *"the ability of a device, equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment*." [IEC 61000-1-1]

- In IEC there are two sides to the EMC equation:
  - *Source equipment whose emissions must be limited; and*
  - *Equipment that needs to have sufficient immunity to those disturbances in its environment within which it operates.*

On-going System-Wide Power Quality Projects

- The Power Quality monitoring project in Australia started in 2004 as a pilot project from the University of Wollongong.
- Later on a utility, the Integral Energy, which is major distributor and retailer of electricity in New South Wales, and a retailer in Queensland, contracted the project to its utility wide monitoring system and has supported the project for the last five years and will continue till 2011.
- Much has been learned about power quality by the utility and use to guide Australia in its decision.
- Another nation-wide Power Quality project in New Zealand is started in 2010 for three years period.

Power Quality Project in New Zealand

- The New Zealand project regards that there are two important sides that need to be analyzed which are:

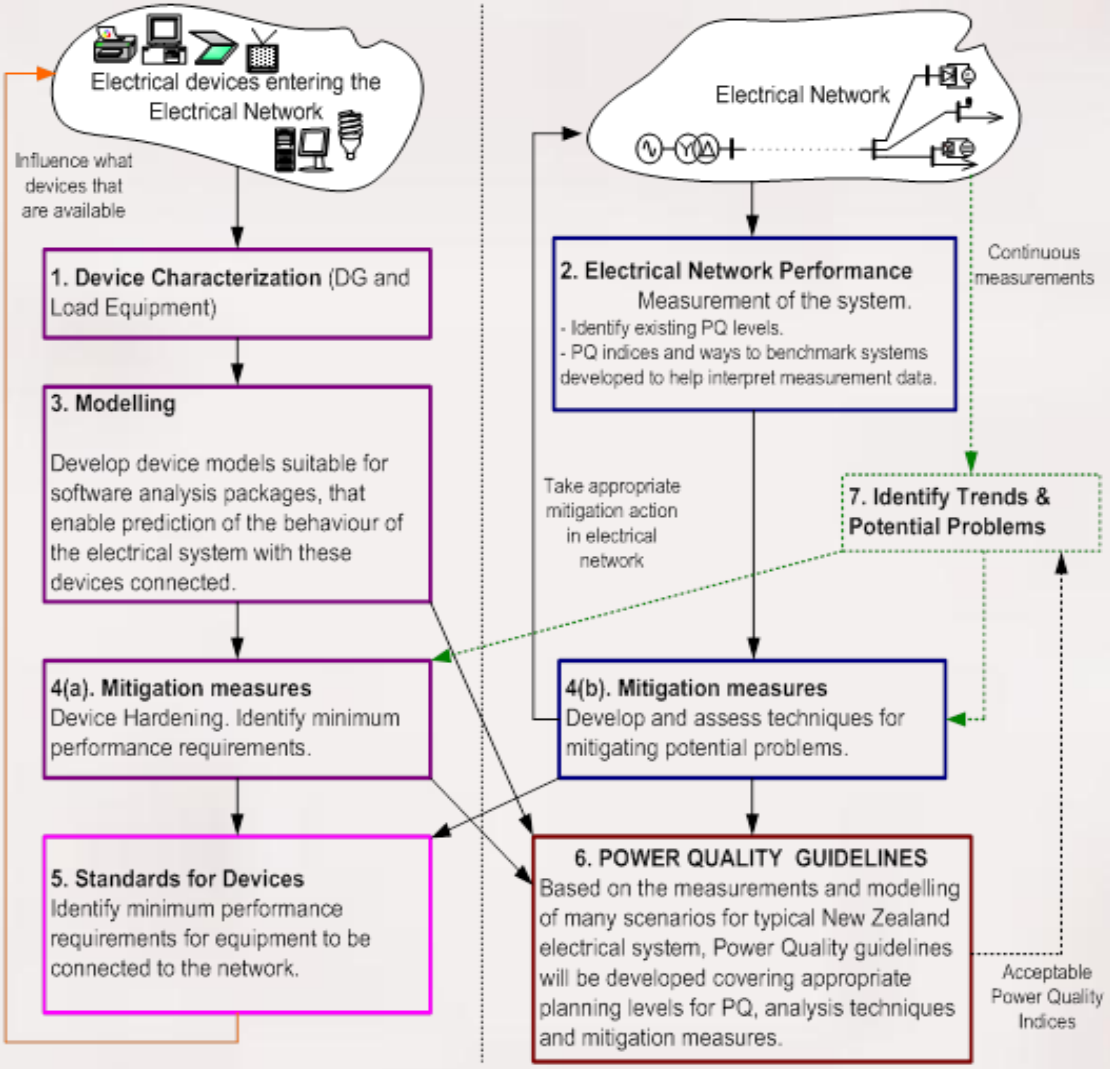
Electrical Device side

The characteristics of the emission and immunity levels of electrical devices.

Electrical Network side

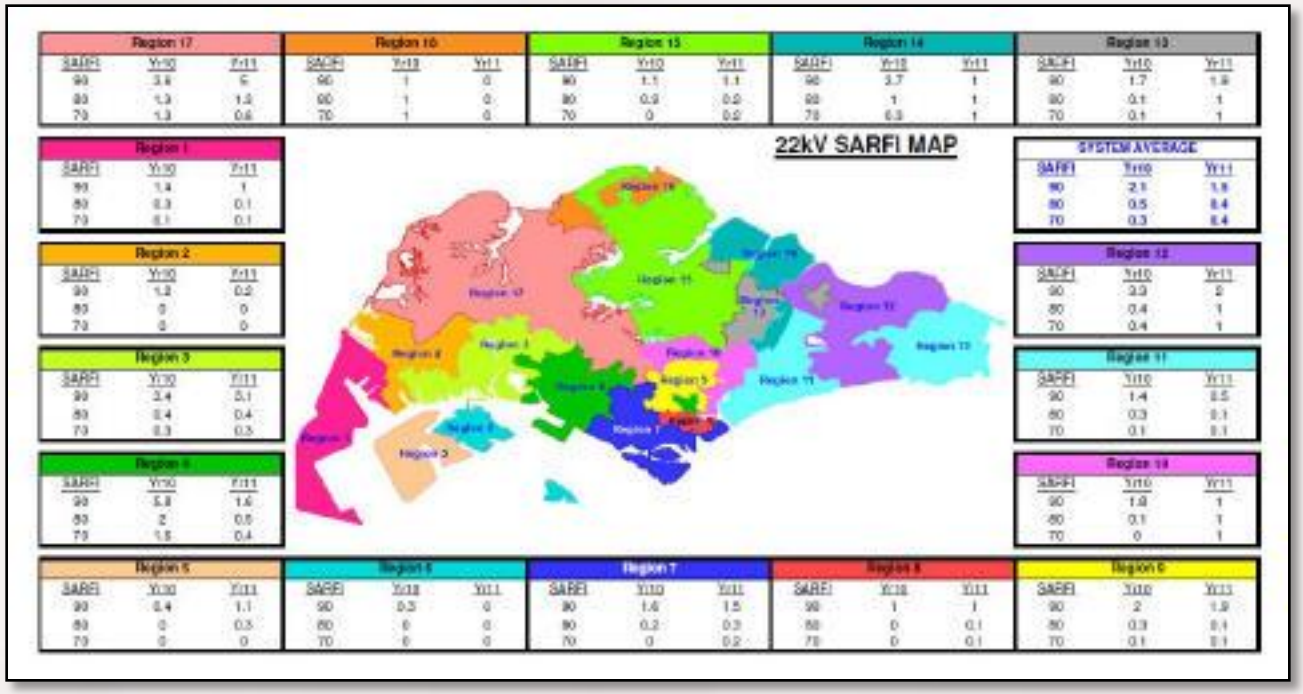
The characteristics of the electrical network need to be determined on the electrical network side.

- After analyzing these two sides, the mitigation techniques can be applied due to the systems compatibility.



Power Quality Project in Singapore

- In Singapore, Singapore_Power publishes a SARFI map on its website.
- The System Average RMS (Variation) Frequency Index, or $SARFI_x$ in short is the number of sags per year a customer on the average would have experienced, with remaining voltage is less than *x* percent of the declared voltage.



SARFI Comparison among Power Utility Companies in Selected Countries in 2010

Power Company	$SARFI_{90}$	$SARFI_{80}$	$SARFI_{70}$
Singapore Power Grid	13.2	10.6	7.8
United State DPQ Project	49.7	27.3	17.7
Europe Mixed System (UNIPEDE)	103.1	0	44
Europe Cable System (UNIPEDE)	34.6	0	11
South Africa NRS-048 Indicate Levels	153	78	47
Tenaga National Berhad	34	21	15

Extracted from Suruhanjaya Tenaga report

Bentong , Malaysia, Year 2011 ITIC = 6 SEMI F47 = 2	11	6	5

Power Quality Baseline Study: Peninsular Malaysia

- The Malaysian Power Quality Baseline Study is almost similar to the Power Quality Project being undertaken in New Zealand.
- One of the deliverables that is not address in New Zealand is the regulatory framework, in other words standards that need to be enforced.
- There is also more emphasis on the economic aspects, in terms of economic losses.
- In Malaysia, the project consultant focused on the following tasks:
  - Analysis of power quality events (ie: voltage sag, harmonics)
  - Power quality survey to analyze the economic losses due to power quality events
  - Determine the suitable mitigations
  - Validation of standards regarding power quality

Comparison to Previous Studies

- TNB and AAIBE has conducted a PQ study in year 2001 and 2002 for Peninsular Malaysia. Internationally many study have been done on Power Quality.
- The present study used the latest and up-to-date standards and better equipment than the study in by TNB and AAIBE in 2002.
- In contrast to the previous study which is strictly from utility perspective, the present study used measurements from customer side of the meter.
- The present study include study on harmonics which was not done in 2002.
- Another important aspect is the estimation of the cost impact to the customer as well for utility and thus by extension to all stakeholders, which has not been done before in Malaysia.
- The present study benchmarks its findings and recommendations against international standards and findings.

Project Objectives

To obtain baseline data on power quality events and sources of events through power quality monitoring programs and ascertain in power quality limits based the results obtain.

To estimate the economic loss to industry due to power quality events.

To validate the international standards applicability to Malaysian Environment.

To determine the suitable period for implementation & enforcement of the regulations and standards.

To determine the standard utility and consumer reference impedance of the Malaysia electricity supply network.

Scope of Consultant Work

- The duration of this project is approximately 30 months
- The study is carried out at sites covering the northern, southern, eastern and central region of Peninsular Malaysia, involving all utilities and customers in the said area.
- 25 Power quality monitors are to be purchased by the Suruhanjaya Tenaga, maintained by its contractor.
- 500 LV sites are to be logged for 24 hours at one minute interval.

Scope of Consultant Work

- In the first year the 25 power quality monitor will be installed at the Northern and Eastern Region and in the second year the 25 Power Quality monitors will be installed in the Central and Southern region.
- The logging sites is 250 in the north and eastern region and 250 for the central and southern region.
- Customer sites are chosen to be logged for 24 hours at one minute interval.
- Logging sites and monitoring sites are to be proposed by the consultants, with consultation with ST and TNB and agreement with the study technical committee.

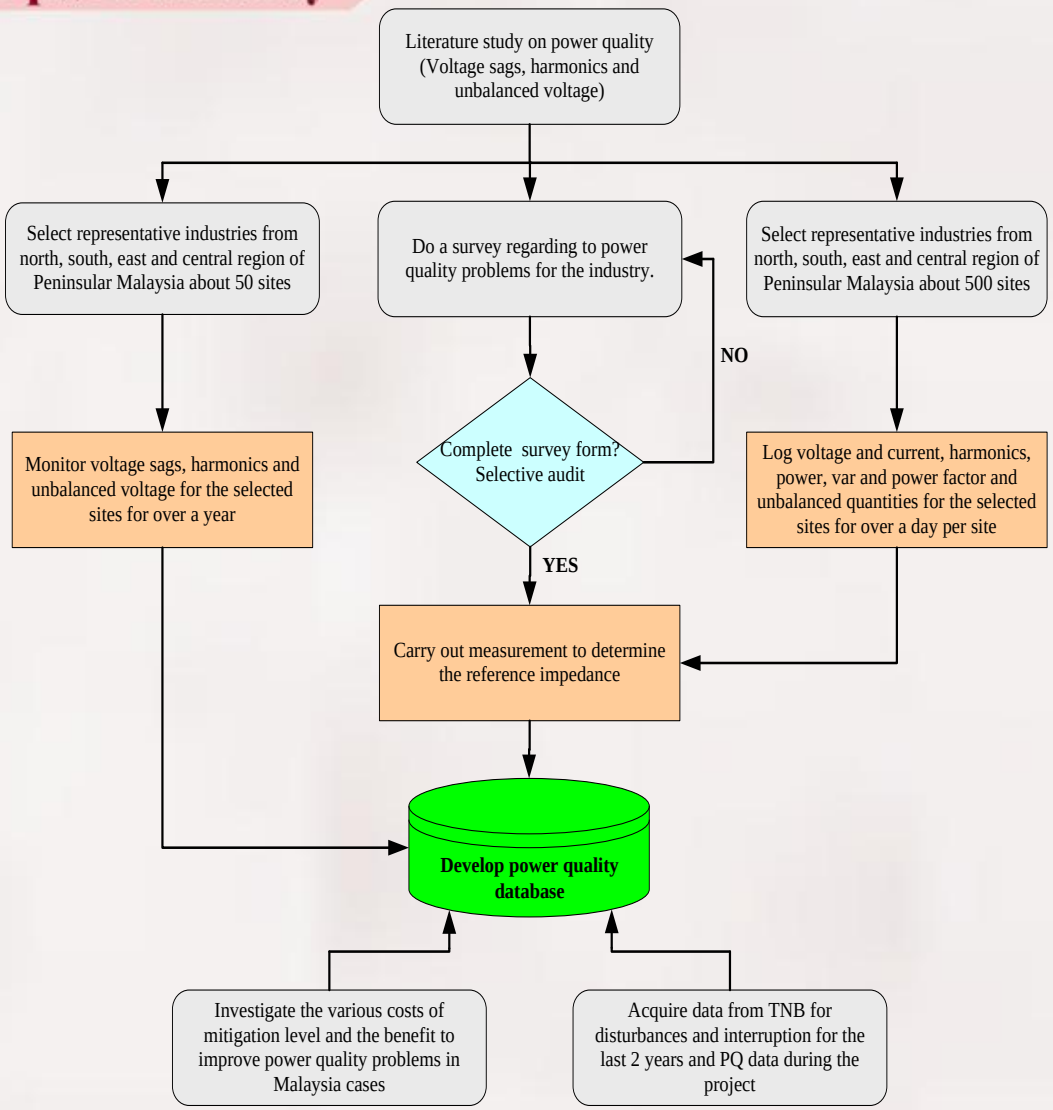
Overall Methodology

- Sites selection is based on proper sampling so that the results are representative of all stakeholders' loads and equipment.
- Customer participation on voluntary basis
- All measurement will use IEC standards equipment with emphasis on safety and accuracy.
- Data collection is through efficient computer network with sufficient backup and redundancy to ensure no corruption or missing data.
- Raw data are archived so that it can be verified independently.

Overall Methodology

- Analysis of data and cost use internationally accepted standards and techniques taken from publication of high international standings. The analysis technique will be transparent such that independent party can repeat the analysis for verification.
- Manufacturers' equipment data will be used in this study.
- Data and results of analysis are benchmarked against international findings to help in verification and validation.
- Recommendation will be based on real data, data analysis, simulation of practical scenarios and feedback from all stakeholders.

Methodology Flow Chart

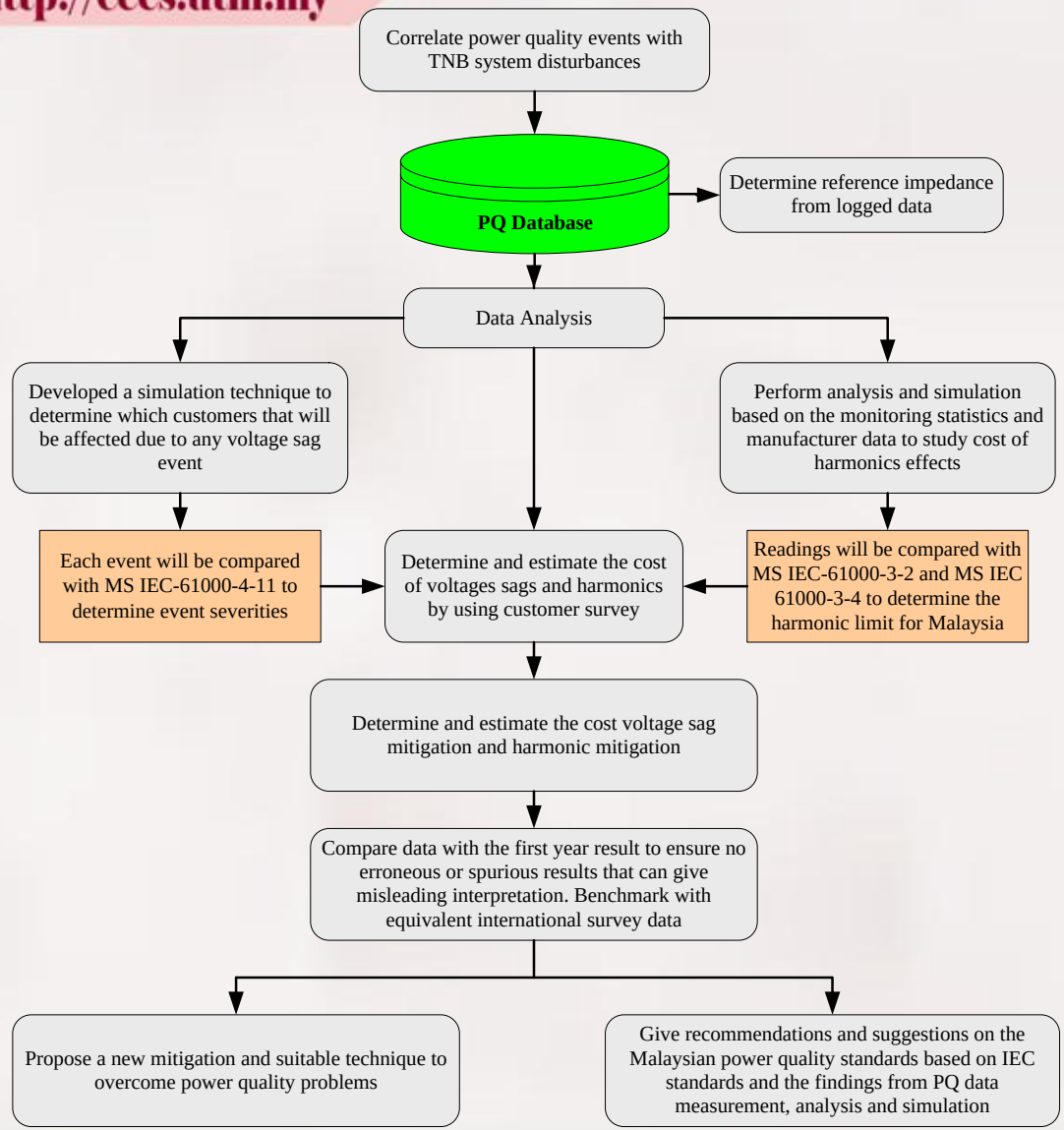


Stage 1: Literature study on power quality.

Stage 2: Selection of industrial site.

Stage 3: Measurement and data collection.

Methodology Flow Chart

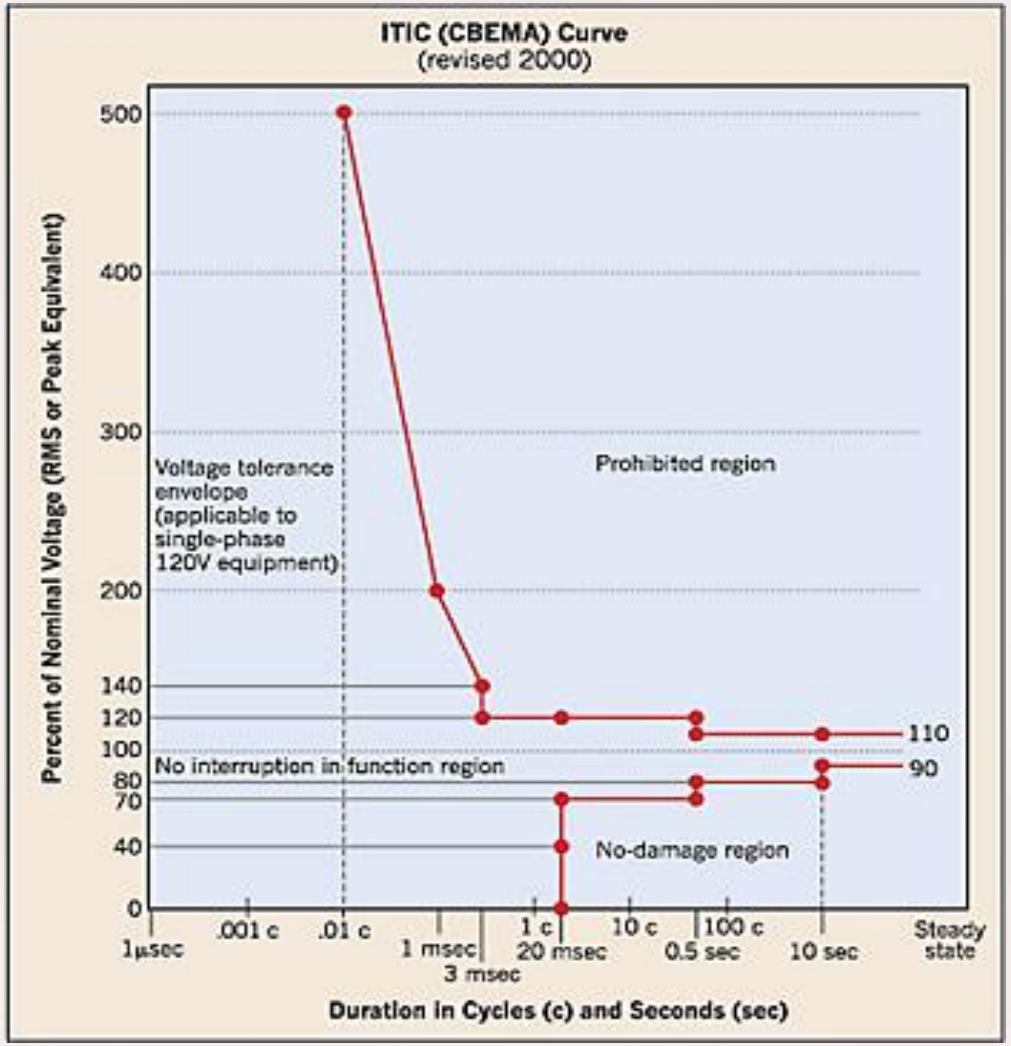


Stage 4: Data analysis.

Stage 5: Evaluation and validation on International and Malaysian Standards on power quality.

Stage 6: Formulation of recommendation

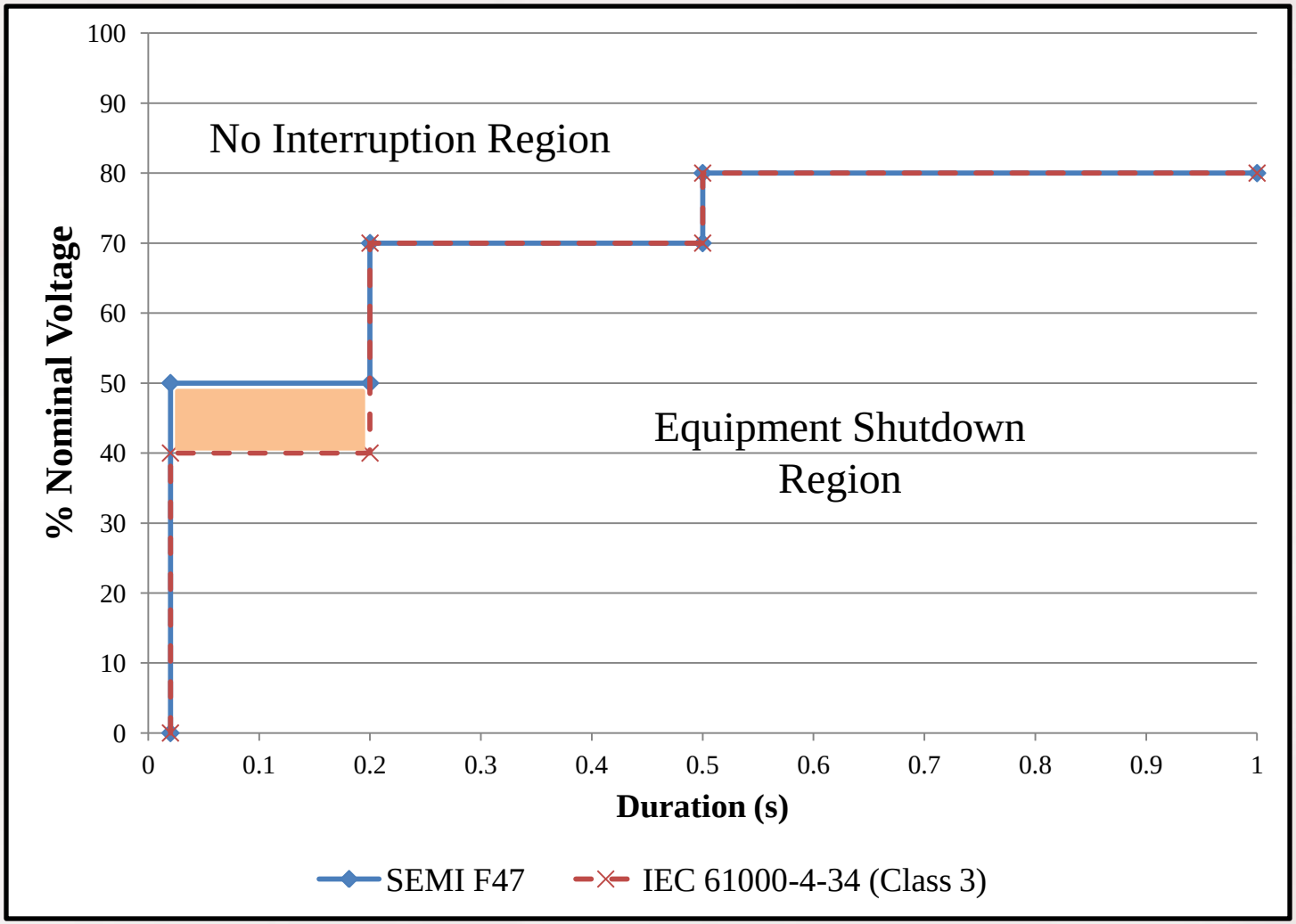
Voltage Sag Standard: ITIC



- The y-axis represents the voltage as a percentage of nominal voltage while the x-axis represents the duration in cycles and seconds.
- This curve contains three regions which are voltage tolerance envelope, prohibited region, and no damage region. In the **voltage tolerance region,** the equipment should operate satisfactorily, while in prohibited region, the equipment might damage.
- **No damage region** means that the equipment might not function without any damage.

Voltage Sag Standard: SEMI-F47

The curve is divided into two regions which are the no interruption region and the equipment shut-down region.



Harmonic Standard: Voltage & Current Harmonic Limits

- According to IEC 61000-3-4, IEC 61000-3-6 and IEEE 519-92, the current and voltage harmonic limits are as follows:

Harmonics	Maximum Permissible Harmonic Current (%)	Maximum Permissible Harmonic Voltage (%)
THD (Total Harmonic Distortion)	16.0	5.0
3rd	21.6	5.0
5th	10.7	6.0
7th	7.2	5.0
9th	3.8	1.5
11th	3.1	3.5

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THANK YOU

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