

# A Review On Power Quality Issues and Standards

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**Abstract** – This Review Paper gives basic idea about power quality, necessity of power quality, evaluation and problems related to power quality. We will focus on issues such as harmonic distortion, short interruption, long interruption, low voltage, voltage sags, Unbalanced Loads, voltage swell, voltage spike, wiring and grounding, Energy wastage on unoccupied space and poor power factor and IEEE standards are mentioned for power quality.

**Keywords:** Disturbances, Energy wastage, Electrical equipment, Harmonic, IEEE Standards, Power quality

## 1. INTRODUCTION

Before we know about power quality audit we must know about what is audit?

*Audit* - The word audit is come from a Latin word "audire" which means "to hear"

*Quality Audit* - Quality audits are performed to verify accordance to standards through review of objective confirmation. A system of quality audits may check the successfulness of a quality management system.

*Power Quality Audit* [2] - in spite of review papers, articles, and books published in the area of electric power quality, its definition has not been universally decided upon. However, everybody accepts that it is a very important aspect of power systems and electric machinery with direct results on efficiency, safety, and reliability. Various sources use the term "power quality" with different aspects. It is used commonly with "supply reliability", "service quality", "voltage quality", "current quality", "quality of supply" and "quality of consumption". Reading all the different definitions, power quality is generally meant to present the quality of voltage and/or the quality of current and can be defined as: the measure, analysis, and improvement of the bus voltage to maintain a sinusoidal waveform at rated voltage and frequency.

## 2. WHY WE NEED POWER QUALITY?

The Main reason that we are interested in power quality is economic value. There are economic effects on utilities, their customers, and suppliers of load equipment. The quality of power can have a direct economic effect on many consumers. This usually means electronically controlled, energy efficient equipment that is often much more sensitive to variation in the supply voltage. Residential customers typically do not suffer direct economic loss or the helplessness to earn income as a result of most power quality problems, but they can be a potent force when they understand that the utility is providing poor service. Many manufacturers are also unaware of the types of disturbances that can happened on power systems. The primary responsibility for correcting shortage in load equipment ultimately lies with the end user who must purchase and operate it. Specifications must include power performance criteria. Since many end users are also unaware of the danger, one useful service that utilities can provide is especially information on power quality and the requirements of load equipment to properly operate in the real world.

## 3. THE POWER QUALITY EVALUATION PROCEDURE [3]

Basic evaluation procedure for the power quality audit. First step is to identify the problem what is the exact problem for ex. Voltage sag, voltage swell, flickering etc. After that list out the problems and arrange into particular list so that we can characterizes what is the root cause of the problem in sense where the problem is being observed. After that only we can list out the solutions regarding to the corresponding problems. Now our task is to choose the solution into the range of the solution which is the best suitable for the problem it considers such aspects such as money, area etc. After selecting suitable solution then and then only we can solve the problem.

Power quality has wide range of problems in different phenomena. For improvement of power quality and equipment performance each phenomenon has range of different causes and individual solutions. Looking forward to

the general steps which are associated with investigating many of these problems, especially if the steps can involve

interaction between the utility supply system and the customer facility.

Some general steps that are often required for the investigation of power quality shows and the major considerations that must be addressed at each step. Measurement will have crucial role for most of power quality concern.

For the evaluation of existing system or segregating the problem, this is the primary method. At the time of measurement, recording of impacts of the power quality variations at the same time so that the problems should be rectified and corrected with possible causes. Considering technical and economical aspect, solutions need to be evaluated using a system perspective. Possible solutions are figured out at all levels of the system from utility supply to the end-use equipment being affected.

Solutions that are not technically possible get thrown out, and the rest of the alternatives are compared on an economic basis. The solution is based on the type of problem, the number of end users being impacted, and the possible solutions. The overall procedure is introduced here to provide a framework for the more detailed technical information and procedures. The relative role of simulations and measurements for evaluating power quality problems is described separately for each type of power quality phenomenon.

#### 4. POWER QUALITY PROBLEMS [4,5]

##### 4.1 Voltage Sag (or dip)

Voltage sag is define as the reduction of rated voltage for short time due to some fault or sudden change in load mainly due to the overload condition.

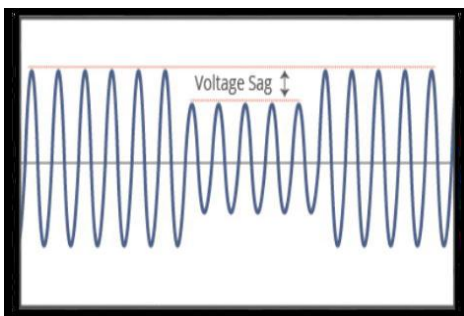


Fig -1: Voltage Sag

##### 4.2 Very Short Interruptions

Very short interruption is define as the absence of electrical power for some millisecond due to the opening of circuit breaker of diesel generator or when the faulty part is disconnected to the healthy part.

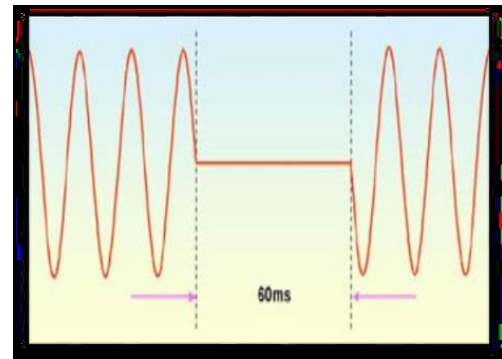


Fig -2: Very Short Interruptions

##### 4.3 Long Interruptions

Long Interruption is define as the absence of electrical power supply for long time due to the equipment failure or due to the insulation failure or due to the fault.

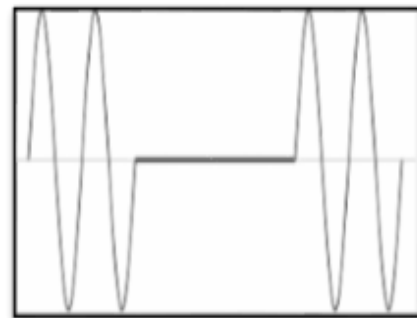


Fig -3: Long Interruption

##### 4.4 Voltage Spike

Voltage Spike is define as the sudden increase in the rated voltage for very short time period due to the lighting stork or due to the impulse.

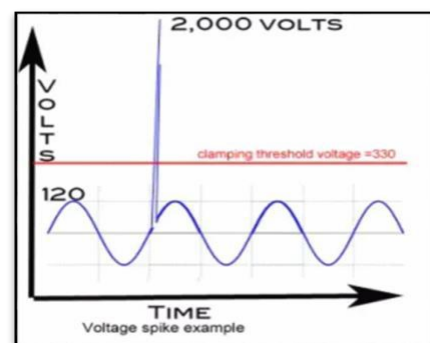


Fig -4: Voltage spike

##### 4.5 Voltage Swell

Voltage swell is define as the increase in the rated voltage due to sudden disconnecting of the load or due to the highly capacitive load.

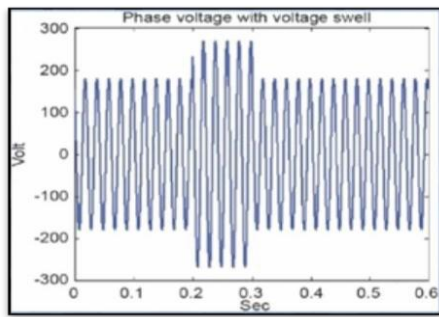


Fig -5: Voltage swell

#### 4.6 Harmonic Distortion [1]

Harmonic distortion is the distorted wave waveform of the normal waveform due to the load. Basically harmonics is the waveform which has the frequency of integral multiple of the fundamental waveform.

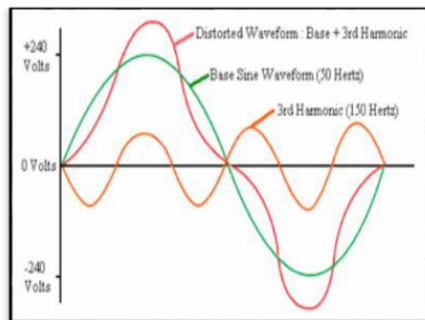


Fig -6: Harmonic Distortion

#### 4.7 Voltage Unbalance

Voltage unbalance is occur when different amount of load is connected on the different phases. Basically it is the voltage variation in three phase system or the phase angel difference.

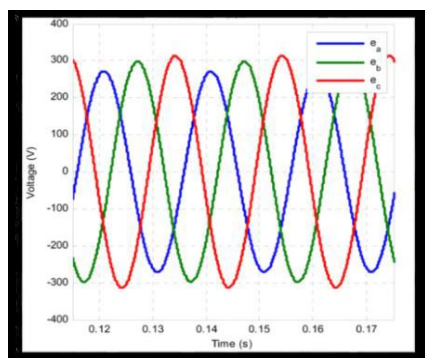


Fig -7: Voltage Unbalance

### 5. IEEE STANDARDS [4]

#### 5.1 519-1992-IEEE

Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems This Standard contains the limit of Current harmonics and the Voltage harmonics for PCC (point of common coupling), Total Harmonic Distortion Limits are tabulated in this standard.

Bus voltage at point of common coupling	Individual voltage distortion (%)	Total harmonic distortion (THD %)
<69kV	3	5
69<161	1.5	2.5
161 above	1	1.5

Table -1: Harmonic voltage distortion limits

$I_{sc}/I_1$	<1 1 <sup>th</sup>	11≤h< 17	17≤h< 23	23≤h< 35	35 ≤h	TD D
<20	4	2	1.5	0.6	0.3	5
20<50	7	3.5	2.5	1	0.5	8
50<100	10	4.5	4	1.5	0.7	12
100<1000	12	5.5	5	2	1	15
>1000	15	7	6	2.5	1.4	20

Table -2: Harmonic current distortion limits

#### 5.2 1100-1992 - IEEE

This standard is for giving power and doing grounding sensitive electronic devices or the equipment it also has recommended design and installation and also it contain maintenance of electronic equipment. In detail process for ground is given in this standard.

#### 5.3 142-2007 - IEEE

This standard is for giving power and doing grounding for the industrial equipment's which has very large rating it also contain some problems related to industrial equipment related to grounding and its solution it's also contain problem related to neutral connection its problems and its solutions its advantages and disadvantages of grounded and

ungrounded conditions. How to connect equipment frames to the ground problem related to bonding is also discussed in this standard.

#### 5.4 141-1993 - IEEE

This standard is for installation of industrial equipment and distribution of industrial plants. Some of the major consideration related to installation and distribution for the industrial plant is given in this standard. This standard is one of the part of color book. Proper guidance for the installation and distribution of industrial plant. It also consist of safety of industrial equipment's and the workers who is working in the industry

#### 5.5 241-1990 - IEEE

This standard is for designing and installation of electrical power system in commercial buildings this book is one of the par of color book it covers the sources, load characteristics wiring system, necessary protection, electrical spacing, coordination of relays etc. It only contains reference but it is very helpful for commercial building. We must follow this stand for commercial buildings.

#### 5.6 C57.110-1986 - IEEE

Recommended Practice for Establishing Transformer Capability When Supplying Non-Sinusoidal Load Currents. The purpose of the Standard is to establish uniform methods for determining the capability of transformers to supply non-sinusoidal load currents, without loss of normal life expectancy. Two methods are described. The first is intended for use by those with access to detailed information on loss density distribution within the transformer windings. The second is less accurate and is intended for use by those with access to transformer certified test report data only. It is anticipated that the first method will be used primarily by transformer design engineers, while the second will be employed primarily by users. This recommended practice will be applicable for evaluating the feasibility of applying non-sinusoidal load

currents to existing transformers and for specifying new transformers to supply non-sinusoidal loads.

#### CONCLUSION

This paper gives a review by analyzing about power quality problems, issues, related IEEE standards. A power quality audit can help determine the causes of your problems and provide a well-designed plan to correct them. The power quality audit checks the facility's wiring and grounding to ensure that it is adequate for your applications and up to code. The auditor normally will check the quality of the ac voltage itself, and consider the impact of the utility's power system. Many businesses and organizations rely on computer systems and other electrical equipment to carry out the mission critical functions, but they aren't safeguarding against the dangers of an unreliable power supply. It is time utilities as well as businesses engage in more proactive approach to power quality treats by engaging in power quality analysis.

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