CHAPTER 2

POWER QUALITY ISSUES, SOLUTIONS AND STANDARDS – A TECHNOLOGY REVIEW

2.1 INTRODUCTION

Power quality is the theory of powering and grounding sensitive equipment that is appropriate for the operation of that equipment. For example, one could infer from this definition that harmonic current distortion is a power quality issue if it affects sensitive equipment. Another limitation of this definition is that the concept cannot be applied anywhere else than towards equipment performance. Angrisani et al.(1998) quality of power is the combination of current quality and voltage quality. Voltage quality is concerned with deviations of actual voltage from the ideal voltage. Current quality is an equivalent definition of the current. The ideal voltage is a sinusoidal voltage waveform with constant amplitude and constant frequency, where both amplitude and frequency equal to their nominal value. Voltage instabilities instigate in the power network and potentially affect the customers, whereas current instabilities start with a consumer and potentially affect the power network.

2.2 POWER QUALITY ISSUES

The sum of the basic analysis of power quality issues originates from voltage frequency variation, voltage magnitude variations; voltage unbalances voltage fluctuations and waveform distortions. Variations in the frequency of the voltage are the first power quality disturbance.
2.2.1 Power Balance and Voltage Frequency Variations

Storage of electrical energy in large amounts for the long period is impossible. Therefore, the generation and conception of electrical energy should be in balance. Any unbalances in generation and production results in a change of energy present in the system. The energy in the system is dominated by the rotating energy $E_{rot}$ of all generators and motors

$$E_{rot} = \frac{1}{2} j \omega^2 \quad (2.1)$$

With $j$ the total moment of inertia of all rotating machines and $\omega$ the angular velocity at which these machines are rotating. An unbalance between generated power $P_g$ and the total consumption and losses $P_c$ causes a change amounting to rotational energy and thus in angular velocity

$$\frac{df}{dt} = \frac{f_0}{2H} (P_g - P_c) \quad (2.2)$$

The amount of inertia is normally quantified through the inertia constant $H$, which is defined as the ratio of the rotational energy at nominal speed $\omega_0$ and a base power $S_b$.

$$H = \frac{1}{2} \frac{J_{\omega_0}^2}{S_b} \quad (2.3)$$

The base power is normally taken as the sum of the (apparent) rated powers of all generators connected to the system, but the mathematics that will follow is independent of the choice of base power. Typical values for the inertia constant of large systems are between 4 and 6 s.
Substituting the equation (2.3) in (2.2), assuming that the frequency remains close to the nominal frequency, and replacing angular velocity by frequency give the following expression:

\[ \frac{df}{dt} = \frac{f_0}{2H} (P_g - P_c) \]  

(2.4)

Where \( P_g \) and \( P_c \) are per unit values on the same base as inertia constant ‘H’.

### 2.2.2 Consequences of Frequency Variations

To retain the steadiness between generation and consumption of electrical energy most large generator units equipped with frequency power control. Maintaining the frequency close to its nominal value is a natural consequence of maintaining the balance between generation and consumption Bollen and styvktakis et al. (2005). The principle of power frequency control is rather simple. The measured frequency is compared to a frequency setting (nominal frequency 50Hz) in most all cases. When the measured frequency is higher than the nominal frequency, this indicates a surplus of rotational energy in the system. To mitigate this, the generator reduces its active power output. More correctly, the mechanical input to the turbine generator is reduced. This leads to a transient to new steady state with a lower amount of electrical energy supplied to the system.

The Figure 2.1 shows that, the input to the speed governor is a corrected power setting (corrected for the deviation of the frequency from its setting). The speed governor is a control system that delivers a signal to the steam valves with a thermal power station to regulate the amount of steam that reaches the turbine. The turbine reacts to this, with a certain delay, by changing the amount of mechanical power. It is sufficient to know that there is a time delay of several seconds (10 s and more for large units) between a
change in the power signal at the input of the governor and an increase in the mechanical power produced by the turbine. Also, note that the speed governor is a controller (its parameters are chosen during the design of the control system) whereas the turbine is a physical system (its parameter cannot be affected).

\[ P = P_{set} - \frac{1}{R} (F-F_{set}) \frac{1}{R} \]  \hspace{1cm} (2.5)

The frequency setting is identical to the nominal frequency of the system and the same for all generators are connected to the systems. In the Nordic system, the frequency should not only be within a certain band but also on average be equal to 50Hz to ensure correct time. When the integrated frequency error exceeds a certain value, the frequency setting of the

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**Figure 2.1 Power frequency control**

Consider a system in a steady state, where the production of the generator equals the input. Where R is referred as the droop setting. The relation is shown in Figure 2.2 When the system frequency drops, the power production increases. This compensates for the source of the frequency fall.
generators is slightly changed. But the setting remains the same for all generators.

![Diagram](image)

**Figure 2.2** Relation between system frequency and Power generated in one unit

### 2.2.3 Voltage Unbalance

The method of symmetrical components is introduced to analyze and quantify the voltage unbalance. The Power system is designed as a voltage source that results in small negative and zero sequence voltage. During severe disturbances in the system, voltage dips, the situation may be different. The negative and zero sequence power flow is from the unbalanced load back to the system. The positive sequence power is the sum of actual energy consumption by the load and the negative and zero sequence power that is re-injected into the system.

### 2.2.4 Origin of Unbalance

Voltage unbalance is due to unbalance in load current and unbalance in the supplying network. The load unbalances partly due to the natural variation between the single phase loads in the three phases and partly
due to large individuals single phase loads. Even if the loads is equally distributed over the three phases, the variations over time of the individual loads mean there is never perfect balance between the load currents. This is mainly an issue in low voltage network. In the medium voltage network and higher, the load is in most cases three phase loads. The load unbalances from lower voltage levels propagates up to higher voltage levels, but as the unbalance is randomly distributed, the various contributions will cancel each other.

Unbalance due to large single phase loads is mainly an issue at higher voltage levels. Next to the voltage unbalance results from a balanced current flowing through unbalancing impedances. Unbalance may also be due to differences between the phases in three phase types of equipment.

2.2.5 Voltage Unbalances and Three Phase Rectifiers

Three phase rectifiers are also sometimes heavily affected by voltage unbalance. This is very much related to nonlinear nature of these devices. The concept of impedances to apply to power electronic converters. The uncontrolled rectifiers are to distinguish between DC current sources where the current on dc side of the rectifier.

2.2.6 Current Unbalance and Losses

Lyon (1920) Current unbalance leads to additional losses in the simple network. In the extreme case where all power is transported only through three phases. The losses are three times as higher as when the power transport is equally distributed over the three phases. An unbalance loads leads to the flow of negative and zero sequence power, back to the system opposite to the flow of positive sequence power. The net power flows to the load, in which the positive sequence power is higher than the useful power.
As a result, positive sequence current is higher than in a balanced situation with the same useful power being delivered.

### 2.2.7 Voltage Sags

A Sag is a decrease between 0.1 and 0.9 PU in RMS value or current at the power frequency for durations from 0.5 cycle to 1 minute. Voltage sags are generally related with system errors but can also be caused by energization of heavyweight loads are starting of large motors. Figure 2.3 shows typical voltage sags that can be associated with the single line to ground fault on another feeder from the same substation and 80% sags about three cycles until the substation breaker can interrupt the fault current.

![Figure 2.3 Voltage sag caused by SLG fault](image)

Fault clearing times varies from 3 to 30 cycles depending on fault current magnitude and type of over current protection. The effect of large motor starting is illustrated in Figure 2.4 an induction motor will draw 6 to 10 times its full capacity current during start up. If the current magnitude is large
about available fault current in the system at that point, the resulting voltage sag can be significant. In this case, the voltage sags to 80% and then gradually return to normal in about 3s. the difference in the time frame between this and sags due to utility system faults.

![Figure 2.4 Temporary Voltage Sag Caused by Motor Starting](image)

Sag duration is subdivided into instantaneous, momentary and temporary which coincides with three categories of interruptions and swells.

### 2.2.8 Voltage Swells

An increase between 1.1 and 1.8 pu in RMS voltage or current at power frequency for the duration of 0.5 cycles to 1 minute is known as voltage swell. As like sags, swells are usually associated with system fault conditions but they are not as common as voltage sags. A swell can occur from the temporary voltage rise on the unfaulted phase during an SLG fault. Figure 2.5 shows a voltage swell caused by an SLG fault. Swells can also be caused by switching of a large load or energizing a large capacitor bank.
2.5 Instantaneous voltage swell caused by SLG Fault

Swells characterize by magnitude and duration. The severity of a voltage swell during the fault condition is a function of the fault location system impedance and grounding near to the substation on a grounded system, there will be slight or no voltage increase on the unfaulted phases because the substation transformer is generally connected delta –wye, providing a low impedance zero sequence path for the fault current. Faults at different points along four wires, multi-grounded feeders will have varying degrees of voltage swells on the unfaulted phases.

2.2.9 Waveform Distortion

A steady state deviation from an ideal sine waveform of power frequency principally characterized by the spectral content of the deviation is known as waveform distortion.

2.2.10 Harmonics

Harmonics are sinusoidal voltages or currents having frequencies that are an numerical multiple of the frequency at which the supply system is considered to operate harmonic distortion initiates in the nonlinear
characteristics of loads and devices on the power system. Harmonic distortions are described by the complete harmonic spectrum with magnitude and phase angles of each individuals harmonic components. The Total Harmonic Distortions (THD) values for the input current when operating at very light loads, it will exhibit high THD values.

2.2.11 Inter Harmonics

Voltages or currents having frequency components that are integer multiples of the frequency at which the supply system is designed to operate (50Hz) are called inter-harmonics. Inter harmonics can be found networks of all voltage classes. The main source of Inter harmonics waveform distortions of static frequency converters, cycloconverters, induction furnaces and arcing devices. Interharmonics can be considered as Power line carrier signals. The result of frequency conversion is not constant it varies with load. Such Interharmonics currents can excite severe resonances on power system as the varying Interharmonics frequency becomes coincident with natural frequencies of the system.

2.3 CONFIGURATION OF ACTIVE POWER FILTERS

APF’s can be classified based on topology, number of phases and converter types.

Two type of converter types mainly:

- Voltage source inverter (VSI)
- Current source inverter (CSI)

The active power filter topology is classified into three types.

- Series active power filters
Shunt active power filters
Hybrid active power filters

Finally based on the phases there are two types of APF.

- Two wire (single phase) system.
- Three or four wire three phase system.

2.4 VOLTAGE SOURCE INVERTER (VSI)

In voltage source inverter (VSI), the dc voltage constantly has one polarity, and the power problem takes place through reversal of DC current polarity. For performance reasons, VSI's are frequently preferred over current source inverter (CSI) for flexible AC transmission (FACTS). Meanwhile the direct current in a VSI flows in both direction, the Converter valves have to be bidirectional, and then the dc voltage doesn't inverse, the turn off device which are not needed to have reverse voltage capability. IGBTs, MOSFETs, etc. may have a parallel reverse diode built in as a part of the whole integrated device suitable for voltage source inverter. Figure 2.6 Topology of the VSI.

On the dc side, voltage is unipolar and is supported by the capacitor.

![Figure 2.6 Basic topology of Voltage source inverter](image-url)
This capacitor is huge enough to however handle a sustained charge or discharge current that go along with the switching structure of the converter valves and shifts in phase angle of the switching valves without significant variation in the dc voltage.

2.5 CURRENT SOURCE INVERTER (CSI)

A current sourced inverter (CSI) is considered by the fact that the DC current flow is constantly in one direction and the power flow contraries with the reversal of DC voltage. There are three types of CSI i.e. Diode inverter, Line-commutated inverter, Self-commutated inverter. For flexible AC transmission (FACTS) application self-commutated inverter is preferred, and mostly it is based on turn off devices (MOSFET, IGBT, etc.), where commutation of current from valve to valve takes place with the device turn-off action and providing of AC capacitors, to ease transfer of current from valve to valve. However, in a voltage sourced converter the commutation of current is supported by a stiff dc bus with a dc capacitor. Figure 2.7 shows the topology of CSI.

![Figure 2.7 Basic Topology of Current Source Inverter](image)
2.6 SHUNT ACTIVE POWER FILTERS

The shunt active filter method is produced on the principle of injection of harmonic currents into the AC system, of the similar amplitude but conflicting in phase to that of the load harmonic currents. Figure 2.8 shows the active power filter compensation principle, which is controlled in a closed loop manner to shape actively the source current into sinusoid.

2.7 SERIES ACTIVE POWER FILTERS

In series active filter configuration, a voltage source is created in such a way that as soon as its voltage is added to the load voltage, the distorted voltage is cancelled, therefore resulting in a sinusoidal voltage at the Point of Common Coupling (PCC). Figure 2.8 shows the series active filter compensation principle.

![Figure 2.8 Series connected active filter](image)

For harmonic compensation, shunt and series active filters both have lesser ratings than the apparent power of the load. The shunt active filter is used for supply voltage, then a reduced current. In the case of dynamic series filters, the rated load current passes through the filter but the rated voltage is again lower are shown in Figure 2.9. Therefore, harmonic
minimization can be implemented with converters having a reduced power rating.

Figure 2.9 Principle of Shunt Connected Active Filters

2.8 HYBRID ACTIVE FILTERS

Hybrid structures were recommended for harmonic compensation of huge rated loads in high voltage networks. By using hybrid active filter configuration passive and active filters are combined. These filters increase the compensation features of the passive filters and therefore realize a decrease in the rating of the active filter. They are mostly suited in installations wherever LC tuned passive filters already exist.

In the hybrid series configuration, the series voltage injection is to be considered as an isolator, both defining the harmonic currents to be provided to the non-linear load or the harmonic currents that will be absorbed by the tuned LC filters. Figure 2.10 and Figure 2.11 show two hybrid active filter configuration, series, and shunt. In the first case, the injected voltage is in series, Figure 2.10, and in the second case it is in series with the shunt passive filter Figure 2.11.
2.8.1 Active Filter Topologies

There are two types of power circuits for the active filters as shown in Figure 2.10, current and voltage source types. The voltage type inverter uses a capacitor with a regulated dc voltage, Figure 2.12(a) while the current-type approach uses a reactor supplied with a regulated DC current, Figure 2.12(b). One of the main advantages of voltage type converters is that they are easily expandable and are less expensive than current type converters.
Some actions have been taken to regulate the minimum PQ level that utilities have to afford to consumers and the resistance level that equipment should have to operate accurately when the power supplied is within the standards. Standardization organizations like IEC, CENELEC, and IEEE have established a set of standards with the same purposes. In Europe, the most relevant standards in PQ are the EN 50160 (by CENELEC) and IEC
IEEE Power Quality Standards do not have such a organized and complete set as compared to IEC. However, the IEEE standards give additional practical and certain theoretical background on the phenomena, which makes it a very useful reference. Some of the IEEE power quality standards are described in the ensuing sections.

### 2.9.1 IEEE 519

Power system troubles that were related with harmonics began to be of overall concern in the 1970s, when two independent developments took place. The main was the oil restriction, which led to price escalations in electricity and the move to save energy. Industrial consumers and utilities started to apply power factor improvement capacitors. The move to power factor improvement resulted in a significant increase in the number of capacitors connected to power systems. American standards regarding harmonics have been laid out by the IEEE in the 519 Standard: IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems. There is a collective result of all nonlinear loads on utility systems that have a limited capability to absorb harmonic current. Additional, utilities are charged with the responsibility to deliver a high quality supply in terms of voltage level and waveform. IEEE 519 recognizes not only the absolute level of harmonics produced by an individual source but also their size relative to the supply network. It should be noted that IEEE 519 is limited to existence a collection of Recommended Practices that help as a guide to both suppliers and consumers of electrical energy. Where problems happen, because of excessive harmonic current injection or excessive voltage distortion, it is obligatory upon supplier and consumer to resolve the issues within a commonly acceptable framework.
2.9.2 IEEE 519 Standard for Harmonic Voltage Limits

According to IEEE 519, Table 2.1 shows that, harmonic voltage distortion on power system 69 kV and below is limited to 5% Total Harmonic Distortion with each individual harmonic limited 3%.

Table 2.1. Harmonic Voltage Distortion Limits

<table>
<thead>
<tr>
<th>Bus Voltage at Point of Common Coupling</th>
<th>Individual Voltage Distortion (%)</th>
<th>Total Harmonic Distortion (THD %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 69 kV</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>69 &lt; 161</td>
<td>1.5</td>
<td>2.5</td>
</tr>
<tr>
<td>161 above</td>
<td>1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

2.9.3 IEEE 519 Standard for Harmonic Current Limits

General Distribution Systems [GDS 120V- 69,000V]: Current distortion confines for odd harmonics. Even harmonics are limited to 25% of the odd Harmonic limits. For all power generation equipment, distortion limits are those with \( \frac{I_{SC}}{I_L} < 20 \). \( I_{SC} \) is the maximum short circuit current at the point of coupling “PCC”. \( I_L \) is the maximum fundamental frequency 15 or 30 minutes load current at PCC. TDD is the Total Demand Distortion (=THD normalized by \( I_L \)) are shown in Table 2.2

General Sub-Transmission Systems [GSTS 69 kV-161 kV]: The current harmonic distortion restrictions apply to limits of harmonics that loads must draw from the utility at the PCC. Note that the harmonic limits differ based on the \( \frac{I_{SC}}{I_L} \) rating, where \( I_{SC} \) is the maximum short circuit current at the PCC, and \( I \) is the maximum demand load current at the PCC.
Table 2.2 Harmonic Current Distortion Limits

<table>
<thead>
<tr>
<th>( I_{sc} / I_1 )</th>
<th>( H &lt; 11 )</th>
<th>( 11 \leq h &lt; 17 )</th>
<th>( 17 \leq h &lt; 23 )</th>
<th>( 23 \leq h &lt; 35 )</th>
<th>( 35 \leq h )</th>
<th>TDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>4</td>
<td>2</td>
<td>1.5</td>
<td>.6</td>
<td>.3</td>
<td>5</td>
</tr>
<tr>
<td>20 ≤ 50</td>
<td>7</td>
<td>3.5</td>
<td>2.5</td>
<td>1</td>
<td>.5</td>
<td>8</td>
</tr>
<tr>
<td>50 &lt; 100</td>
<td>10</td>
<td>4.5</td>
<td>4</td>
<td>1.5</td>
<td>.7</td>
<td>12</td>
</tr>
<tr>
<td>100 &lt; 1000</td>
<td>12</td>
<td>5.5</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>&gt; 1000</td>
<td>15</td>
<td>7</td>
<td>6</td>
<td>2.5</td>
<td>1.4</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 2.3 Maximum Harmonic Current Distortion level

<table>
<thead>
<tr>
<th>( I_{sc} / I_L )</th>
<th>( H &lt; 11 )</th>
<th>( 11 \leq h &lt; 17 )</th>
<th>( 17 \leq h &lt; 23 )</th>
<th>( 23 \leq h &lt; 25 )</th>
<th>( h &gt; 35 )</th>
<th>TDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50</td>
<td>2</td>
<td>1</td>
<td>.75</td>
<td>.3</td>
<td>.15</td>
<td>2.5</td>
</tr>
<tr>
<td>&gt; 50</td>
<td>3</td>
<td>1.5</td>
<td>1.15</td>
<td>.45</td>
<td>.22</td>
<td>3.75</td>
</tr>
</tbody>
</table>

\( I_{sc} \) is the existing short circuit current at the point of common coupling. The \( I_{sc} \) is determined by the size, impedance, and voltage of the service feeding the PCC. \( I_L \) is the maximum demand load current (fundamental frequency component) measured at the PCC are shown in Table 2.3. It is proposed that present facilities measure this over a period of time and average it. The point of common coupling with the consumer/utility interface is the closest point on the utility side of the customer service where another utility service customer is or could be supplied. The ownership of any apparatus for instance a transformer that the utility might provide in the customers system is immaterial to the definition of PCC. This definition has been approved by IEEE working group.
2.9.4 IEEE Standard 142-1991, Recommended Practice for Grounding of Industrial and Commercial Power Systems

This standard provides a thorough investigation of the problems of grounding and the methods for solving these problems. Separate chapter which explains about grounding sensitive equipment.

2.9.5 IEEE Standard 446-1987, Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications

This standard is proposed engineering practices for the selection and application of emergency and standby power systems. It provides facility designers, operators and owners with procedures for guaranteeing uninterrupted power, voltage dips, surges, and transients and virtually free of frequency excursions.

2.9.6 IEEE Standard 1100-1999, Recommended Practice for Powering and Grounding Sensitive Electronic Equipment

Recommended design is installation, and maintenance practices for electrical power and grounding (including both power-related and signal-related noise control) of sensitive electronic processing equipment used in commercial and industrial applications.


A standard methodology for the financial and technical analysis of voltage sag compatibility between electric power systems and process
equipment is recommended. The method presented is intended to be used as a planning tool to quantify the voltage sag environment and process sensitivity.

2.9.8 IEEE Standards Related to Voltage Sag and Reliability

The distribution voltage quality standard i.e. IEEE Standard P1564 provides the recommended guides and procedures for describing voltage sag performance and relating performance across different systems. A new IEC Standard 61000-2-8 titled “Environment —Voltage Dips and Short Interruptions” has come recently. This standard warrants considerable discussion within the IEEE to avoid conflicting methods of characterizing system performance in different parts of the world.

2.9.9 IEEE Standards Related to Flicker

Developments in voltage flicker standards determine how the industry can effectively coordinate IEEE and IEC activities. IEC Standard 61000-4-15 describes the measurement procedure and monitor requirements for characterizing flicker. The IEEE flicker task force functioning on Standard P1453 is set to adopt the IEC standard as its own.

2.9.10 Standards Related to Custom Power

IEEE Standard P1409 is presently developing an application guide for custom power technologies to make enhanced power quality on the distribution system. This is a vital area for many utilities that may need to offer enhanced power quality services.
2.9.11 Standards Related to Distributed Generation

The new IEEE Standard P1547 provides guidelines for interconnecting distributed generation with the power system.


This standard identifies the design requirements for new and/or modified Class 1E control boards, panels, and racks and establishes the systems to verify that these requirements have been fulfilled. Methods for meeting the separation criteria contained in IEEE Std 384 are addressed. Qualification is also incorporated to address the overall requirements of IEEE Std 323 and recommendations of IEEE Std 344.


The independent requirements of the circuits and equipment containing or associated with Class 1E systems are defined. Criteria for the independence that can be attained by physical separation and electrical isolation of circuits and equipment that are redundant are set forth. The determination of what is to be considered redundant is not addressed.


Requirements and Practices for semiconductor power rectifier transformers for dedicated loads rated single-phase 300 kW and above and
three phase 500 kW and above are included. Static precipitators, high voltage converters for DC power transmission, and other nonlinear loads are excluded. Service conditions, both usual and unusual, are identified, or other standards are referenced as suitable. Routine tests are specified. An informative annex offers several instances of load loss calculations for transformers after subjected to nonsinusoidal currents, based on calculations provided in the standard.


All oil-immersed or dry-type, single-phase or three phase, outdoor or indoor shunt reactors rated over 500 kVA are covered. The general requirements and terminology are stated, and the basis for rating shunt reactors is set forth. Design, routine and other tests are defined, and procedures for performing them are given. Temperature rise, dielectric test, losses and impedance and insulation levels are covered. Construction requirements for oil-immersed reactors and installation requirements for dry-type reactors are presented.

2.10 SUMMARY

This Chapter gives a comprehensive review by critically analysing about the power quality problems, issues, related international standards, and the solutions. The correct solutions were also discussed which could be the remedy for power quality problems generated in different phenomena. Synchronisation with existing industry practices and international harmonic standards is as well considered in this chapter. To overcome the negative impact of poor quality of power on equipment and businesses, suitable power
quality equipment is invested. Finding the right solution remains the first step. Many power quality problems are easily recognized once a good description of the problems is obtained. Unfortunately, the tensions caused by power problems repeatedly result in vague or excessive descriptions of the problem.

A power quality audit can help to determine the causes of the 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 the 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 depend on computer systems and additional 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.