Power Quality Issues, Problems solution for Indian transmission system

Nilesh r. budukhale
nileshbudukhale@gnmail.com

Abstract

PQ is an important for ideal transmission system .reliability and continuously of electricity supply is the most important for consumer satisfaction also the activities of industrial and service companies. poor power quality include interruptions, dips or swell transient . therefore the loads connected to a network with such problems will fail, have a short lifetime and low efficiency *power quality is one of the major concerns* now present and future scope all the electrical equipment is affected by power quality problems quality issues depending on the severity of problems. this paper reviewed the power quality problems, effect of power quality problems and methods to improve the power quality problems. Key words- IEEE 519, Power quality problem.voltagesag ,harmonic,intruptionStandards

Introduction

In modern power system there is need of power is increasing due to increasing power demand of consumer Power systems, there is increase demand so we need to increase generatioin of power but there is problem of quality .consumer need rekliable power with uninterrupted power supply at smoothsinusoidal voltage However, in practice, power systems,especially the distribution systems, have numerous nonlinearloads, affect the quality of power supplies and the stability of system is lost.Apart from nonlinear loads, some system events, both usual capacitor switching, motor startingFaults could also inflict power quality (PQ) problems As the power quality problem majorly occure in distribution system eg, Voltage sags and harmonics.swell,fluctuation transient, unbalance,intruptionetc.Power quality defined as provision of voltages andsystem design so that consumer of electric power can utilized electric energy from the distribution system without interruption. This paper discusses about the power quality problems, issues and causes and its methods of improvement, knowledge of harmonics. Power quality standards are defined in the IEEE, IEC,CENELEC, ANSI, and NER. The most universally

accepted standards for power quality are IEC and IEEEstandard .The voltage sag/swell magnitude is ranged from 10% to 90% of nominal voltage and with duration from half a cycle to 1 min.Voltage sag is causedby a fault in the utility system, a fault within thecustomer's facility or a large increase of the load current. Voltage sags are one of the most occurringpower quality problems. For an industry voltage sagsoccur more often and cause severe problems andeconomical losses. Utilities often focus ondisturbances from end-user equipment as the mainpower quality problems. Harmonic currents in distribution system cancause harmonic distortion, low power factor andadditional losses as well as heating in the electrical equipment. It also can cause vibration and noise.

POWER QUALITY

Institute of Electrical and Electronic Engineers (IEEE)Standard IEEE1100 defines power quality as "the concept ofpowering and grounding sensitive electronic equipment in manner suitable for the equipment"[4].The performance ofelectronic devices is related to the power quality .power quality disturbance canbe defined as the deviation of the voltage and the current from its ideal waveform. Power is simply the flow power and the current demanded by a load/ utility due to Faults in the transmission ,distribution system may cause voltage sag or swell in the entire systemVoltage sag and swell can cause sensitive equipmentto fail, shutdown and create a large current unbalance. Theseeffects cause equipment damage. So that to provideuninterrupted power supply to consumer accoarding to requirement wihout damage the equipment quality improvement is necessary Electrically operated affected by Power Quality

POWER QUALITY STANDARDS

Power quality is a worldwide issue, and keeping related standards current is a never-ending task Most of the ongoing work by the IEEE in harmonic standards development has shifted to modifying Standard 519-1992.

A. IEEE 519

IEEE 519-1992, Recommended Practices and Requirements for Harmonic Control in Electric PowerSystems, established limits on harmonic currents and voltages at the point of common coupling (PCC), orpoint of metering [1,18].

The limits of IEEE 519 are intended to:

1) Assure that the electric utility can deliver relatively clean power to all of its customers;

2) Assure that the electric utility can protect its electrical equipment from overheating, loss of life from excessive harmonic currents, and excessive voltage stress due to excessive harmonic voltage. Eachpoint from IEEE 519 lists the limits for harmonic distortion at the point of common coupling (PCC) ormetering point with the utility. The voltage distortion limits are 3% for individual harmonics and 5%THD.

All of the harmonic limits in IEEE 519 are based on a customer load mix and location on the power system. The limits are not applied to particular equipment.

B.IEC 61000-3-2 and IEC 61000-3-4 (formerly 1000-3-2 and 1000-3-4) specifies limits for harmonic current emissions applicable to electrical and electronic equipmenthaving an input current up to and including 16 A per phase, and beyond 16 A respectively.

C.***IEEE Standard 142-1991*** presents a thorough investigation of the problems of grounding and the methods for solving these problems.

D.***IEEE Standard 446-1987*** provides guidelines for theselection and application of emergency and standby powersystems.

E.***IEEE Standard 493-1997*** provides guidelines forplanning and design of industrial and commercial electricpower distribution systems.

F.***IEEE Standard 1100-1999 provides information about***design, installation, and maintenance practices for electrical power and grounding of sensitive electronic processing equipment used in commercial andindustrial applications.

G.***IEEE Standard 1250-1995 provides guidance against***momentary voltage disturbances occurring in ac powerdistribution and utilization systems, their potential effectson this new, sensitive, user equipment.

Power Quality Problems & Issues:

all PowerQuality problems are related to grounding, Various power quality problems, causes and their effects There are several effect power quality problems due towhich an electrical machinery fail or not operate safely and also effect on sensitiveequipment.there are some problem discuss below

1.Voltage Sags:. Sag is defined as the variation of RMS voltage from its normal value for a time greater than 0.5 cycles of the power frequency.

Short duration variation is caused by fault conditions, Short duration under-voltages are called "Voltage Sags" or "Voltage Dips [IEC]". Voltage sag [5, 6] is a reduction in thesupply voltage magnitude followed by a voltage recovery after a short period of time. The major cause of voltage dips on asupply system is a fault on the system, i.e. sufficiently remote electrically that a voltage interruption does not occur. Othersources are the starting of large loads and, occasionally, the supply of large inductive loads [6]. The impact on consumers may range from the annoying to the serious tripping of sensitive loads and stalling of motors.

2.Voltage surges:

Voltage surges/spikes are the opposite of dips – a rise that may be nearly instantaneous (spike) or takes place over a longerduration (surge). A voltage surge takes place when the voltage is 110% or more above normal. The most common cause is heavy electrical equipment being turned off. Under these conditions, computer systems and other high tech equipment canexperience flickering lights, equipment shut down, errors , Possible Solutions are surge suppressors, voltageregulators, uninterruptable power supplies, power conditioners[4].

3.Voltage fluctuation:

Oscillation of voltage value, amplitude modulated by a signal with frequency of 0 to 30 Hz. Causes are arc furnaces, frequentstart/stop of electric motors oscillating loads. The most perceptible consequence is the flickering of lighting and screens, giving the impression ofunsteadiness of visual perception [1].

4.Voltage Unbalance:

A voltage variation in a three-phase system in which the three voltage magnitudes or the phase angle differences betweenthem are not equal. Causes are large single-phase loads (induction furnaces, traction loads), incorrect distribution of allsingle-phase loads by the three phases of the system (this may be also due to a fault). Consequences are Unbalancedsystems imply the existence of a negative sequence that is harmful to all three phase loads. The most affected loads are three-phase induction machines [13].

5.Very short interruptions:

Total interruption of electrical supply for duration from few milliseconds to one or two seconds. Mainly due to the openingand automatic reclosure of protection devices to decommission a faulty section of the network. The main fault causes are insulation failure, lightning and insulator flashover. Consequences of these interruptions are tripping of protection devices,loss of information and malfunction of data processing equipment [11].

6.Long interruptions: Long interruption of electrical supply for duration greater than 1 to 2 seconds. The main fault causes are Equipment fail in the power system network.A consequence of these interruptions is stoppage of all equipment [1].

7. Voltage swell: Momentary increase of the voltage, at the power frequency, outside the normal tolerances, with duration of more than one cycle and typically less than a few seconds. The main causes are Start/stop of heavy loads, badly dimensioned power sources, also is data loss, flickering of lighting.damage of sensitive equipment, if the voltage values are too high [11].

8.Harmonicdistortion:Voltage or current waveforms assume non-sinusoidal shape. The waveform corresponds to the sum of different sine-waveswith different magnitude and phase, having frequencies that are multiples of power-system frequency. all non-linear loads, such as power electronicsequipment including ASDs, switched mode power supplies, data processing equipment, high efficiency lighting [11].Consequences are increased probability in occurrence of resonance, neutral overload in 3-phase systems, overheating of allcables and equipment, loss of efficiency in electric machines, electromagnetic interference with communication systems.

POWER QUALITY Improvement Method

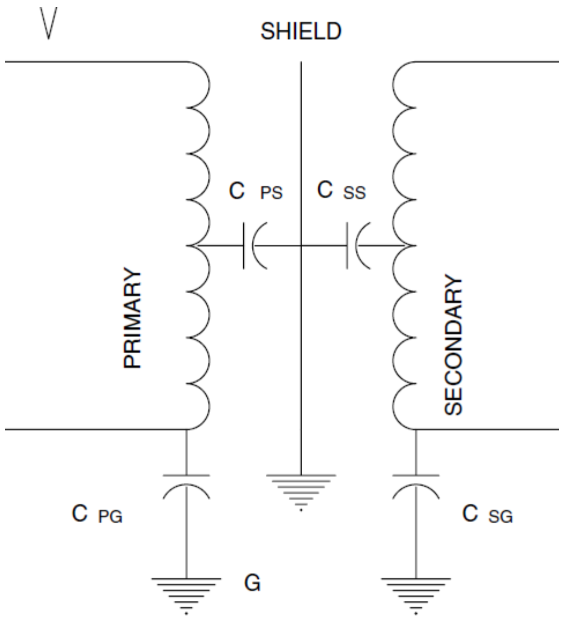
Several types of powerimproving devices have been developed over the years to protect equipment from powerdisturbances. The following devices play a crucial role in developing an effective power quality strategy[14].

1.Noise Filters: Noise filters are used to block unwanted frequency current or voltage signals (noise) from reaching sensitive equipment.

This can be accomplished by using a combination of capacitors and inductances that creates a low impedance path to thefundamental frequency and high impedance to higher.Proper designing of the Load equipment.

Harmonic Filters :Harmonic filters are used to reduce undesirable harmonics. They can be divided in two groups: passive filters and active filters. Passive filters consist in a low impedance path to the frequencies of the harmonics to be attenuated using passivecomponents Several passive filters connected in parallel may be necessary to eliminateseveral harmonic components. If the system varies (change of harmonic components), passive filters may become ineffective and cause resonance. Active filters analyze the current consumed by the load and create a current that cancel theharmonic current generated by the loads. Active filters were expensive in the past

2. Isolation Transformers



Isolation transformers are used to isolate sensitive loads from transients and noise deriving from the mains. In some cases(Delta-Wye connection) isolation transformers keep harmonic currents generated by loads from getting upstream the transformer. The particularity of isolation transformers is a grounded shield made of nonmagnetic foil located between theprimary and the secondarywinding noise or transient that come from the source in transmitted through the capacitancebetween the primary side and the shield and on to the ground and does not reach the load. It provides a degree of filteringThese devices effectively reduce noise.Isolation transformers reduce normal and common mode noises, however, they do notcompensate for voltage fluctuations [16].

3. Voltage Regulators :Voltage regulators maintain output voltage at nominal voltage under all but the most severe input voltage variations.

Voltage regulators are normally installed where the input voltage fluctuates, but total loss of power is uncommon. There arethree basic types of regulators:

A.Tap Changers: Designed to adjust for varying input voltages by automatically transferring taps on a powertransformer. The main advantage of tap changes over other voltage regulation technology is high efficiency,good noise isolation. Disadvantages are noise createdwhen changing taps and no waveform correction..

B.Constant Voltage Transformer (CVT): Also known as ferroresonant transformers. The CVT is a completely staticregulator that maintains a nearly constant output voltage during large variations in input voltage. Advantages are superior

noise isolation, very precise output voltage and current limiting for overload protection. The lack of moving parts mean the
transformer requires little or no maintenance. Disadvantages are large size, audible noise and low efficiency.Constant voltage transformers (CVT) were one of the first PQ solutions used to mitigate the effects of voltage sags and
transients. To maintain the voltage constant, they use two principles that are normally avoided: resonance and core
saturation. When the resonance occurs, the current will increase to a point that causes the saturation of the magnetic core of
the transformer. If the magnetic core is saturated, then the magnetic flux will remain roughly constant and the transformer
will produce an approximately constant voltage output. If not properly used, a CVT will originate more PQ problems than
the ones mitigated. It can produce transients, harmonics (voltage wave clipped on the top and sides) and it is inefficient
(about 80% at full load). Its application is becoming uncommon due to technological advances in other areas [14].

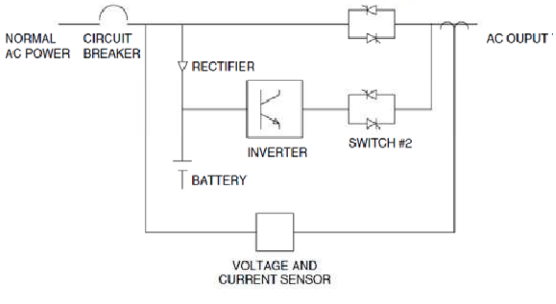
Energy Storage (restoring technologies)

• Electrochemical batteries
• Flywheels
• Super capacitors

Uninterruptible Power Supply (UPS)

UPS systems provide protection in the case of a complete power interruption (blackout). They should be applied where
"down time" resulting from any loss of power is unacceptable. UPS are designed to provide continuous power to the load in
the event of momentary interruptions. They also provide varying degrees of protection from surges, sags, noise or
brownouts depending on the technology used [14]. There are three major UPS topologies each providing different levels of
protection:

 Off-Line UPS (also called Standby)



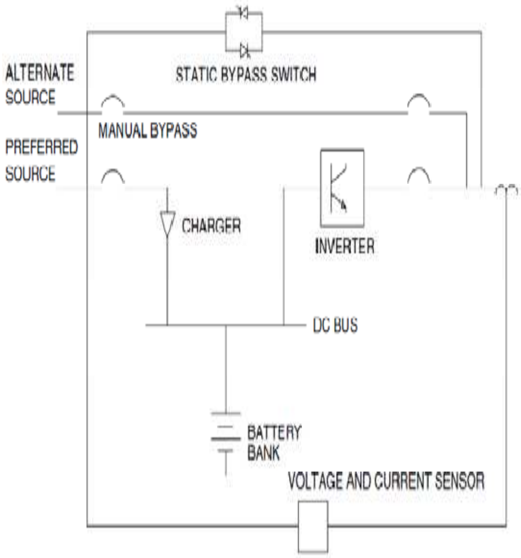
Low cost solution for small, less critical, stand-alone applications such as programmable logic controllers, personal
computers and peripherals. Off-line UPS systems supply the load directly from the electrical utility with a limited
conditioning. The unit provides power to the load from the battery during sags, swells and power interruptions. They of fer
some noise suppression through a filter/surge suppressor module. Advantages of off-line UPS are high efficiency, low cost
and high reliability. The main disadvantage is that protection from high and low voltages is limited by the battery capacity.
Other disadvantages are poor output voltage regulation and noticeable transfer time. To keep unit cost low, most off-line
units utilize step-sine wave outputs when on battery power.

 Line-Interactive UPS

Line-Interactive UPS provides highly effective power conditioning plus battery back-up. These units are ideal in areas
where voltage fluctuations are frequent. The defining characteristic of line-interactive models is they can regulate output
voltage without depleting the battery. Advantages are good voltage regulation and high efficiency. Disadvantages are
noticeable transfer time and difficulty in comparing competing units. The output waveform can be either a sine wave or
step-sine wave depending on the manufacturer and model.

 True On-Line UPS

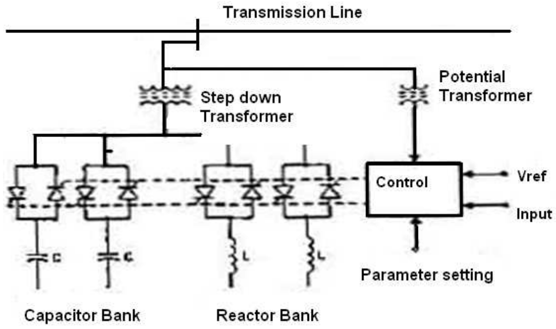
True On-Line UPS provides the highest level of power protection, conditioning and power availability. True on-line
technology, also called double conversion is unique in that the power is converted from AC utility to DC for battery
charging and to power the inverter. The DC is then converted back to AC to power the critical load. Advantages of the online
UPS include the elimination of any transfer time and superior protection from voltage fluctuations. Voltage regulation
is achieved by continuously regenerating a clean sine wave. Disadvantages are lower



efficiency and higher audible noise

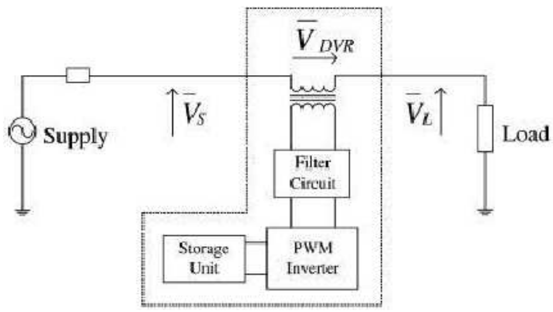
7. Motor-Generators Set
Generators are machines that convert mechanical energy into electrical energy. They are usually used as a backup power
source for a facility's critical systems such as elevators and emergency lighting in case of blackout. However, they do not
offer protection against utility power problems such as over voltages and frequency fluctuations, and although most can be
equipped with automatic switching mechanisms, the electrical supply is interrupted before switching is completed, so it
cannot protect against the damage that blackouts can cause to expensive equipment and machinery. Motor generators are
consists of an electric motor driving a generator with coupling through a mechanical shaft. This solution provides complete
decoupling from incoming disturbances such as voltage transients, surges and sags. Motor-Generators ride through short periods of power loss, but will not protect against sustained outages without the addition of an additional motor powered by
an alternate fuel source (such as diesel or propane) [14].

8. Static Var Compensators (SVCS)



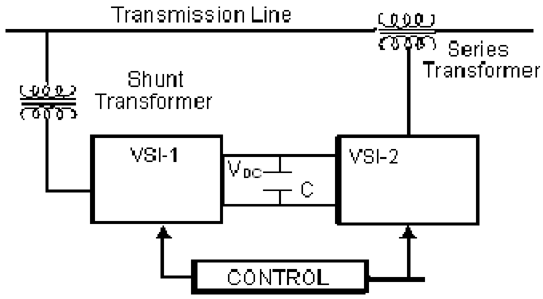
Static VAR compensators (SVR) use a combination of capacitors and reactors to regulate the voltage quickly. Solid-state
switches control the insertion of the capacitors and reactors at the right magnitude to prevent the voltage from fluctuating.
The main application of SVR is the voltage regulation in high voltage and the elimination of flicker caused by large loads
(such as induction furnaces

Dynamic Voltage Restorer (DVR)
A dynamic voltage restorer (DVR) acts like a voltage source
connected in series with the load. The output voltage of the
DVR is kept approximately constant voltage at the load
terminals by using a step-up transformer and/or stored
energy to inject active and reactive power in the output
supply through a voltage converter [17].



Unified Power Quality Conditioner (UPQC)
The UPQC employs two voltage source inverters (VSI) that
is connected to a dc energy storage capacitor .A UPQC,
combines the operations of a Distribution Static Compensator (DSTATCOM) and Dynamic Voltage

Regulator (DVR) together. This combination allows a
simultaneous compensation of the load currents and the
supply voltages, so that compensated current drawn from the
network and the compensated supply voltage delivered to the
load are sinusoidal and balanced [18].



CONCLUSION

The Power quality is important in all theAREA
the solutions to problems, equipment, regulations
. Due to rising non-linear load harmonic problems are increased.
. This paper IS GIVES INFORMATION TO understand the power quality..
research to find an efficient answer to the power quality problems. So, , this paper has a good *future scope*and will help research workers, users and suppliers of
electrical power to gain a guideline about the power quality The corrective measures are also discussed which can be remedy for power quality
problems generated in different equipments. harmonic standards is also considered in this paper.
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