A RESEARCH REVIEW OF POWER QUALITY ISSUES, SOLUTIONS AND STANDARDS

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Abstract: Now-a- days, Power quality is only major concerns and it has very emerging issues. The power quality with increasing quantities of non –linear loads being added to electrical power system. Power quality issues have become very important to electricity. The non- linear loads are now-a-day's very common place in commercial and industrial area. Computer industries are biggest of semiconductor devices and consumer electronic material. It's evaluate the problem of power quality in power system in order to improve compressive knowledge of power quality issues is more important for the electric power system. Power quality draw harmonic and reactive power components of current from ac main, the quality of power deteriorates. This paper presents a review of main power quality issues with associated causes and solution with power quality standards.

Key Words: Power Quality, UPQC, Power Quality Issues, SVC, DVR, Voltage Sag (Dip), Harmonic.

I. INTRODUCTION

Power Quality is defined as "A set of electrical boundaries that allows equipment to function in its intended manner without significant loss of performance". The power quality is equal to voltage quality. It's a very important for quality of power being supplied in a power system. Dynamic operation loads cause different type of power quality disturbance such as voltage sag or dip, flickering, voltage swell, harmonics, voltage fluctuation, harmonic distortion, over voltage, under voltage, etc. these all non – linear loads cause faults and disturbances in the voltage waveform. Any amount of power can be drawn from and delivered to an infinite bus without effects.

1.1The magnitude of bus voltage
1.2 The frequency of bus voltage

The short circuit ratio at a loads bus is defined as:
SCR = Short circuit current at rated voltage with loads short circuited/rated load current Electric power quality may be loosely defined as a measure of how well the electric power can be utilized by consumers. When wave shapes are irregular, voltage regulation is poor, harmonics are present there are momentary events that distort usually sinusoidal voltage wave.

II. POWER QUALITY INDEX

The Harmonics components of the current and voltage are used as per quality of power indices:

Let i(t) to be a load current is periodic
I_1, I_2 ……. are fundamental and harmonic of I (t).
The total harmonic distortion (THD) is:

$$THD = \sum_{i=2}^{\alpha} i_1/i_2$$

The single phase and three phase bridge rectifiers contributes to harmonic distortion and different factors such as THD. Displacement factor is the cosine of the angle between fundamental voltage and fundamental current, power factor is the ratio of real power to apparent power $V_{RMS,} I_{RMS.}$

III. CLASSIFICATION OF PQ PROBLEM

The PQ problem is very useful to the various different type of disturbances need to be classified with magnitude and duration.

3.1 VOLTAGE SAG (DIP):

A decrease of the normal voltage level between 10% - 90% of the rms nominal voltage at the power frequency, for duration of 0.5 cycle to 1 minute. Its causes by faults on the transmission network. Faults in consumer's installation with connect to heavy loads and large motors. Total interruption of electric power system supplies for duration from new milliseconds to 1 to 2 seconds.

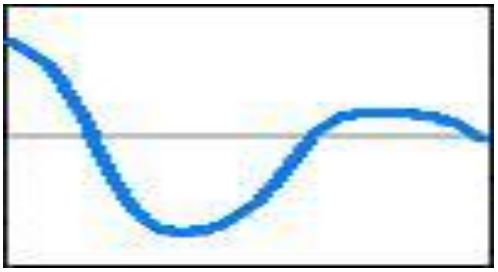

Figure-1 voltage sag

3.2 VOLTAGE SPIKES:

In the electrical power system, the voltage spikes are very fast and short duration electrical transients in voltage. The voltage spike occurs by lightning strikes, power outage, short circuit and tripped circuit breakers. Voltage spikes also effect a rapid build – up of a magnetic field which may include energy in to the associated circuit. It has very Common place for decay of magnitude field.

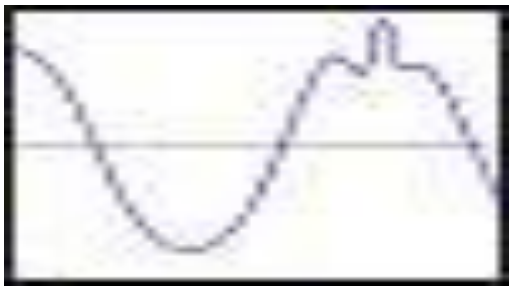

Figure-2 voltage spikes

3.3 VOLTAGE SWELL**:**
Voltages swell also increase of the voltage at the power frequency, outside the nominal voltage tolerances with duration of more than 1 cycle and less than a few seconds. Its causes by heavy loads, badly dimensioned power sources, badly regulated transformers. It has flickering of light, damage or sensitive equipment when the voltage value is very large.

3.4 HARMONIC DISTORTION:
Harmonic distortion consists voltage and current assume non – sinusoidal shape. The sum of more sine wave with different magnitude and phase of power system. It causes classic sources, welding machine, dc brush motors and rectifiers. It includes all non- linear loads such as ASD_s, lightning strikes, arc furnaces, switched mode power supply. The neutral overloads in three phase system over heating of equipment, nuisance tripping of thermal protection.

Fig-3 Harmonic distortion

3.5 NOISE:
The electrical noise in electrical power system as superimposing of high frequency signals on wave of the frequency of electrical power. When dealing with the uncertain external influences acting on controlled process, it's important to distinguish between noise and disturbances. The disturbances on sensitive electrical devices, usually not destructive may cause data loss and data processing errors.

3.6 VOLTAGE SURGE:
It's a very commonplace for electrical power system, voltage surges a voltage rise that endangers the insulation of electrical devices. There are two types as;
3.6.1 Lightning surges

3.6.2 System –generated surges Its causes short circuiting, shutdown of heavy loaded circuit, disconnecting of current.

3.7 VOLTAGE FLUCTUATION:
Oscillation of value of voltage, the amplitude modulated with a signal with frequency of 0 – 30 Hz. Voltage fluctuation causes by arc furnaces, stop of electric motor, oscillating load.

Figure-4 Voltage fluctuation

3.8 BLACKOUTS**:**
The blackout is a short term and long term loss of electrical power to an electric power boundary. The effects of blackouts on total power loss of electric power, tripping of substation as distribution and transmission.

3.9 VOLTAGE UNBALANCE:
Voltage unbalance in the form of voltage variation in the three phase electrical power system in which three voltage magnitude or phase angle different between them are not equal. Voltage unbalance causes furnaces, traction loads, large single phase loads. There are important affected loads are three phase induction machines as three phase induction motor.

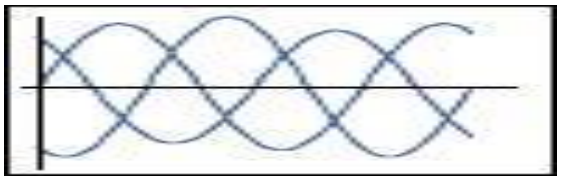

Figure-5 Voltage unbalance

IV. STATIC VAR COMPENSATOR (SVC):

It is a very useful facts device for electrical power system which supplies capacitive or inductive current so as to maintain, voltage at any bus. It is a combination of capacitor and reactors to regulate the voltage quickly. SVC are used for increasing power transfer in long loads lines, control of dynamic over voltage and under voltage, low frequency oscillation damping.

4.1 CHARACTERISTICS OF SVC:

There are some characteristics of Static VAR Compensator (SVC) in the form as:

4.1.1Controllable reactor

4.1.2 Fixed capacitor

4.1.3 SVS

Composite Characteristics of SVC

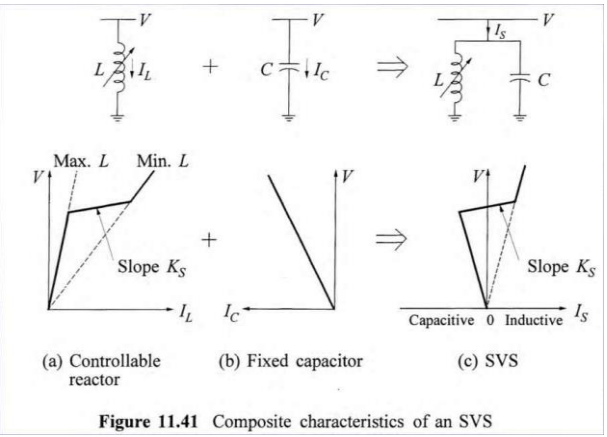

Figure-6 Characterstics of SVC

V. UNITED POWER FLOW CONDITIONER (UPQC) :

UPQC is a combination of shunt and series connected static compensators (STATCOM and SSSC). Integration of series active and shunt avtive filters. They are connected with the D.C link.Its a bi- directional flow of active power between series output terminal of SSSC and shunt terminal ogf STATCOM.Main purpose of UPQC is to compensate for voltage imbalance , reactive power , voltage flicker and harmonic.

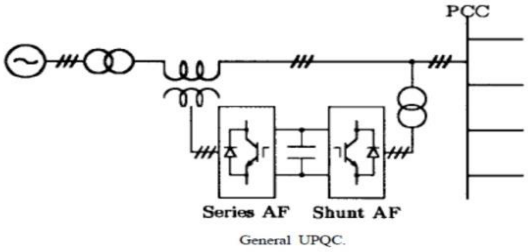

Figure-7 United power flow conditoner

VI. DYNAMIC VOLTAGE RESTORER:

DVR Is referred to the sereis voltage booster (SVB) and static series compensatore(SSC) which is utilized solid state power electronic circuit components . Its produced three phase controllable voltage whose vector (angle and magnitude) adds source voltage to restore loads voltage to pre – sag condition.

6.1 COMPENSATING VECTOR DIAGRAM:

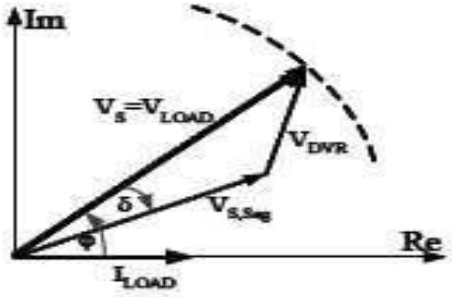

Figure-8 Compensating vector diagram

6.2 CONTROL TECHNIQUES:

There are two types of control techniques as-

6.2.1 LINEAR CONTROLLERS (open loop or closed loop system)

6.2.2 NON- LINEAR CONTROLLERS (sinusoidal pulse with modulation)

VII. HARMONIC FILTERS

A harmonic filter is an electrical device, which reduces or mitigates harmonics to tolerable levels. It is used for detect of harmonics distortion, harmonic filter commonly used for lower harmonic distortion. IEEE includes practice for harmonic control in electrical power system. Power factor depends on-

1. Displacement between current and voltage phasors.
2. Total harmonic distortion

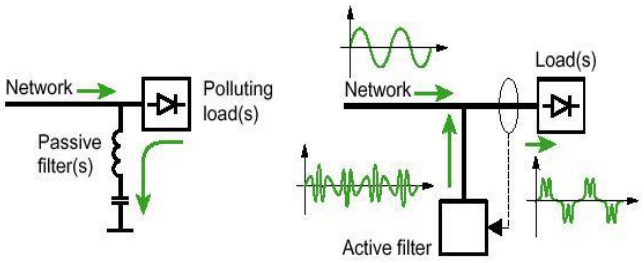

Figure -9 Harmonic filter

P. F= displacement pf*distortion pf

The current and voltage also decrease by capacitor banks and synchronous condensers. The Matrix AP harmonic filter is a most advanced filter today. Matrix AP allows you to meet IEEE-519 standards. The MTE also preferred for single phase application.

It provides fast and time delay for detection of harmonic distortion.

VIII. POWER QUALITY ISSUES AND ITS INDICES

The PQ can be a measure of reliability of a supply. It has supply which is free from disturbances can be considered as a high quality of the power. PQ determines the fitness of a supply of the electrical power system. "Any power problem in voltage. Current or frequency deviation that results in failure of the customers' equipment.

8.1 CLASSIFICATION OF POWER QUALITY ISSUES:

8.1.1 Conducted low frequency phenomena:
a. Voltage Fluctuation
b. DC in AC network
c. Signalling Voltage
d. Interharmonics
8.1.2 Conducted high frequency phenomena:
a. Unidirectional Transients
b. Oscillatory Transients
c. Directly Coupled
8.1.3 Radiated – low frequency phenomena:
a. Magnetic field
b. Electric field
8.1.4 Radiated high – frequency phenomena:

a. Electromagnetic field
b. Electric field

8.1.5 Electrostatic discharge phenomena (ESD):

a. sudden discharge between two electrically bodies.

IX. POWER QUALITY SOLUTIONS

9.1 power conditioning equipment's.

9.2 transient voltage surge suppressor (tvss):

It's used for interface between the power source and sensitive loads, the transient voltage is clamped by the TVSS before it reaches the loads. TVSS usually contain a component with a non – linear resistance that limits excessive line to the voltage and conduct any excess impulse electrical energy to the ground point.

X. CONCLUSION

The power quality maintenance is an important aspect in the economic operation of an electrical power system. There are various type of power quality problem may lead to another undesirable problem, proper mitigation equipment may be used to maintain the level of power quality as desired and international harmonic standards is considered in this paper. This paper consists an ideal solution and it has very good scope for future and will help for research users, workers of electrical power to gain guide for power quality problem, solution and standards.

XI. REFERENCES

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