SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

UNIT-IV- Power Quality in Smart Grid

Power Quality in smart grid

What is power quality?

Power quality refers to electricity that consistently meets the agreed-upon specifications for optimal and efficient use in home electronics. In North America, home appliances and electronics are designed to operate within a range of 106 volts to 127 volts of alternating current (AC). However, equipment operates most efficiently in a range of 114-126 volts, which is the standard for delivered voltage in North America.

• Utilities also manage a number of other components of power quality, including:Frequency, which is set at 60 Hz in North America; and

•Power factor, which measures how much of the electricity delivered is actually useable by customers.

Voltage and power factor, in particular, are very dependent on how many customers are on an electrical line, and how much they are using. For example, if every house in a neighborhood is running their air conditioning, voltage at the last house in the neighborhood circuit could be at—or even below—114 volts. This low voltage condition can cause problems with electric equipment in that house

Why is power quality important?

Today's modern and sensitive electronics demand a **steady voltage and frequency**, a considerable change from electronics in the 1960s. Higher than normal voltage causes electronic equipment to operate inefficiently, and may even cause damage to certain equipment. Low voltage has similar impacts, and may cause equipment to work erratically or not at all, like when you turn on your vacuum and your lights dim momentarily. This is especially true of digital electronic equipment such as computers and TVs. Digital equipment relies on low-voltage (usually around 5 volts) direct current to operate. In order to get this type of electricity, digital electronics rely on a transformer—either as part of their plug (the typical "wall wart" pictured at left) or built into it like on a desktop computer. If a digital device isn't able to get the right voltage, it simply won't work. Additionally, research has found that every 1 percent change in voltage has a corresponding 1 percent change in power usage. As a result of these factors, utilities strive to keep the voltage that's delivered to your house within the standard range.

How does the Smart Grid help improve power quality?

The Smart Grid includes several components that help utilities better deliver quality power to your home: smart meters and technology on the distribution grid that helps manage voltage and power factor.

Smart meters are advanced electric meters that provide both you and your utility with more information about the power delivered to your home. Like other digital devices, they include a transformer to step down voltage for the digital electronics. Also like other digital devices, they are engineered to meet strict FCC requirements to keep from interfering with other electronic or communications equipment.

Smart meters allow your utility to see what the actual voltage delivered to your home is. Before smart meters, utilities would base their equipment settings on voltage readings at an electric substation and engineering estimates of what that would mean for actual voltage at each customer's home. They would often set voltages unnecessarily higher to ensure that the last home on a line didn't receive voltage below 114.

With actual information on voltage, utilities can use Smart Grid technology to optimize the voltage for every customer they serve—settings are based on actual customer voltages rather than engineering estimates, which enables a more efficient and accurate supply of power.

Power Quality Problems

Power quality events could be categorized as follows:

•Voltage variation; which occur when the voltage is temporarily under or over a specified limit, called voltage sag or voltage swell, or if a complete loss of voltage occurs. Voltage sag or voltage dip is the most disturbing power quality (PQ) issue in power delivery system. Many of the critical and sensitive loads such as radio frequency generators in semiconductor manufacturing industries or flow rate dependent pumps in process industries shall not be affected during voltage sag.

•Frequency variation; which occurs when the system frequency is temporarily over or under a specified frequency limit. Generally, the impact of frequency variations in a large power delivery system on different types of equipment is almost insignificant, However, the frequency variations within an islanded Nano-grid could be larger than in a large power delivery system and therefore a large increase in volt per Hertz (V/Hz) ratio could cause saturation of the induction motors and their overheating.

Power Quality Problems

•Voltage unbalance variations; which occurs if the voltage unbalances of three (3) phase power system is outside of a predetermined value range. The negative sequence currents flow along with positive sequence current results in increasing of motors losses or decreasing their efficiency, motors torque fluctuation, and motors failure. It also causes the increasing of cables losses and poor operation of UPS, inverters, and VFDs.

•Current Unbalance variations; which occurs if the current unbalances in three (3) phase power system is outside of a predetermined value range. Current unbalance occurs due to the load imperfection and results in voltage unbalance.

•Waveform distortion; which is a steady state deviation from an ideal sinusoidal wave of power frequency and includes DC offset, harmonics, interharmonics, notching and noise, o DC offset is the presence of a DC voltage or current in an AC power system and can cause transformer saturation, additional stressing of insulation, and other adverse effects.

Smart grid power quality

Smart Grid technologies and systems address the power quality needs for all kinds of end-user equipment of consumers.

Volt/Var management (VVM) system, which, typically operate to regulate distribution system voltage profiles within allowable limits and minimize reactive power flow, can provide significant benefits in the areas of conservation, efficiency, and peak reduction by optimizing the voltage levels for consumers along feeder lines. VVM also improves phase balancing and in conjunction with capacitor banks can flatten the voltage profile, facilitating the voltage regulation.

The VVM software is the key component of the VVM solution. The major function of VVM Software is to calculate optimal settings for voltage and reactive power control devices, including load tap-changer (LTC) controllers, regulators and capacitor banks.

VVM Software uses the advanced metering infrastructure (AMI) data to ensure that optimal set-points are calculated without violating any constraints.

A geographic information system (GIS) interface enables network model updates with the latest configuration data.

A SCADA system primarily monitor and control power delivery system, including substations, equipment.

Distribution automation (DA) system proactively solve problems before they affect customers or limit their effects if service interruptions do result.

THANK YOU