SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

UNIT-IV- Power Quality Issues in Smart Grid

Power Quality issues in smart grid

Power quality is defined as —the concept of powering and grounding sensitive electronic equipment in a manner suitable for the equipment.

All electrical devices are prone to failure or malfunction when exposed to one or more power quality problems.

The electrical device might be an electric motor, a transformer, a generator, a computer, a printer, communication equipment, or a household appliance.

All of these devices and others react adversely to power quality issues, depending on the severity of problems.

A simpler and more concise definition might state: —Power quality is a set of electrical boundaries that allows a piece of equipment to function in its intended manner without significant loss of performance or life expectancy.

This definition embraces two things that we demand from an electrical device: performance and life expectancy.

In light of this definition of power quality, this chapter provides an introduction to the more common power quality terms along with descriptions, causes and consequences of the terms. A.

Power Quality Issues

VOLTAGE SAG (OR DIP) Description: A decrease of the normal voltage level between 10 and 90% of the nominal rms voltage at the power frequency, for durations of 0, 5 cycle to 1 minute.

Causes: Faults on the transmission or distribution network (most of the times on parallel feeders).Faults in consumer's installation. Connection of heavy loads and start-up of large motors.

Consequences: Malfunction of information technology equipment, namely microprocessor-based control systems (PCs, PLCs, ASDs, etc) that may lead to a process stoppage.

Tripping of contactors and electromechanical relays. Disconnection and loss of efficiency in electric rotating machines.

VERY SHORT INTERRUPTIONS Description: Total interruption of electrical supply for duration from few milliseconds to one or two seconds. **Causes**: Mainly due to the opening and 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**: Tripping of protection devices, loss of information and malfunction of data processing equipment. Stoppage of sensitive equipment, such as ASDs, PCs, PLCs, if they're not prepared to deal with this situation.

LONG INTERRUPTIONS Description: Total interruption of electrical supply for duration greater than 1 to 2 seconds. Causes: Equipment failure in the power system network, storms and objects (trees, cars, etc) striking lines or poles, fire, human error, bad coordination or failure of protection devices. Consequences: Stoppage of all equipment.

Power Quality Issues

VOLTAGE SPIKE Description: Very fast variation of the voltage value for durations from a several microseconds to few milliseconds. These variations may reach thousands of volts, even in low voltage. Causes: Lightning, switching of lines or power factor correction capacitors, disconnection of heavy loads. Consequences: Destruction of components (particularly electronic components) and of insulation materials, data processing errors or data loss, electromagnetic interference. E. VOLTAGE SWELL Consequences: Data loss, flickering of lighting and screens, stoppage or damage of sensitive Description: 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. Causes: Start/stop of heavy loads, badly dimensioned power sources, badly regulated transformers (mainly during off-peak hours) equipment, if the voltage values are too high. F. **HARMONIC DISTORTION Description:** Voltage or current waveforms assume non-sinusoidal shape. The waveform corresponds to the sum of different sine-waves with different magnitude and phase, having frequencies that are multiples of power-system frequency. Causes: Classic sources: electric machines working above the knee of the magnetization curve (magnetic saturation), arc furnaces, welding machines, rectifiers, and DC brush motors. Modern sources: all non-linear loads, such as power electronics equipment including ASDs, switched mode power supplies, data processing equipment, high efficiency lighting. Consequences: Increased probability in occurrence of resonance, neutral overload in 3-phase systems, overheating of all cables and equipment, loss of efficiency in electric machines, electromagnetic interference with communication systems, errors in measures when using average reading meters, nuisance tripping of thermal protections.

Power Quality Issues

VOLTAGE FLUCTUATION Description: Oscillation of voltage value, amplitude modulated by a signal with frequency of 0 to 30 Hz. Causes: Arc furnaces, frequent start/stop of electric motors (for instance elevators), oscillating loads. Consequences: Most consequences are common to under-voltages. The most perceptible consequence is the flickering of lighting and screens, giving the impression of unsteadiness of visual perception.

VOLTAGE UNBALANCE Description: A voltage variation in a three-phase system in which the three voltage magnitudes or the phase-angle differences between them are not equal. Causes: Large single-phase loads (induction furnaces, traction loads), incorrect distribution of all single-phase loads by the three phases of the system (this may be also due to a fault). Consequences: Unbalanced systems imply the existence of a negative sequence that is harmful to all three phase loads. The most affected loads are three-phase induction machines.

THANK YOU