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Issues of Power Quality

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***Abstract:** In this modern era, the electricity dependence for domestic, commercial and industrial purposes has been increasing day to day. The non-linear loads associated will leads to some of the power quality issues. Such Power Quality Issues viz., voltage sag, Interruptions, spikes in voltage, fluctuations etc. briefly discussed in this paper.*
***Keywords:** Power quality, voltage sag, interruptions, spikes in voltage, fluctuations*

I. INTRODUCTION

Energy is the basic necessity for the economic development of a country. Energy exists in different forms in nature but the most important form is the “electrical energy”. Modern society is too much dependent on the utilisation of electricity which has become the most important part of our livelihood.
Electricity is superior to all the other forms of energy due to its convenient form, ease of control, better flexibility, cleanliness etc. Electrical energy is produced from energy available in various forms of nature such as from sun, wind, water, nuclear energy, fuels viz., solid fuel as coal, liquid fuel as oil, gas fuel as natural gas.
Power quality refers to the level of voltage magnitude consistency, reliability, and stability of electrical power. It is important because any deviation from the expected levels of power quality can cause negative impacts like equipment damage or malfunction, system shutdown and data loss.

II. POWER QUALITY ISSUES

Power Quality Issues are listed and discussed below:

A. Voltage Transients

These occurs due to sudden Lightening, back to back Capacitor Switching, Transformer Energization. Such transients cause the sudden failure of electronics equipment, motor running at very high temperatures, formerly tripping.

B. Voltage Dip

A Dip in the voltage refers to the decrease of the normal voltage level between 10 and 90% of the normal RMS voltage at the power frequency, for durations of 0.5 cycle to 1 minute. It is caused by fault on the line, starting of electric motor or switching of heavy load, excessive loading.

C. Voltage Flicker

Flicker in the voltage is the effect of random and repetitive variations in voltage between 0.9-1.1 per unit. It results in rapid visible changes in brightening and dimming of screen and variation in the luminosity produced by light bulb. It causes irritation to human sight. It is caused by switching on and off of electric motor, pulsating load, arc furnaces and welding equipment.

D. Momentary Interruptions

These are very short planned or accidental power loss from milliseconds to second or two. These occurs due to Switching operations attempting to isolate an electrical problem and maintain power to your area which results in Equipment trips off, programming is lost, or disc drive crashes

E. Harmonics

Voltage harmonics occurs due to the non-linearity property of loads which in further results in Resonance, Overheating of Cables, Electromagnetic Interference with Communication Lines, Excessive Losses

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F. Low Power Factor

This occurs due to the Varying loads in power system, Industrial heating furnaces, Induction machine, Harmonic currents which further results in Increase costing of transmission lines, losses, reduced efficiency

G. Over Voltages

Overvoltage is an increase in nominal RMS voltage greater than 1.1 per unit for duration longer than one minute. It result from switching off of large load, incorrect tap setting of transformers, inadequate voltage control, fault on the line.

H. Voltage Interruptions

Causes include insulation failure, improper/faulty grounding, and lightning and insulator flashover. It results in opening and automatic re-closure of protection devices to isolate faulty section of the system.

I. Fluctuations in Frequency

Frequency variation or fluctuation is deviation of power system frequency from acceptable standard nominal value (usually 50 or 60Hz).

J. Supply Interruptions

These are the interruptions due to small/ acute shortage in the grid to meet electricity demand, occasioned by lack of adequate investment in the power sector.

K. Power Outage

Power outage is a condition of zero voltage for long period. Outage is also use of power equipment failure. Failure of equipment in the power system network, storms, objects (trees, cars, etc.) falling on or hitting power lines or poles, small error, badly co-ordinated or failure of protection systems are causes of power outage

L. Voltage Swell

Voltage swell is a rise to within 1.1 to 1.8 per unit of the normal voltage for duration from half a cycle to several seconds. It occurs when heavy load is turned off, loss of generation, badly regulated transformer, and faulty conditions at various points in the AC distribution system, under-loading of a phase while other two phases in a 3-phase system are overloaded.

M. Voltage Spikes

Voltage surge is similar to voltage swell but it is very high increase on the nominal voltage usually for very short duration. It is usually caused by lightning strikes, arcing during switching operation on circuit breakers and contactors, switching surge or transients.

N. Long Interruptions

Long Interruptions are the total interruption of electrical supply for duration greater than 1 to 2 seconds. These are caused due to the 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 which in further results in Stoppage of all equipment performance.

O. Voltage Unbalance

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

P. Power Interruptions

These occurs when the supply line voltage reduces to less than 0.1 per unit for a period not longer than 60 seconds. It becomes sustained interruption if it is longer than one minutes. Causes include insulation failure, improper/faulty grounding, and lightning and insulator flashover. It results in opening and automatic re-closure of protection devices to isolate faulty section of the system.

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Q. Noise

Noise is the superimposing of high frequency signals on the waveform of the power-system frequency. These occurs due to the Electromagnetic interferences provoked by Hertzian waves such as microwaves, television diffusion, and radiation due to welding machines, arc furnaces, and electronic equipment. Improper grounding may also be a cause. Finally Noise results in Disturbances on sensitive electronic equipment, usually not destructive. May cause data loss and data processing errors

R. Temporary Interruption

These are planned or accidental total loss of power in a localized area of community Duration may be two seconds to two minutes. The causes are Equipment failure, weather, animals which results in Systems shut down

S. Voltage Fluctuation

These rise due to the oscillation of voltage value, amplitude modulated by a signal with frequency of 0 to 30 Hz. These occurs due to Arc furnaces, frequent start/stop of electric motors (for instance elevators), and oscillating loads. Most consequences are the flickering of lighting and screens, giving the impression of unsteadiness of visual perception.

T. Very Short Interruptions

Very Short Interruption of electrical supply occurs for a very short duration from few milliseconds to one or two seconds. These are caused mainly due to the opening and automatic re-closure of protection devices to decommission a faulty section of the network. The main fault causes are insulation failure, lightning and insulator flashover. Finally, results in 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.

U. Under Voltages

Under Voltage is a reduce in nominal voltage to less than 0.9 per unit for longer than one minute duration. Causes include switching on of large load, circuit overloading, fault on the line

V. Voltage Impulse

It is a sudden change in voltage up to several hundred to thousand volts. Its Duration is Microseconds; occurs due to Utility switching operations, starting and stopping equipment or machinery, static discharges, lightning which results in Processing errors, data loss, and burned circuit boards.

W. Blackouts

A blackout is a complete interruption of power in a given service area. These occur without any warning; last for determine periods, and are typically caused due to equipment failure or it may be also due to several changes.

X. Notch

Notch is A disturbance of opposite polarity from the waveform Duration: Microseconds Causes: Utility switching operations, starting and stopping machinery, static discharges, lightning. Effect: Processing errors, data loss, burned circuits

Y. Long Term Outage

Planned or accidental total loss of power in a localized area of community Over two minutes which results in sudden Systems shut down

Z. Voltage Variations

Voltage variation is deviation from nominal voltage value which can be for a very short duration (millisecond to seconds) or long duration (longer than one minute). Short-duration voltage variation mostly occurs as dips or sags, spike or surge, swells, while long duration voltage variation occurs as flicker (voltage fluctuation), under-voltage, overvoltage, and interruption.

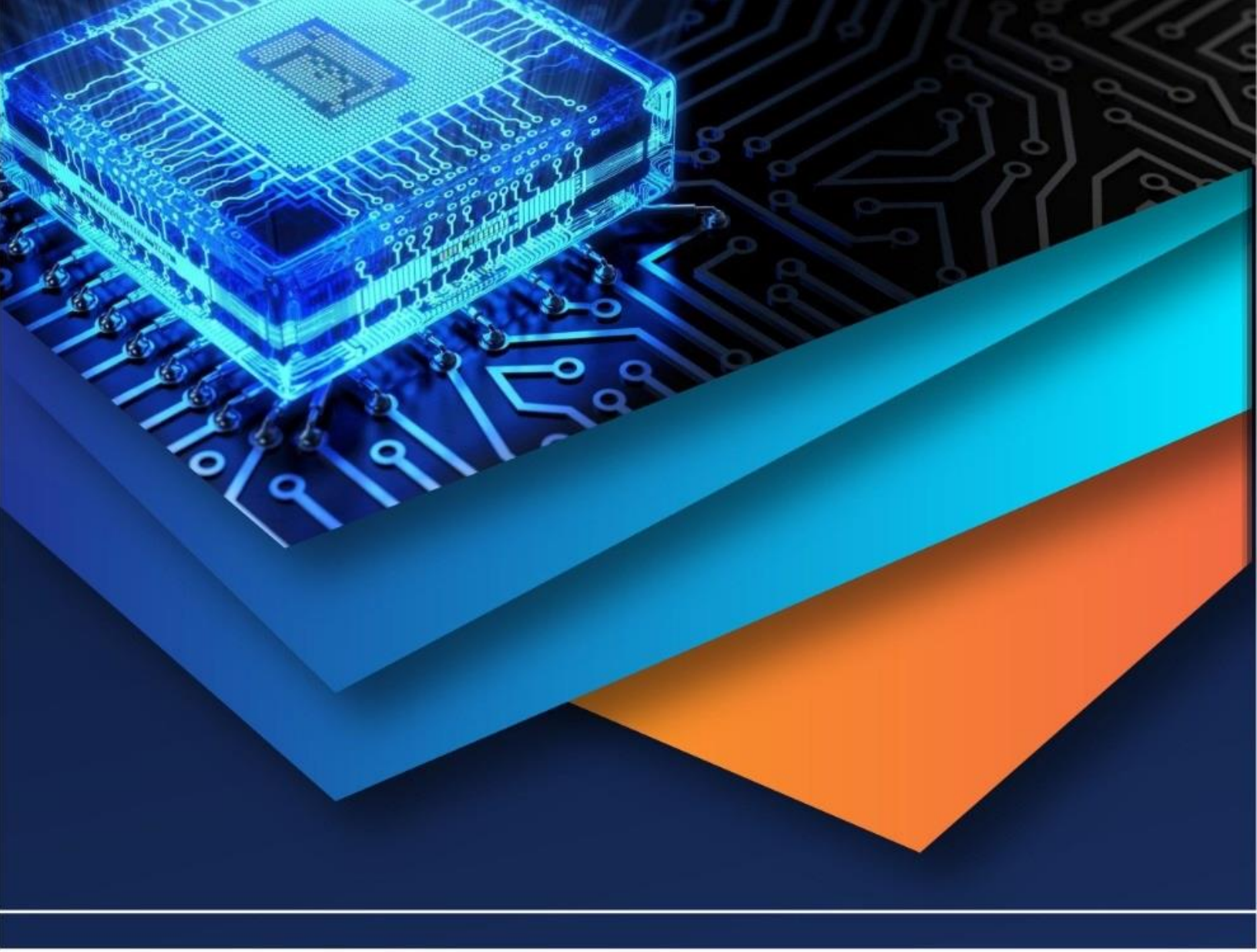
III. CONCLUSIONS

Power quality is defined as the maintenance of the voltage profile to all types of loads. But due to some reasons this voltage profile is disturbed known as the power quality issues. Some of these power quality issues are briefly discussed in this paper.

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