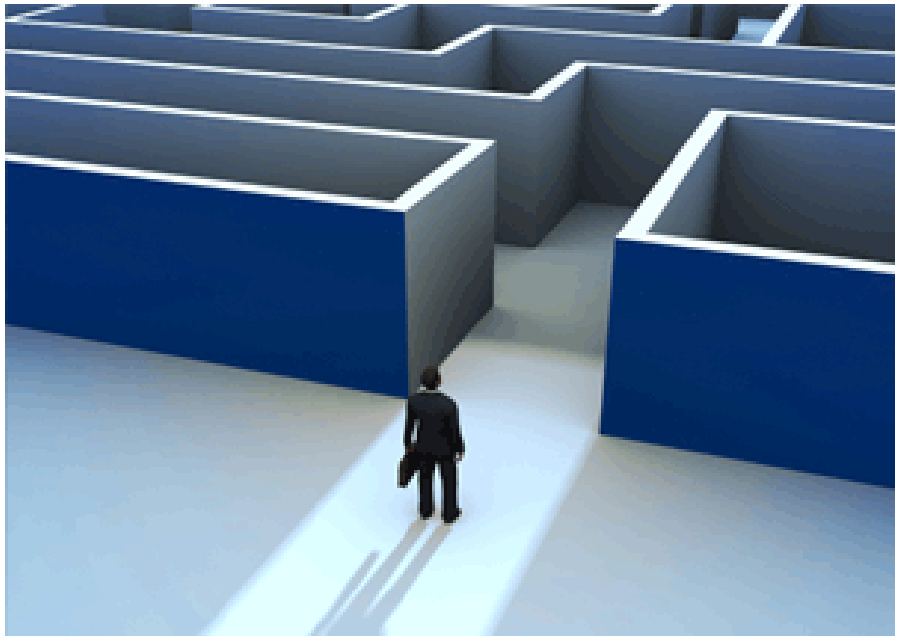
LIVELINE
POWER THAT PROTECTS

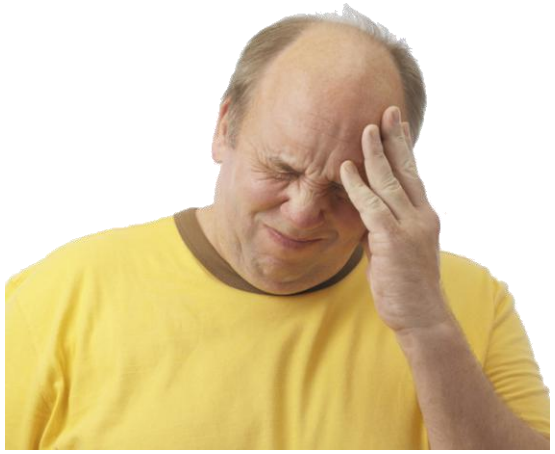
9 MOST COMMON PQ PROBLEMS

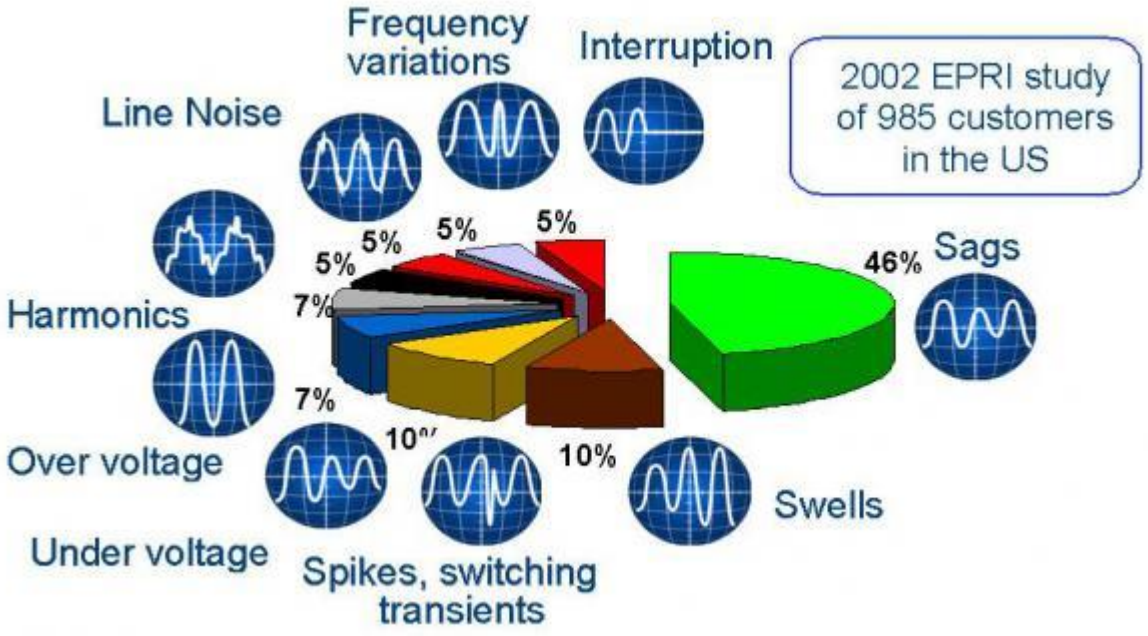
CAUSES AND CONSEQUENCES



Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

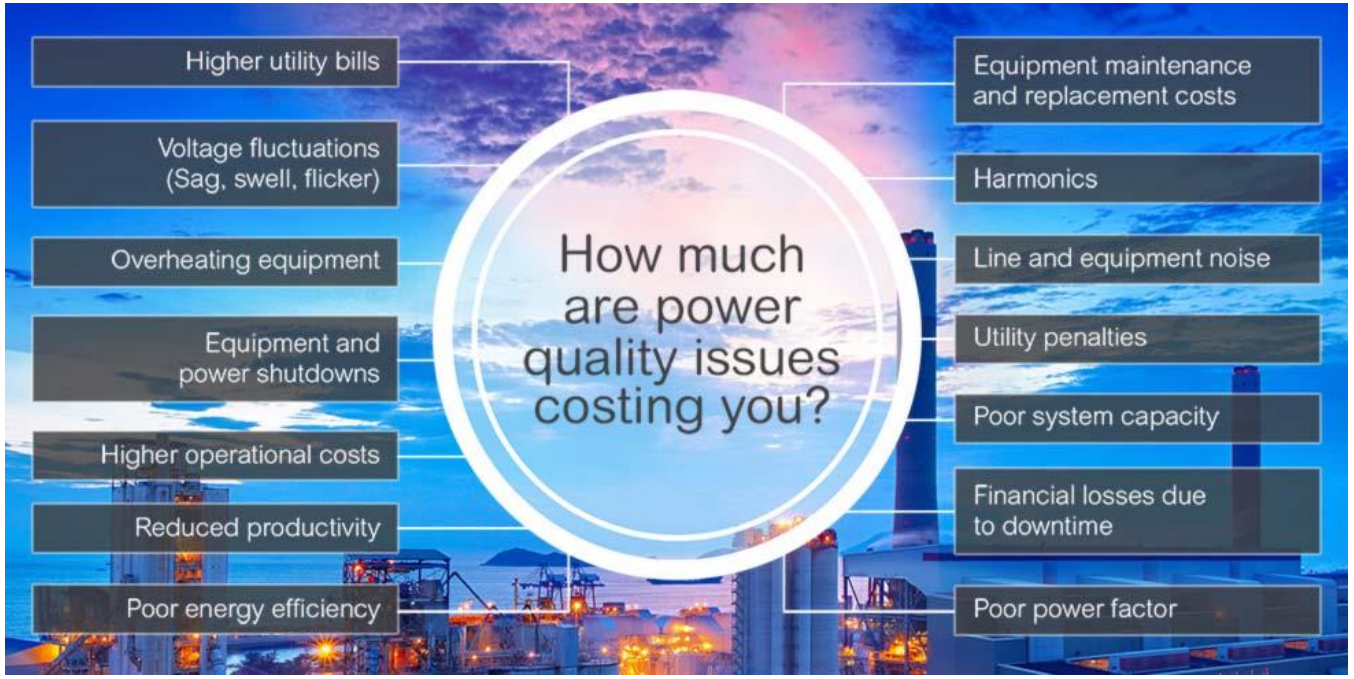
WHAT ARE THEY





Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

HOW DO THEY AFFECT



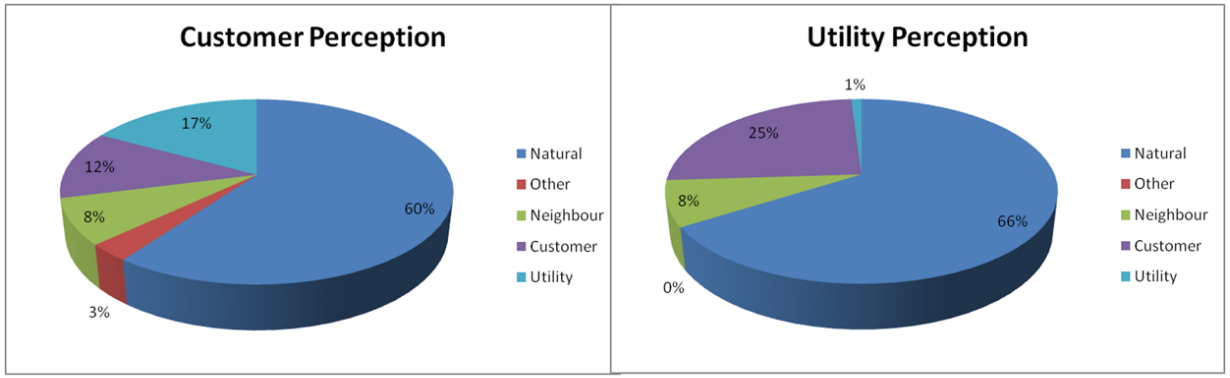
40%

OF BUSINESS DOWNTIME STEMS FROM POWER QUALITY PROBLEMS

Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

WHAT CAUSES THEM

1. Difficult to pinpoint the actual cause of a specific problem
2. Broadly there are two categories of problems



Results of a survey on the causes of PQ Problems - Georgia Power Co

INTERNAL CAUSES : 80%

Caused by the nature and behaviour of the consumer's load and installation

EXTERNAL : 20%

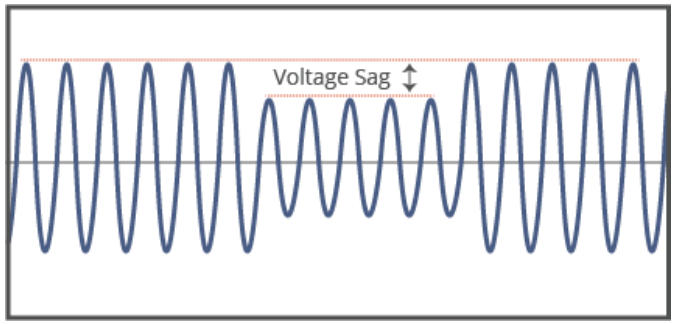
Deficiencies and disturbances in the supply

Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

WHAT CAUSES THEM

1. 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.

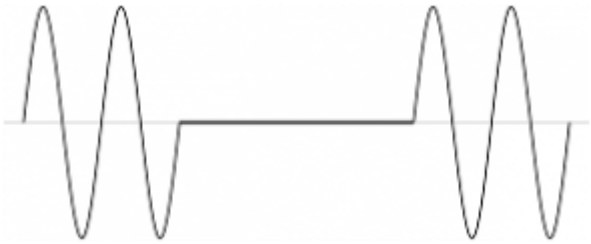
Consequences: Malfunction of information technology equipment, namely microprocessor-based control systems (PCs, PLCs, ASDs, etc) that may lead to a process stoppage. Tripping of contactors and electromechanical relays. Disconnection and loss of efficiency in electric rotating machines.

Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

CAUSES OF PQ PROBLEMS

2. 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.

Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

CAUSES OF PQ PROBLEMS

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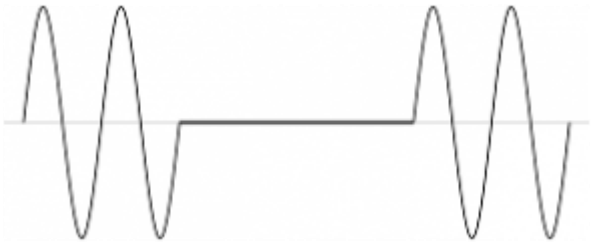
3. Long interruptions

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.

Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

CAUSES OF PQ PROBLEMS

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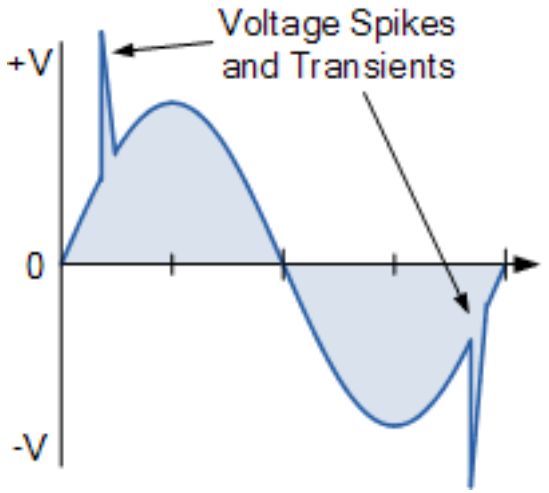
4. Voltage spike

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.

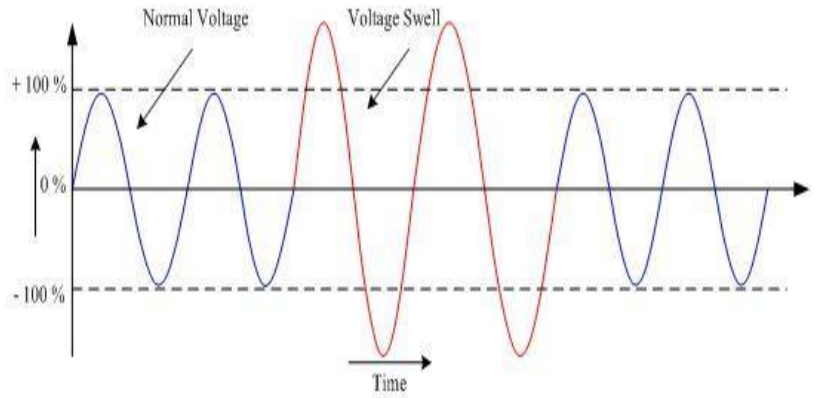


Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

CAUSES OF PQ PROBLEMS

5. Voltage swell

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).

Consequences: Data loss, flickering of lighting and screens, stoppage or damage of sensitive equipment, if the voltage values are too high

Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

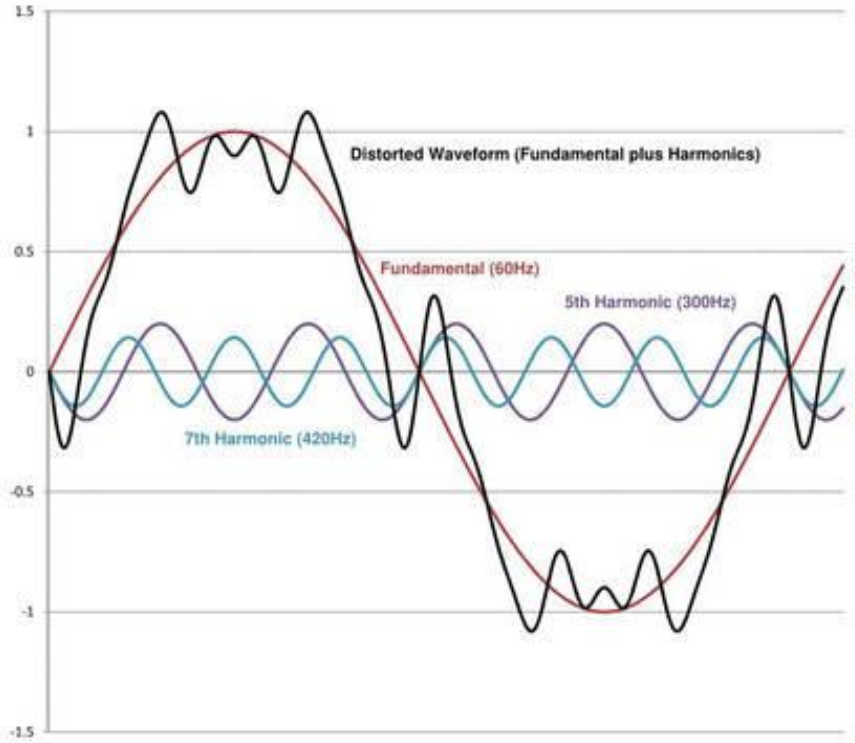
CAUSES OF PQ PROBLEMS

6. 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.



CAUSES OF PQ PROBLEMS

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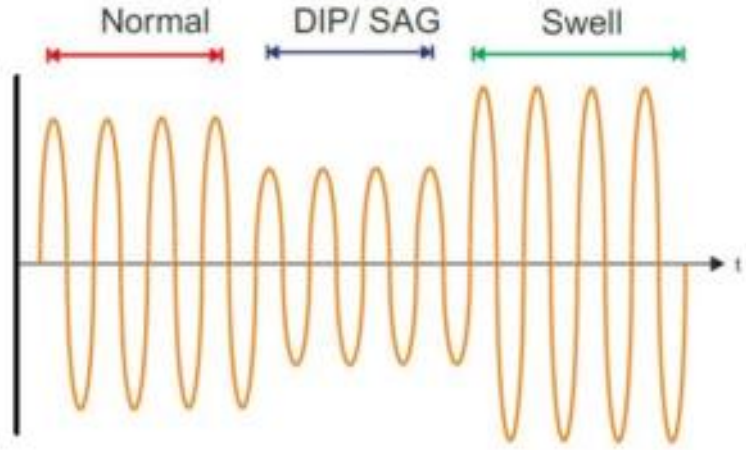
7. Voltage fluctuation

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.



Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

CAUSES OF PQ PROBLEMS

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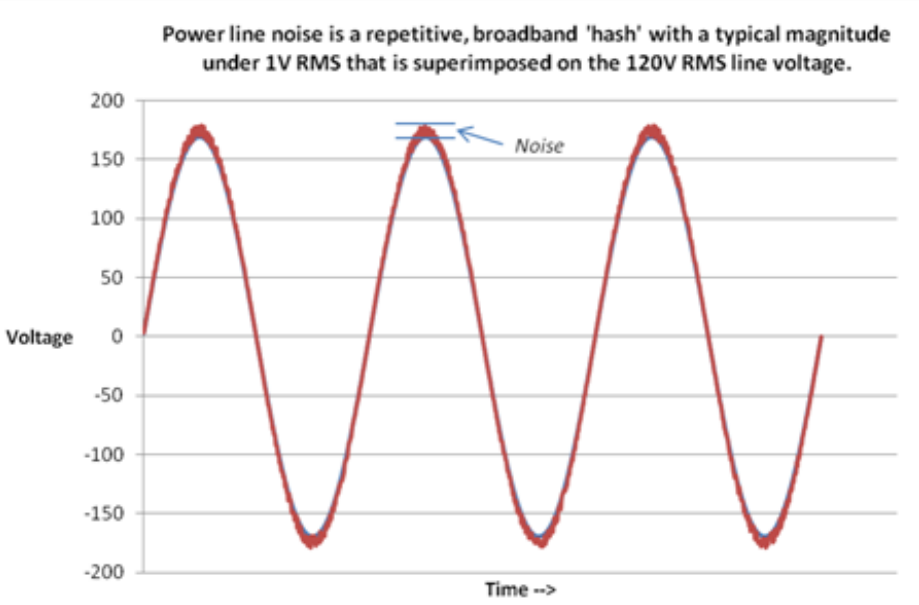
8. Noise

Description: Superimposing of high frequency signals on the waveform of the power-system frequency.

Causes: 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

Consequences: Disturbances on sensitive electronic equipment, usually not destructive. May cause data loss and data processing errors.



Reference: *Power Quality Problems and New Solutions – A. de Almeida, L. Moreira. J. Delgado*

CAUSES OF PQ PROBLEMS

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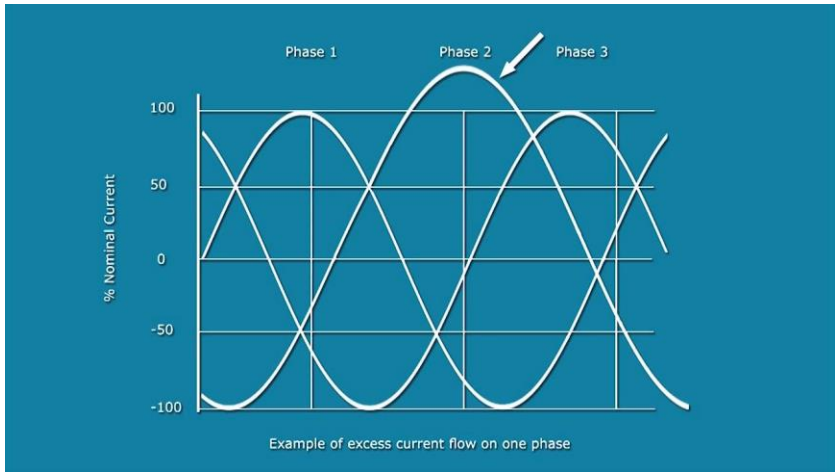
9. Voltage Unbalance

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.



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IN SERCH OF SOLUTION

LIVELINE
POWER THAT PROTECTS

Unified Power Quality Conditioner (UPQC)

UPQC allows the alleviation of voltage and current disturbances that could affect sensitive electrical loads while compensating the load reactive power.

UPQC consists of combined series and shunt active power filters. The main function of UPQC includes:

(i) Reactive power compensation.
(ii) Voltage regulation.
(iii) Compensation for voltage sags and swells.
(iv) Unbalance compensation for current and voltage (for 3-phase systems).