

Glossary Of Power Generation Terms

Alternating Current (AC)

Alternating current is electric current that alternates or reverses polarity, between a positive maximum value and a negative maximum value at a characteristic frequency, usually 50 or 60 cycles per second (Hertz).

AC Generator

AC generator is the preferred term for referring to a generator that produces alternating current (AC).

Acoustic Material

Acoustic material is any material considered in terms of its acoustic properties, especially its properties of absorbing or deadening sound.

Active Power

Active power is the real power (kW) supplied by the generator set to the electrical load. Active power creates a load on the set's engine and is limited by the power of the engine and efficiency of the generator. Active power does the work of heating, lighting, turning motor shafts, etc.

Air Circuit Breaker

An air circuit breaker automatically interrupts the current flowing through it when that current exceeds the trip rating of the breaker. Air is the medium of electrical insulation between electrically live parts and grounded (earthed) metal parts.

Annunciator

An annunciator is an accessory device used to give remote indication of the status of an operating component in a system. Annunciators are typically used in applications where the equipment monitored is not located in a portion of the facility that is normally attended. The NFPA has specific requirements for remote annunciators used in specific applications, such as hospitals.

American National Standards Institute (ANSI)

ANSI is a private, non-profit organization that administers and coordinates the U.S. voluntary standardization and conformity assessment system. Founded October 18, 1918, ANSI is the official U.S. representative to the International Accreditation Forum (IAF), the International Organization for Standardization (ISO) and, via the U.S. National Committee, the International Electrotechnical Commission (IEC).

Alternator

Alternator is another term for AC generator.

Amortisseur Windings

The amortisseur windings of a synchronous AC generator are the conductors embedded in the pole faces of the rotor. They are connected together at both ends of the poles by end rings. Their function is to dampen waveform oscillations during load changes.

Ampacity

Ampacity is the safe current-carrying capacity of an electrical conductor in amperes as defined by code.

Ampere

The ampere is a unit of electric current flow. One ampere of current will flow when a potential of one volt is applied across a resistance of one ohm.

Apparent Power

The product of current and voltage, expressed as kVA. It is real power (kW) divided by power factor (PF).

Armature

The armature of an AC generator is the assembly of windings and metal core laminations in which the output voltage is induced. It is the stationary part or stator, in a revolving-field generator.

Authority Having Jurisdiction

The authority having jurisdiction is the individual with the legal responsibility for inspecting a facility and approving the equipment in the facility as meeting applicable codes and standards.

Automatic Exciter Paralleling

Automatic exciter paralleling describes a system where two or more generator sets can be started and paralleled while coming up to rated frequency and voltage. Because the generator excitation system is not turned on until the generator set is started, thus the term "Dead Field", the generator sets automatically synchronize as they come to rated speed and voltage.

Backup Protection

Backup protection consists of protective devices, which are intended to operate only after other protective devices have failed to operate or detect a fault.

Base Load

The portion of a building load demand that is constant. It is the "base" of the building demand curve.

Black Start

Black start refers to the starting of a power system with its own power sources, without assistance from external power supplies.

Bumpless Transition

Bumpless transition is make-before-break transfer of an electrical load from one source to another where voltage and frequency transients are kept to a minimum.

Bus

Bus is a term that refers to the current-carrying copper bars that connect AC generators and loads in a paralleling system, to the paralleled output of the AC generators in a system, or to a feeder in an electrical distribution system.

Bus Bars

Bus bars are rectangular copper or aluminum bars that connect the out put of the generator set circuit breakers to the transfer switches, circuit breakers, or fusible switches that transfer power to the distributed loads. The bus bars are sized and assembled in multiples according to the current they must carry. There is one bar for each phase and for the neutral (if used). A typical sizing criteria for copper bus bars rated from 500-5000 amps is to maintain a current density of 1000 amps per square inch of cross sectional area. This results in a bus temperature rise at full load that is within acceptable limits.

Bus Capacity

Bus capacity is the maximum load that can be carried on a system without causing degradation of the generator frequency to less than a prescribed level (usually 59 Hz in a 60 Hz system).

Canadian Standards Association (CSA)

The Canadian Standards Association is a not-for-profit, membership-based association, serving business, industry, government and consumers in Canada and the global marketplace. CSA works in Canada and around the world to develop standards that enhance public safety & health, preserve the environment and help advance the quality of life.

Circuit

A circuit is a path for an electric current across a potential (voltage).

Circuit Breaker

A circuit breaker is a protective device that automatically interrupts the current flowing through it when that current exceeds a certain value for a specified period of time.

Circulating Harmonic Currents

Circulating harmonic currents are currents that flow because of differences in voltage waveforms between paralleled power sources, or induced by operation of non-linear loads.

Contactor

A contactor is a device for opening and closing an electric power circuit.

Continuous Load

A continuous load is a load where the maximum current is expected to continue for three hours or more, as defined by the NEC for electrical design calculations.

Cross Currents

Cross currents are currents that circulate between paralleled generator sets when the internal excitation voltage of one set is different from other sets. The set with the higher internal voltage supplies reactive power (kV AR) to the other sets. The amount of cross current that flows is a measure of this reactive power. Cross currents are 90 degrees out of phase (lagging) compared to the current that the generator would supply at 1.0 unity power factor.

Cross Current Compensation

Cross current compensation is a method of controlling the reactive power supplied by AC generators in a paralleling system so that they equally share the total reactive load on the bus without significant voltage droop.

Current Transformer (CT)

Current transformers are instrument transformers used in conjunction with ammeters, control circuits and protective relaying. They usually have 5-ampere secondaries.

Cross Current Transformer (CCT)

Current Transformers are used to step down the higher line current to the lower currents that the control system is designed for.

Current

Current is the flow of electric charge. Its unit of measure is the ampere.

Current Limiting Fuse

A current limiting fuse is a fast-acting device that, when interrupting currents in its current-limiting range, will substantially reduce the magnitude of current, typically within one-half cycle, that would otherwise flow.

Cycle

A cycle is one complete reversal of an alternating current or voltage, from zero to a positive maximum to zero again and then from zero to a negative maximum to zero again. The number of cycles per second is the frequency.

dB Scale

The decibel (dB) scale used in sound level measurements is logarithmic. Sound level meters often have several decibel weighting scales: A-scale, B-scale & C-scale. The A-scale, dB(A), is the most commonly used weighting scale for measuring the loudness of noise emitted from generator sets.

Dead Bus

Dead bus refers to the de-energized state of the power connections between outputs of paralleled generator sets. The term bus in this usage can either be rigid solid bus bars or insulated flexible cables.

Dead Field Paralleling

See Automatic Exciter Paralleling

Delta Connection

Delta connection refers to a three-phase connection in which the start of each phase is connected to the end of the next phase, forming the Greek letter “~”. The load lines are connected to the corners of the delta.

Demand Factor

The demand factor is the ratio of actual load to the potential total connected load.

Deviation Factor

The deviation factor is the maximum instantaneous deviation, in percent, of the generator voltage from a true sine wave of the same RMS value and frequency.

Dielectric Strength

Dielectric strength is the ability of insulation to withstand voltage without rupturing.

Direct Current (DC)

Direct current is current with no reversals in polarity.

Differential Relay

A differential relay is a protective device, which is fed by current transformers located at two different series points in the electrical system. The differential relay compares the two currents and picks up when there is a difference in the two measured currents. This action signifies a fault in the zone of protection. These devices are typically used to protect windings in generators or transformers.

Distribution Circuit Breaker

A distribution circuit breaker is a device used for overload and short current protection of loads that are connected to a main distribution device.

Distribution Switchgear

Distribution switchgear refers to electrical equipment, including automatic transfer switches, drawout airframe circuit breakers, fusible switches and molded case breakers that effectively transfer utility power or emergency generator power to given loads.

Draw Out Circuit Breaker

A circuit breaker mounted in a specially designed enclosure. It has a movable carriage and contact structures that permits the breaker to be removed from the enclosure without manually disconnecting power cables and control wires.

Droop Load Sharing

Droop load sharing is a method of making two or more parallel generator sets share a system kW load. This is accomplished by having each governor control adjusted so that the sets have the same droop (reduction of speed). Typical droop is two cycles in frequency from no load to full load.

Earth Fault Protection

See Ground Fault Protection

Efficiency (EFF)

Efficiency is the ratio of energy output to energy input, such as the ratio between the electrical energy input to a motor and the mechanical energy output at the shaft of the motor.

Electrical Operator

An electrical operator is the electric, motor-driven, operation of closing and tripping (opening) devices that permit remote control of a circuit breaker.

Emergency Bus

An emergency bus is the silver-plated copper bus bars or flexible cable used to connect paralleling breakers to the emergency system feeder breakers, and ultimately to automatic transfer switches or other distribution devices.

Emergency System

An emergency system is independent power generation equipment that is legally required to feed equipment or systems whose failure may present a life safety hazard to persons or property.

Energy

Energy is manifest in forms such as electricity, heat, light and the capacity to do work. It is convertible from one form to another, such as in a generator set, which converts rotating mechanical energy into electrical energy.

Exciter

An exciter is a device that supplies direct current (DC) to the field coils of a synchronous generator, producing the magnetic flux required for inducing output voltage in the armature coils or stator. See Field.

Fault

A fault is any unintentional flow of current outside its intended circuit path in an electrical system. This term may refer to either: (1) The failure of an operating piece of equipment, and the specific reason for the failure, or (2) An electrical distribution system failure, where there is a line-to-ground or line-to-line short circuit.

Feeder Circuit Breaker

This is the circuit breaker, usually mounted on the generator control panel, which monitors the alternating current input to the automatic voltage regulator. If a malfunction occurs in the excitation system, the circuit breaker trips on overcurrent, closing an auxiliary switch, thus shutting down the generator set, and energizing an alarm circuit.

Field

The generator field or rotor consists of a multi-pole electromagnet that acts to induce output voltage in the armature coils or stator of the generator when it is rotated by the engine. The field is energized by DC voltage, which is supplied by the exciter.

First Start Sensor

A first start sensor is an electronic device, usually contained within paralleling equipment, that senses generator set & bus voltage and frequency, and determines whether or not a generator set is the first unit ready to close to the bus following a call to start under "Black Start" conditions.

Free Field Noise Measurements

In noise measurements, a free field is a field in a homogeneous, isotropic medium (a medium having the quality of transmitting sound equally in all directions), which is free of boundaries. In practice, it is a field in which the effects of the boundaries are negligible in the proximity of interest. In a free field, the sound pressure level decreases 6 dB upon each doubling of the distance from a point source.

Frequency

Frequency is the number of complete cycles per unit of time of any periodically varying quantity, such as alternating voltage or current. It is usually expressed as (Hz) Hertz or CPS (cycles per second).

Frequency Potentiometer

A frequency potentiometer is typically used in two ways: (1) To fine tune the frequency (engine speed) of a single generator set to the desired setting, usually 60 hertz, or (2) To bring the frequency (engine speed) of a paralleling generator set to match that of the bus, for synchronizing purposes. When a generator set is paralleled, operation of this potentiometer will adjust the kW load assumed by the generator set.

Frequency Regulation

Frequency regulation is a measure that states the difference between no-load and full-load frequency as a percentage of full-load frequency.

Fusible Switch

A fusible switch is an isolating switch and overcurrent protective device used for feeder or transfer switch isolation and protection. It is typically a manually operated, stored energy, opening and closing, bolted compression blade switch, with provisions for installing current limiting fuses.

Generator

A generator is a machine, which converts rotating mechanical energy into electrical energy.

Ground Fault Protection

A ground fault protection system is a system designed to limit the amount of damage to equipment from line-to-ground fault currents.

Governor

A governor is a device on the engine, which controls fuel to maintain a constant engine speed under various load conditions. The governor must have provision for adjusting speed (generator frequency) and speed droop (no load to full load).

Ground

A ground is a connection, either intentional or accidental, between an electrical circuit and the earth or some conducting body serving in place of the earth.

Grounding

Grounding is the intentional connection of the electrical system or the electrical equipment (enclosures, conduit, frames etc.) to earth.

Grounding Bar

A grounding bar is a copper bar that electrically joins all the metal sections of a distribution switchboard. This bar is connected to the earth or other solid ground connection when the system is installed. This grounding protects personnel from stray currents that could leak to the metallic distribution enclosures.

Ground Fault Protection

Ground fault protection equipment functionally trips (opens) a circuit breaker and/or sounds an alarm in the event of an electrical fault between one or more of the phase conductors and ground. Ground fault protection may be incorporated into a circuit breaker.

Grounded Neutral

A grounded neutral is the intentionally grounded center point of a Y-connected, four-wire generator, or the mid-winding point of a single phase generator.

Ground Return

Ground return is a method of ground fault detection that employs a single sensor (CT) encircling the main bonding jumper between the power system neutral and ground. This device in itself is not capable of locating the faulted circuit but when used in conjunction with ground fault sensors on all feeders and source connections, can provide bus fault protection when properly coordinated.

Harmonics

Harmonics are voltage or current components, which operate at integral multiples of the fundamental frequency of a power system (50 or 60 Hertz). Harmonic currents have the effect of distorting the shape of the voltage waveform from that of a pure sinusoidal sine wave.

Harmonic Distortion (THD)

Total harmonic distortion is an expression of the total harmonic content of a voltage waveform. The harmonic distortion, or harmonic content, of a waveform is usually expressed as the square root of the sum of the squares of each of the harmonic amplitudes (with amplitude as a percent of the fundamental voltage amplitude).

Hertz (Hz)

The term Hertz is the accepted designation for cycles per second (CPS).

Hunting

Hunting or engine speed oscillation, is a phenomenon that can occur upon generator load changes in which the frequency or the voltage continues to rise above and fall below the desired value without reaching a steady-state value.

Import/Export Control

An Import/Export control is an electronic device used in utility paralleling systems to actively control the amount of electrical power created by a generator set while operating in parallel with the utility service.

Incoming Set

This is the generator set that is about to be connected to and paralleled with, the energized bus.

Insulation

Insulation is non-conductive material used to prevent leakage of electric current from a conductor. There are several classes of insulation in use for generator construction, each recognized for a maximum continuous-duty temperature.

Insulated Case Circuit Breaker

An insulated case circuit breaker is a power circuit breaker that is provided in a preformed case, similar to a molded case breaker.

Internal Voltage

Internal voltage is the voltage a generator would develop at no load if it were not connected in a parallel operation. Excitation of the generator field controls internal voltage.

Interruptible

This refers to the practice of operating onsite power systems, at the request of a utility, to reduce electrical demand on the utility grid during periods of high power consumption. Interruptible facilities may also be disconnected from all electrical service in the event of high demand on the utility grid, even if no on site power system is available.

Interrupting Capacity

Interrupting capacity is the magnitude of electrical current that a device can safely interrupt (open against), without failure of the component.

Isochronous Load Sharing (ILS)

ILS is a method of controlling the speed of paralleled generator sets so that all sets share the load equally, without any droop in frequency. This is accomplished with electronic governors controlled by isochronous load sharing modules, which are usually contained in the individual generator paralleling controls. ILS usually refers to the electronic component that provides this function.

kVA (kilo-Volt-Amperes)

kVA is a term for rating electrical devices. A device's kVA rating is equal to its rated output in amperes multiplied by its rated operating voltage. In the case of three-phase generator sets, kVA is the kW output rating divided by 0.8, the rated power factor. kVA is the vector sum of the active power (kW) and the reactive power (kVAR) flowing in a circuit.

kVAR (kilo-Volt-Amperes Reactive)

kVAR is the product of the voltage and the amperage required to excite inductive circuits. It is associated with the reactive power, which flows between paralleled generator windings and between generators, and load windings that supply the magnetizing currents necessary in the operation of transformers, motors and other electromagnetic loads. Reactive power does not load the generator set's engine but does limit the AC alternator thermally.

kW (kilo-Watts)

kW is a term used for power rating electrical devices and equipment. Generator sets in the United States are usually rated in kW. kW, sometimes called active power, loads the generator set's engine.

kWh (kilo-Watt-hour)

This is a unit of electric energy. It is equivalent to one kW of electric power supplied for one hour.

kW Load Alarm

An alarm that monitors the kilowatt output at some point in a system and initiates an alarm when the output exceeds a preset amount.

kW Load Sensor

An electronic device provided to sense kW level at various points in a system, for use in control functions within the system, such as kW Load Alarms, or load demand.

Lagging Power Factor

Lagging power factor in AC circuits (a power factor of less than 1.0) is caused by inductive loads, such as motors and transformers, which cause the current to lag behind the voltage. See Power Factor.

Leading Power Factor

Leading power factor in AC circuits (0.0 to -1.0) is caused by capacitive loads or over-excited synchronous motors, which cause the current to lead the voltage. See Power Factor.

Lead Unit

In a paralleling system that has a load demand feature, the lead unit is the last unit to be shut down in the event that load demand mode is in operation.

Leg

A leg is a phase winding of a generator, or a phase conductor of a distribution system.

Line Voltage

Regarding engine-driven, generator sets, typically refers to AC operating voltages from 120 to 600 VAC.

Line- To-Line Voltage

Line-to-line voltage is the voltage between any two phases of an AC generator.

Line- To-Neutral Voltage

In a 3-phase, 4-wire, Y-connected generator, line-to-neutral voltage is the voltage between a phase and the common neutral where the three phases are tied together.

Load Demand

A paralleling load demand system operates in a mode in which the system monitors the total kW output of all combined generator sets and controls the number of operating sets as a function of the total load demand on the system. The purpose of load demand is to control the number of generator sets operating which provides reduced fuel consumption and limits problems caused by light load operation of reciprocating diesel engine-generator sets.

Load Factor

The load factor is the ratio of the average load to the generator set power rating.

Load Management

Load management is the overall control of load connected to match available generator capacity. Priority control and load shedding are the two features required for load management.

Load Shedding

In the event of system bus overloading, load shedding is the process by which the total load on the paralleling system is reduced so that the most critical loads continue to be provided with reliable electrical service.

Low Voltage

Refers to generator AC system operating voltages from 120 to 600 VAC.

Main Breaker

A main breaker is a circuit breaker located at the input or output of the bus, through which all of the bus power must flow. The generator main breaker is the device, usually mounted on the generator set that can be used to interrupt generator set power output. Main breakers provide overcurrent protection and a single disconnect point for all power in a switchboard or device.

Mains

Mains is a term used primarily outside the United States to describe the normal or utility power service.

Master Control

A control section in a typical paralleling system that provides total system metering and the interface point between the paralleling system and the facility.

Medium Voltage

Refers to generator AC system operating voltages from 601 to 15,000 VAG.

Molded Case Circuit Breaker

A molded case circuit breaker automatically interrupts the current flowing through it when the current exceeds a certain level for a specified time. Molded case refers to the use of molded plastic as the medium of electrical insulation for enclosing the mechanisms and for separating conducting surfaces from one another and from grounded metal parts. Molded case circuit breakers usually contain thermal-magnetic trip units, although larger sizes can be equipped with solid-state trip sensors.

Motoring

In paralleling applications, if a generator set is not disconnected from the bus when its engine fails, the generator will drive or motor the engine, while drawing power from the bus. Reverse power protection is essential for paralleling systems as it will automatically disconnect a failed set from the bus to prevent motoring.

National Electrical Code (NEC)

This document is the most commonly referenced general electrical standard in the United States.

National Electrical Manufacturers Association (NEMA)

A standards writing organization commonly recognized in North America. Their standards and ratings define application descriptions and expected performance. Unlike UL & CSA, NEMA does not require independent testing of product; rather they leave the issue of compliance up to the manufacturer.

NEMA Type 1 Enclosure

Enclosures intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist.

NEMA Type 3R Enclosure

Enclosures intended for outdoor use primarily to provide a degree of protection against falling rain and sleet and which will remain undamaged by the formation of ice on the enclosure.

NEMA Type 4X Enclosure

Enclosures intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water and hose-directed water and which will remain undamaged by the formation of ice on the enclosure.

Neutral

Neutral refers to the common point of a Y-connected AC generator, a conductor connected to that point or to the mid-winding point of a single-phase AC generator.

Neutral Current

Neutral current is the current that flows in the neutral leg of a paralleling system. Often, this term is used in reference to circulating neutral currents or cross currents.

National Fire Protection Association (NFPA)

NFPA is an international non-profit membership organization founded in 1896 as the National Fire Protection Association. NFPA serves as the world's leading advocate of fire prevention and is an authoritative source on public safety. NFPA's 300 safety codes and standards influence every building, process, service, design, and installation in the United States, as well as many of those used in other countries.

Nonlinear Load

A nonlinear load is a load for which the relationship between voltage and current is not a linear function. Some common nonlinear loads are fluorescent lighting, SCR motor starters, MRI and/or X-ray equipment and UPS systems. Nonlinear loads cause abnormal conductor heating and voltage distortion.

Normal Standby Mode

Normal standby mode describes an operational condition whereby the power to the load is supplied entirely by the utility. The engine-generator set (or paralleling system) is in standby, ready to provide power to the load in the event of utility failure.

Octave Band

In sound pressure measurements (using an octave band analyzer), octave bands are the eight divisions of the measured sound frequency spectrum, where the highest frequency of each band is twice that of its lowest frequency. The octave bands are specified by their center frequencies, typically: 63, 125, 250, 500, 1,000, 2,000, 4,000 and 8,000 Hz (cycles per second).

Ohm

The ohm is a unit of electrical resistance. One volt will cause a current of one ampere to flow through a resistance of one ohm.

On-Set Paralleling

On-set paralleling is a manual paralleling system that is built onto the generator set, no additional switchboards are required.

One-Line Diagram (Single Line Diagram)

A one-line diagram is a schematic diagram of a three-phase power distribution system, which uses one line to show all three phases. It is understood when using this easy to read drawing that one line represents three.

Operating Source

An operating source is a source of electrical power that delivers power to a load. The operating source can be either a generator set or a commercial (utility bus) power line.

Out-Of-Phase

Out-of-phase refers to alternating currents or voltages of the same frequency, which are not passing through their zero points at the same time.

Overload Rating

The overload rating of a device is the load in excess of the nominal rating the device can carry for a specified length of time without being damaged.

Overshoot

Overshoot refers to the amount by which voltage or frequency exceeds the nominal value as the voltage regulator or governor responds to changes in load.

Overlapping Neutral

Overlapping neutral is a feature of some 4-pole (switched neutral) transfer switches in which all the neutral contacts of the switch remain closed during the time that the phase conductors are operating.

Parallel Operation

Parallel operation is the operation of two or more AC power sources whose output leads are connected to a common load. Connection of the power sources is made so that the sources electrically function as a single source of power. Parallel operation requires that two or more sources of electrical power must match in voltage, frequency, and number of phases.

Paralleling Breaker

A paralleling breaker is the circuit breaker that connects the generator set to the emergency bus, and across which all the individual generator-synchronizing functions occur.

Paralleling Control

A paralleling control contains all essential components electrical equipment required in a paralleling system for control of a single generator set.

Paralleling Suppressors

Paralleling suppressors are semi-conductor devices that protect the silicon diodes on a brushless excitation system from harmful overvoltage. Overvoltage, usually of short duration, occur when a generator is paralleled out of phase with the energized bus.

Peak Load

Peak load is the highest point in the kilowatt demand curve of a facility. This is used as the basis for the utility company's demand charge.

Peak Shaving

Peak shaving is the process by which loads in a facility are reduced for a short time to limit maximum electrical demand in a facility and to avoid a portion of the demand charges from the local utility.

Permissive Paralleling

Permissive paralleling is a feature found in paralleling switchboards that prevents out-of-phase manual paralleling. A synchronizing check relay prevents the electrical closing of the electrically operated circuit breaker if the incoming set is outside of the frequency or phase angle limits required for proper paralleling to a bus.

Phase

Phase refers to the windings of an AC generator. In a three-phase generator there are three windings, typically designated as A-B-C, R-S-T or U-V-W. The phases are 120 degrees out of phase with each other. That is, the instants at which the three phase voltages pass through zero or reach their maximums are 120 degrees apart, where one complete cycle is considered 360 degrees. A single-phase generator has only one winding.

Phase Angle

Phase angle refers to the relation between two sine waves, which do not pass through zero at the same instant, such as the phases of a three-phase generator. Considering one full cycle to be 360 degrees, the phase angle expresses how far apart the two waves are in relation to a full cycle.

Phase Rotation

Phase rotation (or phase sequence) describes the order (A-B-C, R-S-T or U-V-W) of the phase voltages at the output terminals of a three-phase generator. The phase rotation of a generator set must match the phase rotation of the normal power source for the facility and must be checked prior to operation of the electrical loads in the facility.

Pitch

Pitch is the ratio of the number of generator stator winding slots enclosed by each coil to the number of winding slots per pole. It is a mechanical design characteristic a generator designer may use to optimize generator voltage waveform quality.

Pole

Pole is used in reference to magnets, which are bipolar. The poles of a magnet are designated North and South. Because magnets are bipolar, all generators have an even number of poles. The number of poles determines how fast the generator will have to be turned to obtain the specified frequency. For example, a generator with a 4-pole field would have to be run at 1800 rpm to obtain a frequency of 60 Hz (1500 rpm for 50 Hz). Pole can also refer to the electrodes of a battery or to the number of phases served by a switch or breaker.

Power Circuit Breaker

A power circuit breaker is a circuit breaker whose contacts are forced closed via a spring-charged, over-center mechanism to achieve fast closing (5-cycle) and high withstand and current interrupting ratings. A power circuit breaker can be an insulated case or power air circuit breaker.

Power

Power refers to the rate of performing work or of expending energy. Typically, mechanical power is expressed in terms of horsepower and electrical power in terms of kilowatts. One kW equals 1.34 hp.

Power Factor (PF)

The inductances and capacitances in AC circuits cause the point at which the voltage wave passes through zero to differ from the point at which the current wave passes through zero. When the current wave precedes the voltage wave, a leading power factor results. When the voltage wave precedes the

current wave, a lagging power factor results. This is generally the case. The power factor expresses the extent to which the voltage zero differs from the current zero. Considering one full cycle to be 360 degrees, the difference between the zero points can then be expressed as an angle. Power factor is calculated as the cosine of the angle between zero points and is expressed as a decimal fraction (.8) or as a percentage (80%). It is the ratio of kW and kVA.. ($kW = kVA \times PF$.)

Prime Power

Prime power describes an application where the generator set must supply power on a continuous basis and for long periods of time between shutdowns. No utility service is present in typical prime power applications.

Radio Interference

Radio interference refers to the interference with radio reception caused by a generator set.

Radio Interference Suppression

Radio interference suppression refers to the methods employed to minimize radio interference.

Random Access Paralleling

Random access paralleling is a paralleling operation where any generator may be the first unit to close to the bus on startup of the system. Random access systems use active synchronizing to force the second and all subsequent generator sets to close to the bus as fast as possible.

Reactance

Reactance is the opposition to the flow of current in AC circuits caused by inductances and capacitances. It is expressed in terms of ohms and its symbol is X.

Reactive Differential Compensation

Reactive differential compensation is a method of controlling the reactive power supplied by generators in a paralleling system so that they share equally, the total reactive load on the bus without inducing significant voltage droop in the system. See Cross Current Compensation

Reactive Droop Compensation

Reactive droop compensation is a method used in paralleling generator sets to enable them to share reactive power supplied to a load. This system causes a drop in the internal voltage of a set when reactive currents flow from that generator. Typically, at full load, 0.8 PF, the output voltage of a set is reduced by 4% from that at no load when reactive droop compensation is used.

Reactive Power

Reactive power is power that flows back and forth between the inductive windings of the generator and the inductive windings of motors, transformers, etc., which are part of the electrical load. Reactive power is the product of current, voltage and the sine of the angle by which current leads or lags voltage and is expressed as VAR (volts-amperes-reactive).

This power does no useful work in the electrical load nor does it present load to the engine. It does apply load to the AC alternator and limits the capacity of the generator.

Real Power

Real power is the product of current, voltage and power factor (the cosine of the angle by which current leads or lags voltage) and is expressed as W (watts).

Redundant Parallel Configuration

A redundant parallel configuration is a paralleling system that is designed with extra generator sets in the system, so that the failure of one (or more) of the generator sets will not require load shedding.

Regenerative Power

The application of equipment loading having motor-generator drives, such as elevators, which creates regenerative power. In this type of application, the descent of the elevators is slowed by the motor-generator, which pumps electrical power back to the source, which absorbs it. The normal utility source easily absorbs regenerated power because it is essentially an unlimited power source. A generator set however, has a limited capability of absorbing regenerative power, which is typically 10 ~ 20% of the generator set power rating. Functionally, regenerative power forces the generator to drive the engine, which absorbs energy by friction loss. Insufficient regenerative power capability can result in excessive elevator descent speed and overspeeding of the engine-generator. In this case, the addition of a generator load bank might be required to supplement the regenerative power of the generator set.

Resistance

Defined as the opposition to the flow of current in DC circuits. It is expressed in ohms and its symbol is R.

Reverse Power Relay

A reverse power relay senses the direction of power flow. In paralleled sets, a flow of reverse power (i.e., power flow into a set) will activate the reverse power relay and disconnect the set from the system. If one set stops and reverse power protection is not provided, the set still running will drive the set that has stopped. See Motoring

Risers

Risers are rectangular copper or aluminum bars that connect circuit breakers, fusible switches, and transfer switches with the main system bus. As with bus bars, they are sized and assembled in multiples according to the total amount of current they must carry.

Root Mean Square (RMS)

The RMS values of a measured quantity such as AC voltage, current and power are considered the "effective" values of the quantities.

Rotor

A rotor is the rotating element of a motor or generator.

Revolutions Per Minute (RPM)

The measurement of speed at which an engine-driven generator set operates. Typically, either 1800 RPM for 60 hertz operation or 1500 RPM for 50 hertz operation.

Silicon Controlled Rectifier (SCR)

A SCR is a three-electrode, solid-state device, which permits current to flow in one direction only, and does this only when a suitable potential is applied to the third electrode, called the gate.

Selective Coordination

Selective coordination is the selective application of overcurrent devices such that short circuit faults are cleared by the device immediately on the line side of the fault, and only by that device.

Separately Derived System

A separately derived on-site power system has no direct neutral connection with the neutral of the normal electrical service.

Sequential Paralleling

Sequential paralleling is a type of automatic paralleling system where the generators in a system close to the bus in a prescribed order, typically by use of a single synchronizer.

Service Entrance

The service entrance is the point where the utility service enters a facility.

Short Circuit

A short circuit is generally an unintended electrical connection between current carrying parts.

Shunt Trip

Shunt trip is a feature added to a circuit breaker or fusible switch to permit the remote opening of the breaker or switch by an electrical signal.

Sine Wave

A sine wave is a graphical representation of a sine function, where the sine values (usually the y axis) are plotted against the angles (x axis) to which they correspond. AC voltage and current wave shapes approximate such a curve.

Soft Loading

Soft loading refers to the ramping of load on or off a generator in a gradual fashion for the purpose of minimizing voltage and frequency transients on the system.

Sound

Sound is considered both in terms of the sound pressure waves traveling in air (pressures superimposed on the atmospheric pressure) and the corresponding aural sensation. Sound can be "structure-borne", that is, transmitted through any solid elastic medium, but is audible only at points where the solid medium "radiates" the pressure waves into the air.

Sound Level Meter

A sound level meter measures sound pressure level. It has several frequency- weighted decibel (dB) scales (A, B, C) to cover different portions of the range of measured loudness. Sound level meters indicate RMS sound, unless the measurements are qualified as instantaneous or peak sound level.

Sound Pressure Level

Sound pressure level refers to the magnitude of the pressure differential caused by a sound wave. It is expressed on a dB scale (A,B,C) referenced to some standard (usually 10-12 microbars). See dBA

Standby System

A standby system is an independent power system that allows operation of a facility in the event of normal power failure.

Steady State Rating

Steady state rating is the maximum load that a generator set or paralleling system can carry, on a continuous basis, for the duration of a utility power outage.

Star Connection

See Wye Connection.

Starting Current

The initial value of current drawn by a motor when it is started from standstill.

Stator

The stator is the stationary part of a generator or motor. See Armature.

Surge

Surge is the sudden rise in voltage in a system, usually caused by load disconnect.

Surge Rating

Surge rating is the rating of a machine, usually in excess of its normal operating level, for which it can provide power for a very short time.

Surge Suppressor

Surge suppressors are devices capable of conducting high transient voltages. They are used for protecting other devices that could be destroyed by the transient voltages.

Synchronization

In a paralleling application, synchronization is obtained when an incoming generator set is matched with and in-sync to the same frequency, voltage, and phase sequence as the operating power source.

Synchronizer

An electronic device that monitors the phase relationship between two voltage sources and provides a correction signal to an engine governor, to force the generator set to synchronize with a system bus.

Synchronizing Lights

Synchronizing lights are lamps connected across the line contactor of the incoming generator set. The lights indicate when the voltage waveforms of the incoming and operating power sources coincide and paralleling can be completed.

Synchroscope

A meter that indicates the relative phase angle between an incoming set voltage and the bus voltage. The synchroscope pointer indicates whether the set is faster or slower than the bus and allows the operator to adjust the frequency (speed) accordingly before manually paralleling to the bus.

Sync-Check Relay

A sync-check relay is an electrical device that monitors the phase relationship between two voltage sources and provides a signal when the voltage sources are within specific preset parameters.

Synchronous Generator

A synchronous generator is an AC generator having a DC exciter. Synchronous generators are used as stand-alone generators for emergency power and can also be paralleled with other synchronous generators & a public utility.

Telephone Influence Factor (TIF)

The higher harmonics in the voltage wave shape of a generator can cause undesirable effects on telephone communications when power lines parallel telephone lines. The telephone influence factor is calculated by squaring the weighted RMS values of the fundamental and the non-triple series of harmonics, adding them together and then taking the square root of the sum. The ratio of this value to the RMS value of the no-load voltage wave is called the Balanced TIF. The ratio of this value to three times the RMS value of the no-load phase-to-neutral voltage is called the Residual Component RIF.

Transfer Switch

A transfer switch is an electrical device for switching loads between alternate power sources. An automatic transfer switch monitors the condition of the sources and connects the load to the alternate source if the preferred source fails.

Transformer

A transformer is a device that changes the voltage of an AC source from one value to another.

Transient Voltage Dip

Transient voltage dip occurs instantaneously when a motor is started. It is the product of the motor's locked rotor current and the generator set sub-transient reactance.

Undershoot

Undershoot refers to the amount by which voltage or frequency drops below the nominal value as the voltage regulator or governor responds to changes in load.

Underwriter's Laboratories (UL)

Underwriters Laboratories is an independent, non-profit, product-safety testing and certification organization. Founded in 1894, UL is a leader in product-safety testing and certification within the United States. UL is one of the most recognized conformity assessment providers in the world.

Utility

A commercial power source that supplies electrical power to specific facilities from a large central power plant.

Volt

The volt is a unit of electrical potential. A potential of one volt will cause a current of one ampere to flow through a resistance of one ohm.

Voltage Dip

Voltage dip is the dip in voltage that results when a load is added, occurring before the regulator can correct it, or resulting from the functioning of the voltage regulator to unload an overloaded engine-generator.

Voltage Regulation

Voltage regulation is a measure that states the difference between maximum and minimum steady-state voltage as a percentage of nominal voltage.

Voltage Regulator

A voltage regulator is a device that maintains the voltage output of a generator near its nominal value in response to changing load conditions.

Voltage Rheostat

A rheostat that sets the operating point of the voltage regulator and thereby controls the output voltage of the generator set, within its design limits.

Watt

The watt is a unit of electric power. In direct current (DC) circuits, wattage equals voltage times amperage. In alternating current (AC) circuits, wattage equals effective (RMS) voltage times effective (RMS) amperage times power factor times a constant dependent on the number of phases.

Wattmeter

A wattmeter records power being delivered from a source to the load. Wattmeters for paralleling systems are calibrated in kilowatts.

Watthour Meter

A watthour meter records the total power output at a specific point in a system. Typical recording increment is in kW-hours.

Watthour Demand Meter

A watthour demand meter is similar to a watthour meter except that it also provides an indication of the highest kW load level achieved during operation.

Wye Connections

A Wye connection is the same as a Star Connection. It is a method of interconnecting the phases of a three-phase system to form a configuration resembling the letter Y. A fourth (neutral) wire can be connected at the center point.