

Introduction

This Manual is intended to provide guidance in the selection and application of transfer switch equipment in a variety of power generation situations. Transfer equipment is available in many configurations, all sharing the same basic function, that of providing a means to connect electrical loads to either of two independent power sources. Equipment is also available to connect loads to more than two sources but most of the discussion in this manual is directed to two source transfer. This equipment is used to increase the availability and reliability of power to serve the load equipment. In many cases, this equipment may be required by codes and standards, developed and enforced on a national and local level. Proper selection and application of this equipment is the ultimate responsibility of qualified facility designers and engineers.

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Compliance with all applicable local codes and standards is the responsibility of other qualified professionals accountable for facility design and installation. In any installation where transfer equipment will be used to establish a parallel connection between facility on-site generation with the normal utility source, apply equipment designed for that purpose and approved by the utility.

Definitions

The following terms are pertinent to the design and application of transfer switch equipment and are used in this Manual. Where possible, definitions are extracted from sources that developed them with industry consensus such as IEEE, NEMA and NFPA.

Ampacity – The current, in amperes, that a conductor or equipment can carry continuously under the conditions of use without exceeding its temperature rating.

Approved – As used in this document, acceptable to the authority having jurisdiction for permitting equipment installation in a facility.

Arc chute – A structure affording a confined space or passageway, lined with arc resisting material, into or through which, an arc is directed to extinction.

Arcing contacts – The contacts of a switching device on which the arc is drawn after the main contacts have parted.

Automatic transfer switch – Self acting, operating by its own mechanism when actuated by some impersonal influence (such as a voltage sensor).

Branch circuit – The circuit between the final overcurrent device protecting the circuit and the load.

Bypass isolation switch – See switch, bypass isolation.

Definitions (cont'd)

Closed transition – In transfer equipment, a method of switching the load between sources without interrupting power to the load.

Closing rating – The RMS symmetrical current a transfer switch can safely close into and conduct during short circuit conditions.

Enclosure – A surrounding case or housing used to protect the contained conductor or equipment against external conditions and to prevent operating personnel from accidentally contacting live parts.

Equipment ground – A ground connection to noncurrent-carrying metal parts of a wiring installation or of electric equipment, or both.

Equipment grounding conductor – The conductor used to connect the noncurrent-carrying metal parts of equipment, raceways, and other enclosures to the service equipment, the service power source ground, or both.

Feeder circuit – All circuit conductors between the service equipment (or the generator switchboard) and the final branch circuit overcurrent device.

Ground – A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or some conducting body that serves in place of the earth.

Ground fault protection – A system intended to provide protection of equipment from damaging ground faults by operating to cause a disconnecting means to open all ungrounded conductors of the faulted circuit.

Grounded conductor – A system or circuit conductor that is intentionally grounded.

Grounding conductor – A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.

In-phase monitor – A device that monitors the relative phase angle between the two power sources serving a transfer switch. This device is used with the controls of an automatic transfer switch as a permissive control to allow transfer between the two power sources only upon the condition of the two sources achieving a near synchronous condition.

Interrupting rating (capacity) – The highest current at rated voltage that a device can safely interrupt.

Isolating switch – See switch, isolating.

Listed – Equipment, materials or services included in a list published by an organization that is acceptable to an authority (inspector) having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that the equipment, material or services either meets appropriate designated standards or has been tested and found suitable for a specified purpose.

Neutral conductor – The conductor that is intended to be so energized, that, in the normal steady state, the voltages from every other conductor to the neutral conductor are definitely related and usually equal in amplitude.

Definitions (cont'd)

Neutral ground – An intentional ground applied to the neutral conductor or neutral point of a circuit, transformer, machine, apparatus, or system.

Nonautomatic switch – A switch that requires personal intervention for its control.

Nonlinear load – Any electrical load where, when a sinusoidal voltage is applied, a nonsinusoidal current results. Typically solid state type loads which, when connected to a sinusoidal power source, induce harmonic currents in the power system, causing voltage distortion of the power source and may cause current to flow in the neutral conductor.

Open transition – In transfer equipment, a method of switching the load between sources, where power to the load is intentionally interrupted during switching.

Overcurrent – Any current in excess of the rated current of equipment or the ampacity of a conductor.

Overlapping neutral pole – In a four-pole switch, the fourth or neutral pole that is switched in an overlapping fashion with the main phase poles. Commonly, the neutral pole is operated to close the neutral before opening phase poles and maintain the two source neutrals connected until after the phase poles have been switched.

Overload – Operation of equipment in excess of normal, full load rating, or of a conductor in excess of rated ampacity.

Pole – That portion of a device associated exclusively with one electrically separated conducting path (whether phase or neutral) of the main circuit of the device. If a switch has more than one pole, it may be called multi-pole (three-pole, four-pole, etc.) provided the poles are coupled in such a manner as to operate together.

Program(med) transition – A transfer switch control function that causes an intentional delay, during load transfer, in the open position. This function is normally used to allow voltage at the load terminals to decay prior to reconnecting the load to an energized source.

Separately derived system – A premises wiring system whose power is derived from a battery, from a solar voltaic system, or from a generator, transformer or converter windings, and that has no electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

Service – The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

Service (rated) equipment – The necessary equipment usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and accessories, connected to the load end of service conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main control and cutoff of the supply. This includes ground fault protection where required.

Short circuit – An overcurrent resulting from a fault of negligible impedance between live conductors having a difference in potential under normal operating conditions.

Definitions (cont'd)

Switch, bypass isolation – A manually operated device used in conjunction with a transfer switch to provide a means of directly connecting load conductors to a power source and of disconnecting the transfer switch.

Switch, isolating – A switch intended for isolating an electric circuit from the source of power. It has no interrupting rating and is intended to be operated only after the circuit has been opened by some other means.

Switch, transfer – An automatic or nonautomatic device for transferring one or more load conductor connections from one power source to another.

Switched neutral pole – In a four pole switch, the fourth or neutral pole that is switched simultaneously with the main phase poles.

Transfer switch – See switch, transfer.

Withstand rating – The RMS symmetrical current a transfer switch can safely conduct during short circuit conditions.

Transfer Equipment Purpose

Although there are many variations of transfer equipment with different construction, operating modes, and controls, the basic purpose of this equipment, as discussed in this manual, is to provide a means to switch electrical loads between available power sources. This equipment is used to increase availability and reliability of power to the load equipment. This equipment can be manually or automatically operated, open or closed transition, include feeder and load overcurrent protection, employ mechanical or electronic switching means. This manual is intended to provide guidance for the application of this equipment in a variety of uses, where mandated by governing codes or desired for critical processes. Frequently, this equipment is used to transfer the load from the normal utility source to a back-up generator and is supplemented by either a rotary or static UPS to achieve uninterruptible power.

Related Codes and Standards

The following codes and standards are applicable to the design, application and installation of transfer equipment. This is intended for reference only and not intended to be all inclusive. Be sure to check with the local authorities having jurisdiction for the installation location.

IEC 947	NFPA 70
UL 1008	NFPA 110
CSA 282	NFPA 99
NEMA ICS10	CEC