Transfer Switch Fundamentals: Features and Functions Overview

PowerHour webinar series for consulting engineers

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May 3rd, 2022 1:00 Eastern / 10:00 Pacific
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Director - Sales Application Engineering

Cummins facilitator

Mark Taylor
Technical Marketing Advisor
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Course Objectives

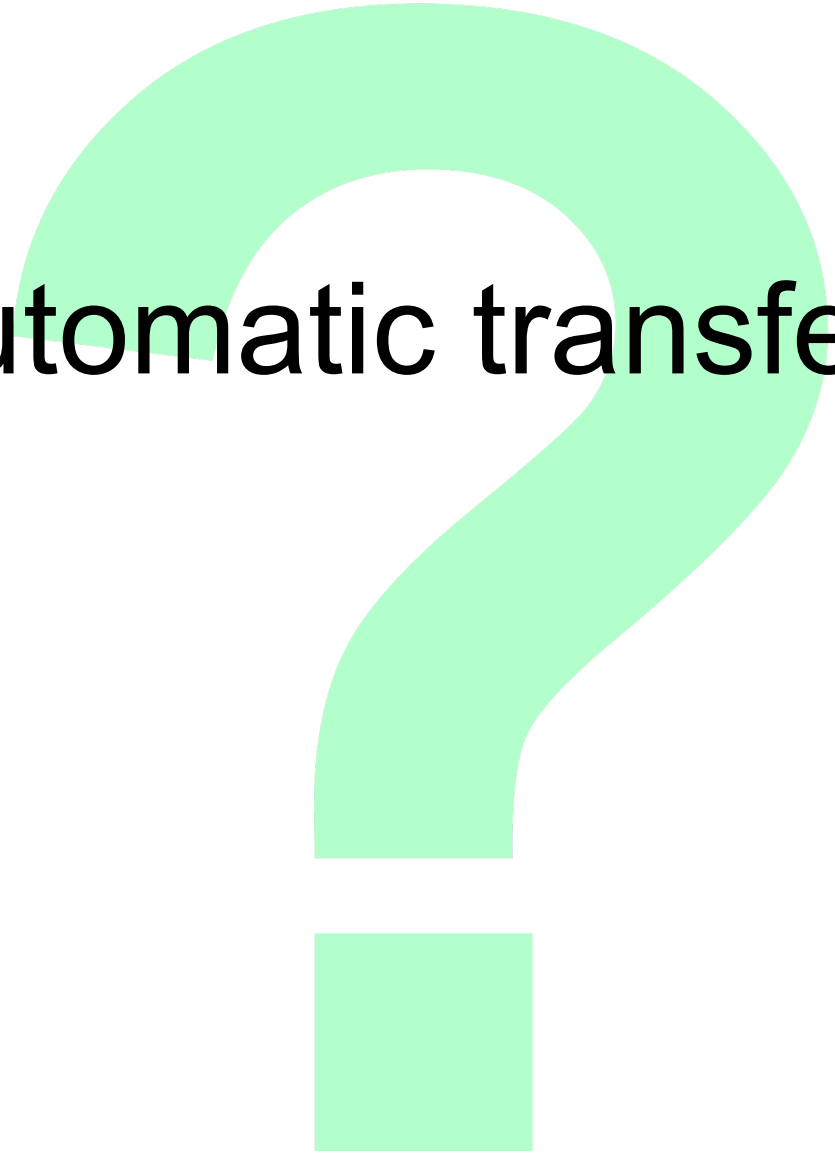
Transfer Switch Fundamentals: Features and Functions Overview

Transfer switches are a vital piece of the puzzle to any electrical or power system. Available in a variety of types with a wide array of options, it is important to understanding these features and functions for the success of any power system. This webcast will review the basics of ATS fundamentals.

After completing this course, participants will be able to:

- Describe the basic operational features and functions of a working transfer switch.
- Recognize the different installation types associated with transfer switch applications.
- Identify the codes and standards associated with transfer switch operation.

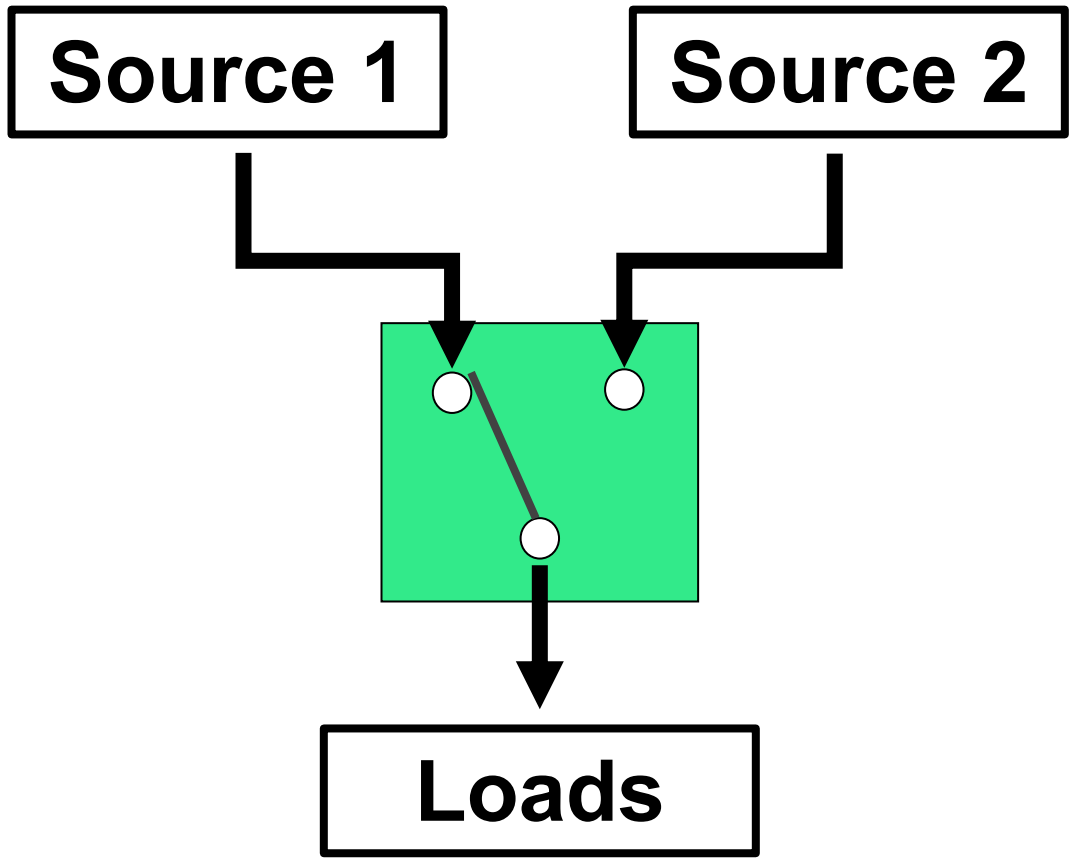
Why is an automatic transfer switch needed?



Why is a Transfer Switch Needed?

Transfer switches are needed to ensure the continuous delivery of electrical power from one of two power sources to a connected load circuit

What does a Transfer Switch Do?



Load transfer between power sources - ATS control monitors quality of both sources

- Voltage, Frequency, Phase Rotation, Phase Loss

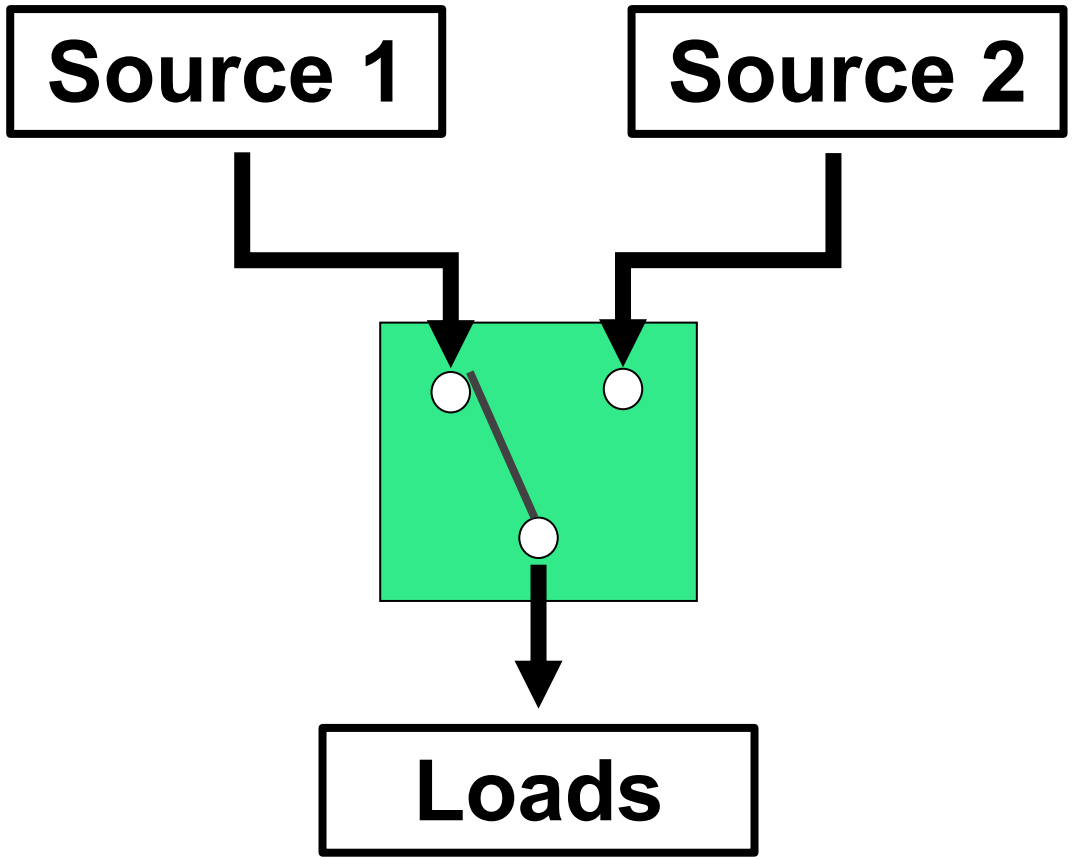
Also allows for

- Means of transferring loads between two power sources
- Allows testing of generator sets
- Allows shedding of non-critical loads
- Allows stepping of loads onto a single generator set

Transfer Switch Functionality

Load transfer between power sources

- Transfer switch control monitors quality of both sources
  - Voltage, Frequency, Phase Rotation, Phase Loss



Transfer Switch Functionality

Load transfer between power sources

- Transfer switch control monitors quality of both sources
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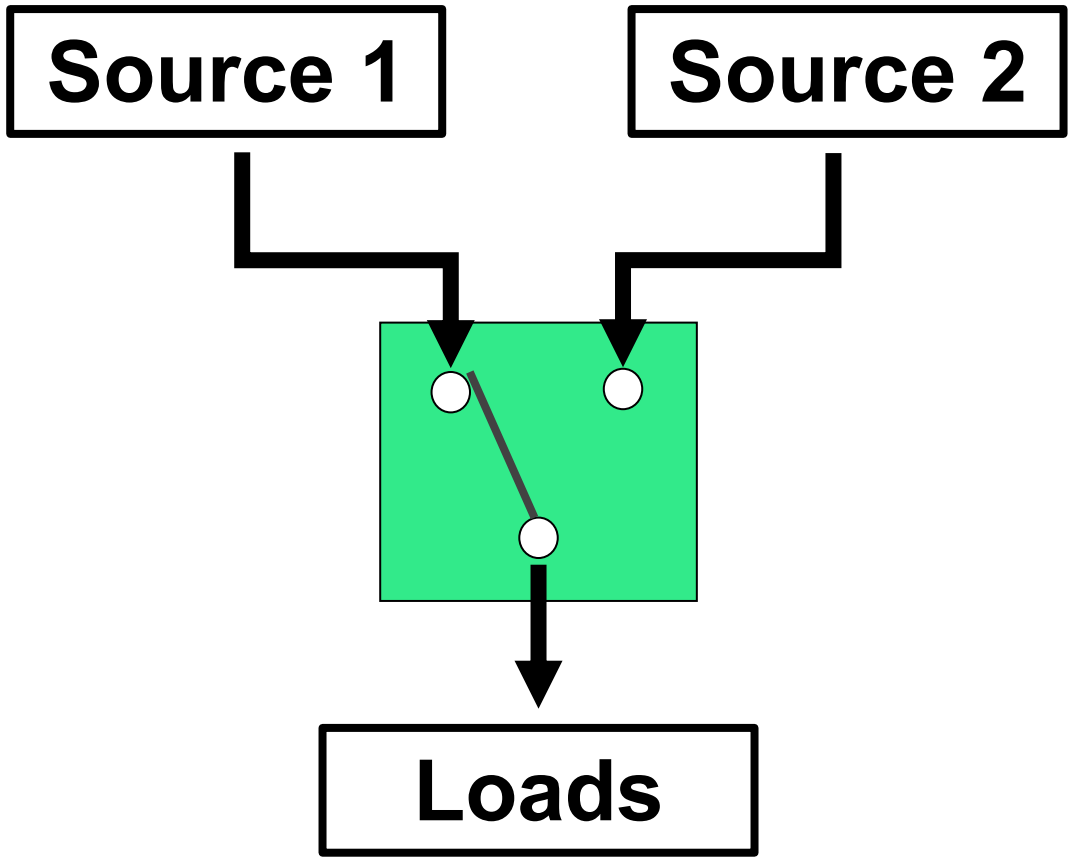
Load shed

- Three position transfer switch is recommended for load shedding
- Emergency systems [NEC 2017 700.4 (B)] may require load shed functionality



Transfer Switch Functionality

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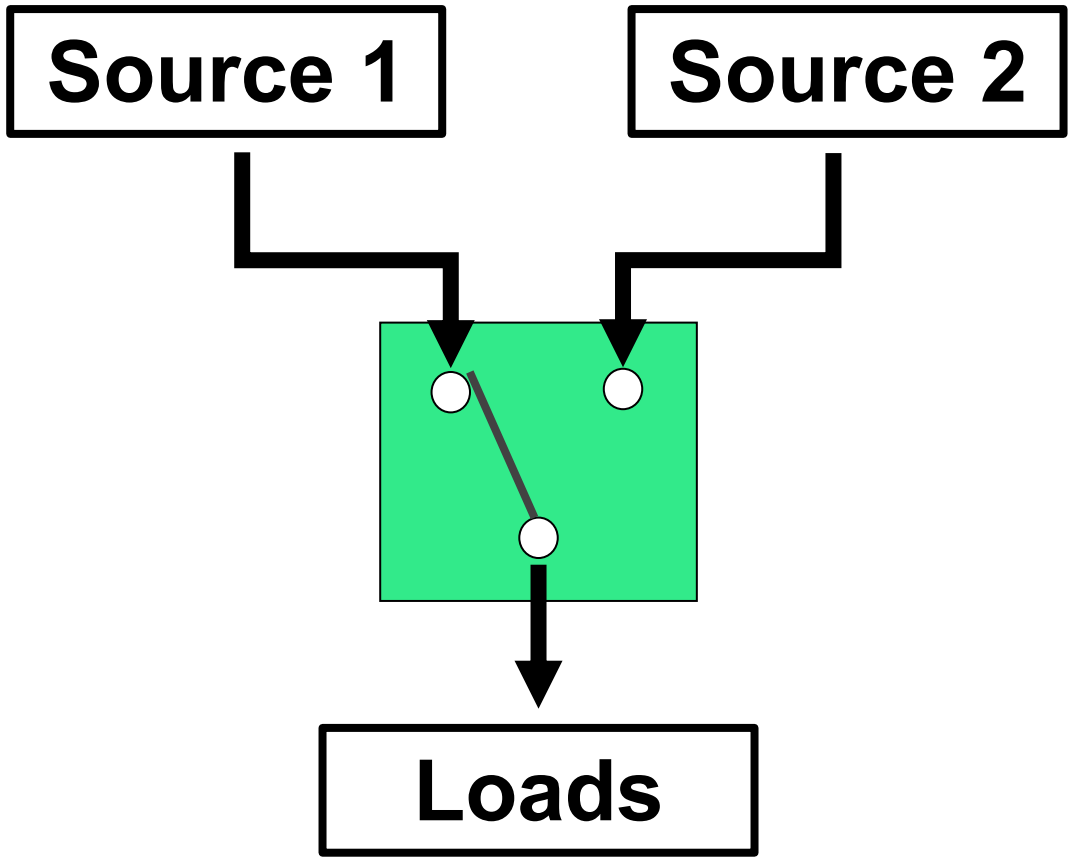
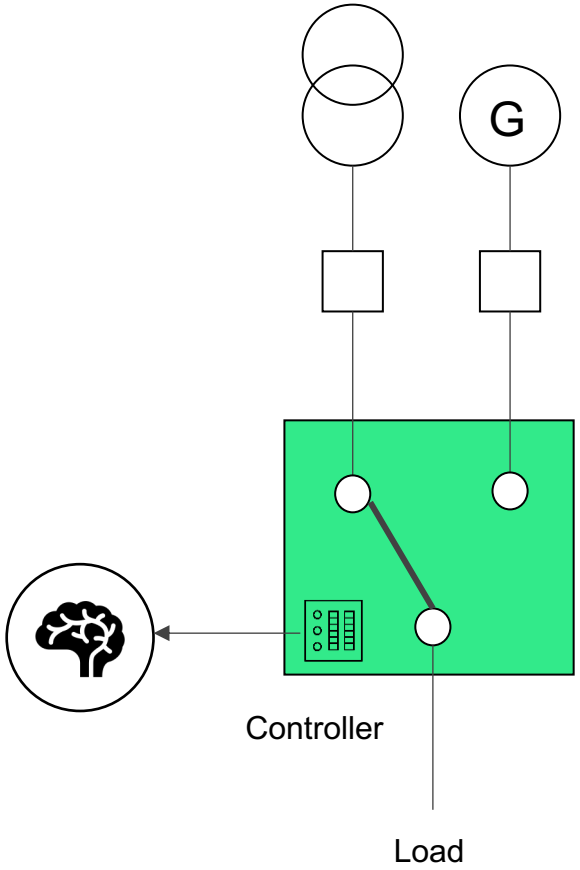
Load sequencing

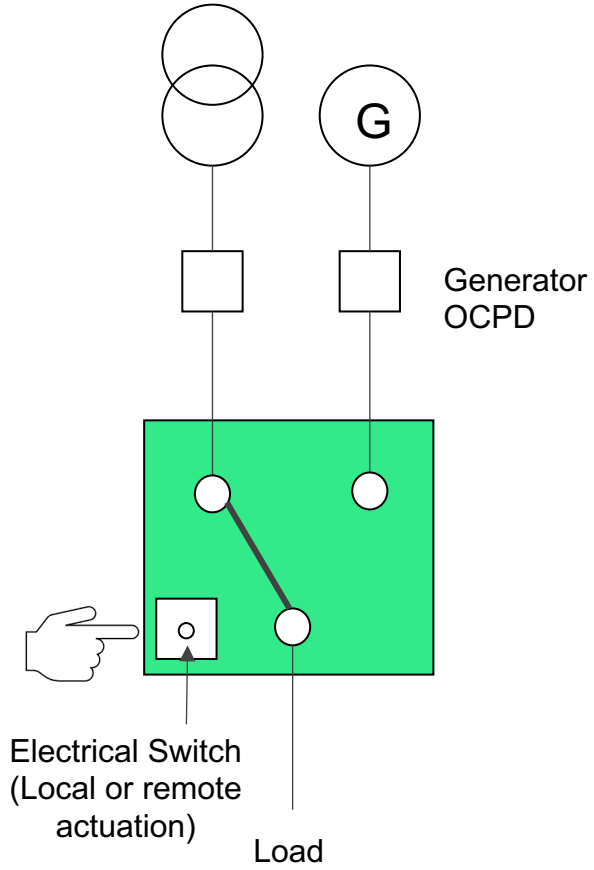
- Multiple transfer switches with different time delays: e.g. motor loads



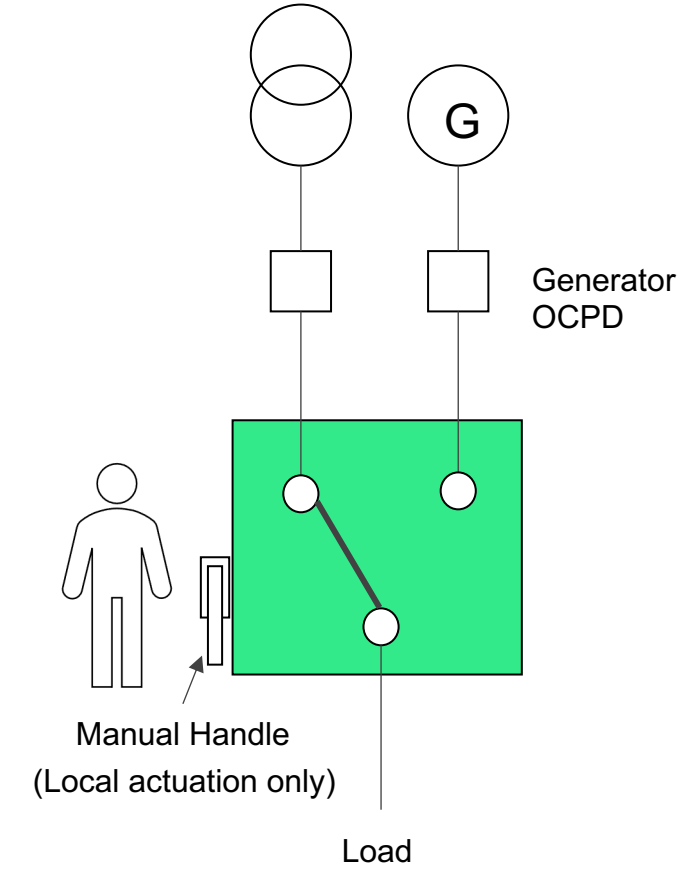
Different Types of Transfer Switches



Automatic Transfer Switch

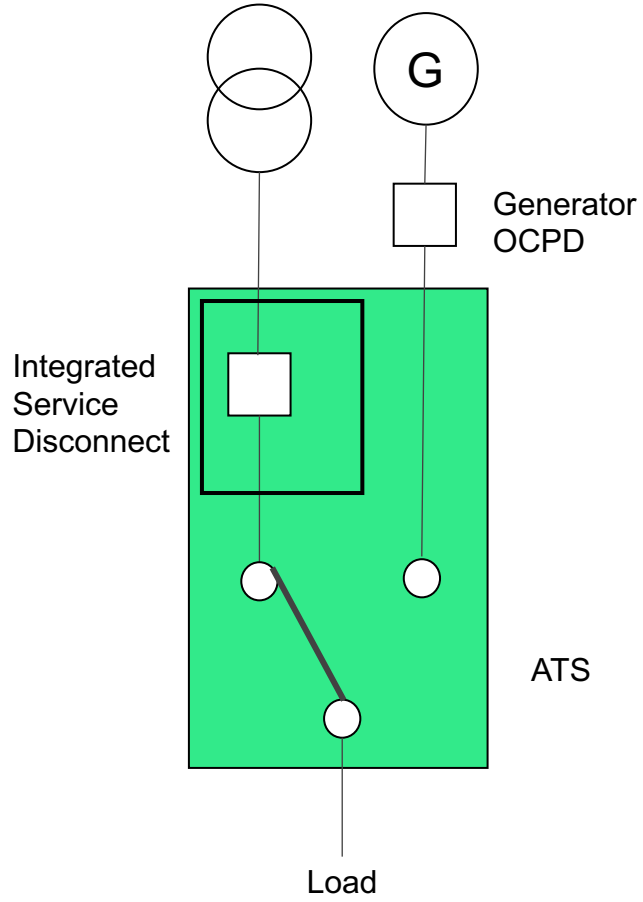


Non-Automatic Transfer Switch

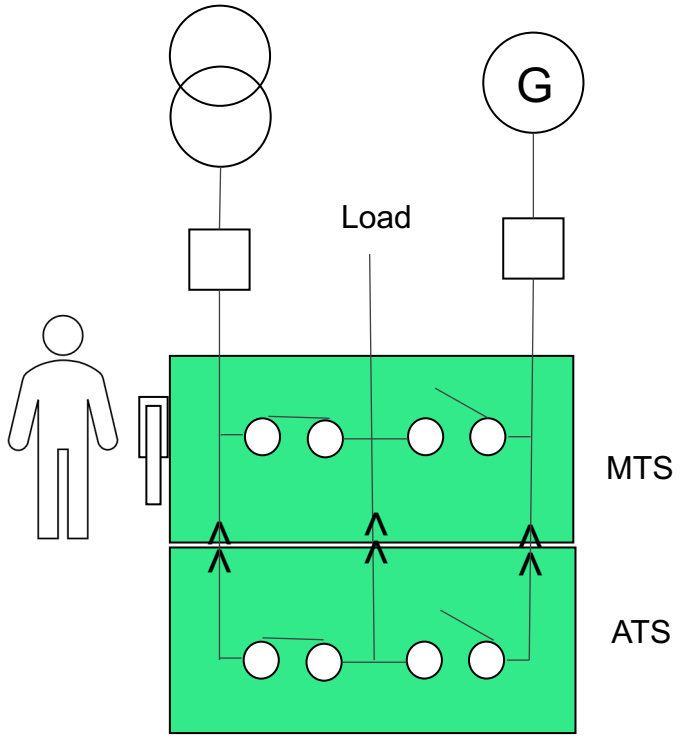


Manual Transfer Switch

Different Types of Transfer Switches

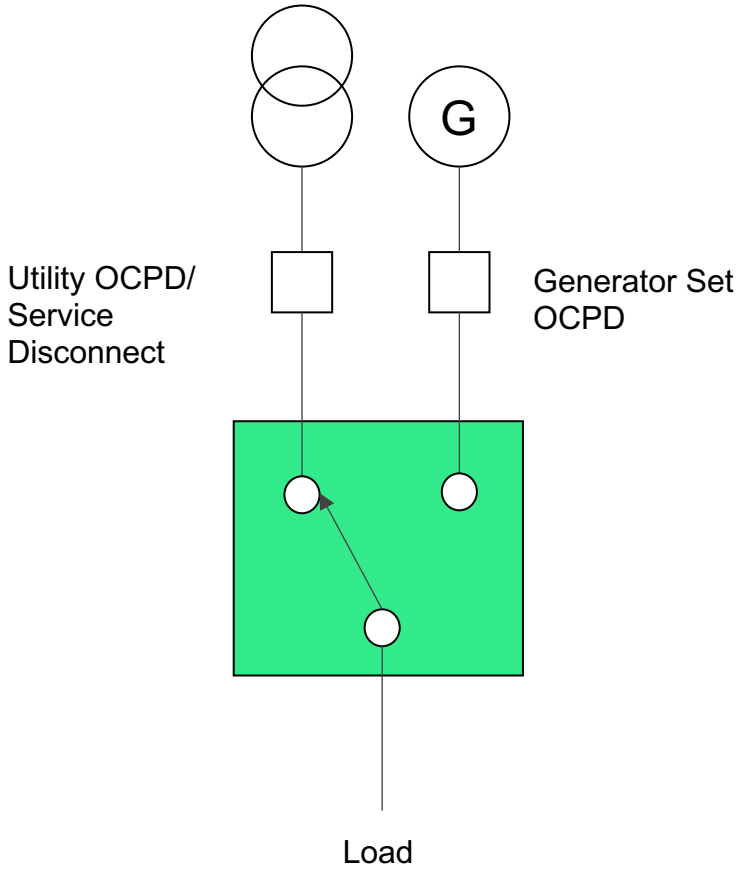


Service Entrance Rated Transfer Switch

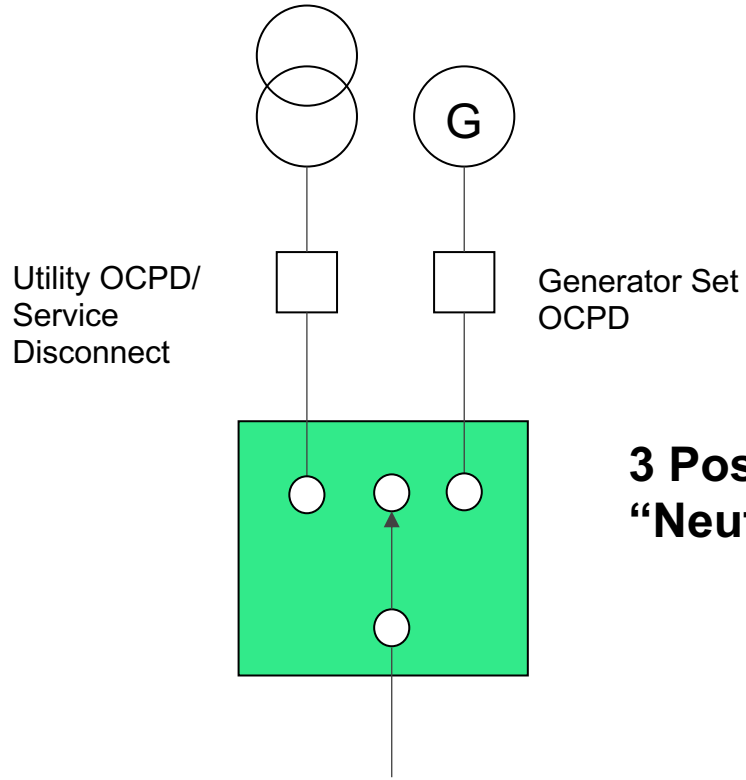


Bypass Isolation Transfer Switch

Two Position vs. Three Position Switches



2 Position
"Double Throw"



3 Position
"Neutral Position Delay"

Overcurrent Protection Device

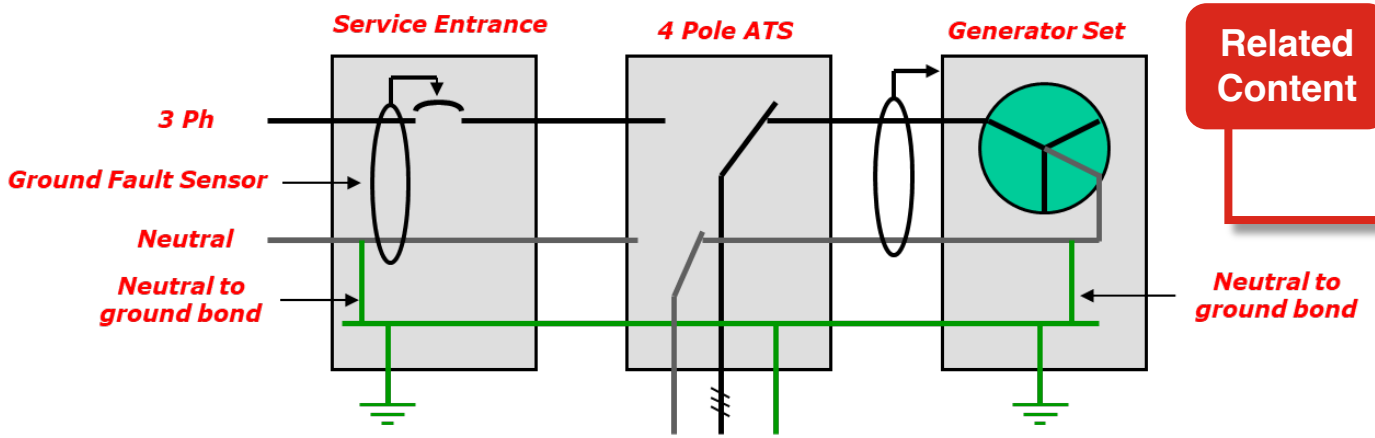
Good choice for switches requiring:

- Delayed Transition
- Load shed – won't transfer to "dead" source

3-Pole Vs. 4-Pole

Ground fault sensing depends on being able to sense ground fault current. In order to accurately sense ground fault current, it must return to its source on a known path relative to ground fault CTs. In basic emergency standby systems there are two rules to follow to meet these requirements:

1. There can only be one neutral/ground connection on any neutral bus at one time
2. Ground fault sensors must be downstream (or on the load side) of the bonding connection



Related Content

Transfer Switches What to Specify and Why
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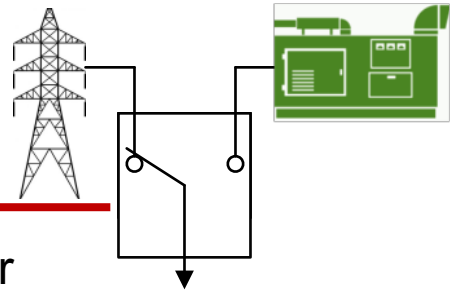
In order to meet both rules when connected to either the normal or the emergency source the neutral must be switched using a 4-pole transfer switch

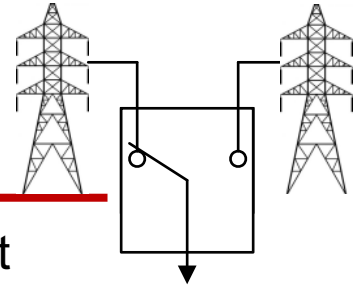
Common Transfer Switch Applications

Utility To Generator



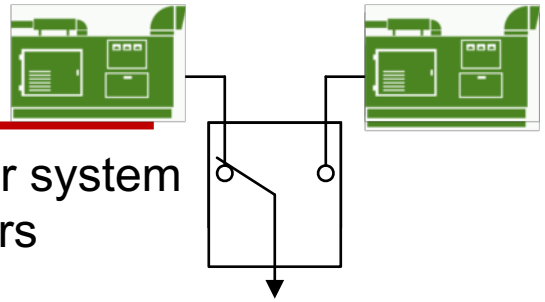
For facilities with a standby power system and a single utility feed

Utility To Utility



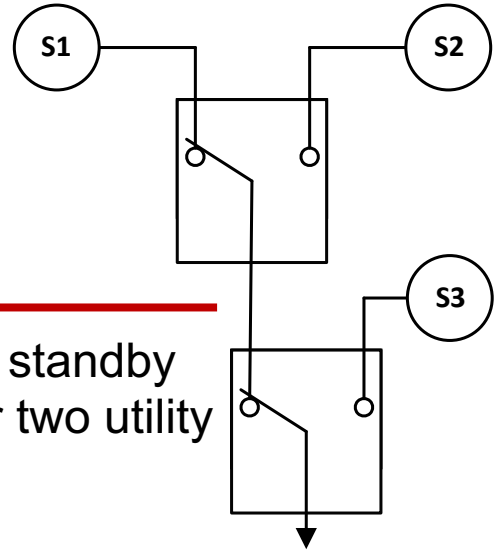
For use in facilities with redundant utility feeds but no standby generator

Generator To Generator



For facilities with a prime power system using multiple on-site generators

Three Source System



For facilities with one or two standby power system(s) with one or two utility feed(s)

Installation Types

Emergency Systems (NEC Article 700)

- Distribute and control electricity to systems essential to life safety during fire or other disasters

Supports functions such as

- Fire pumps
- Fire alarms
- Emergency lighting
- Egress elevators and exits

Installation Types

Legally Required (NEC Article 701)

- Automatically supply power to a selected set of regulated loads. These are not classified as emergency systems when normal power is available.

Supports functions such as

- Heating
- Refrigeration
- Sewage disposal
- Smoke fans
- Communication systems

Installation Types

Critical Operations (NEC Article 708)

- Supply, distribute, and control electricity in designated critical areas when normal power source fails

Supports functions such as

- HVAC
- Fire alarms
- Security
- Signaling

Installation Types

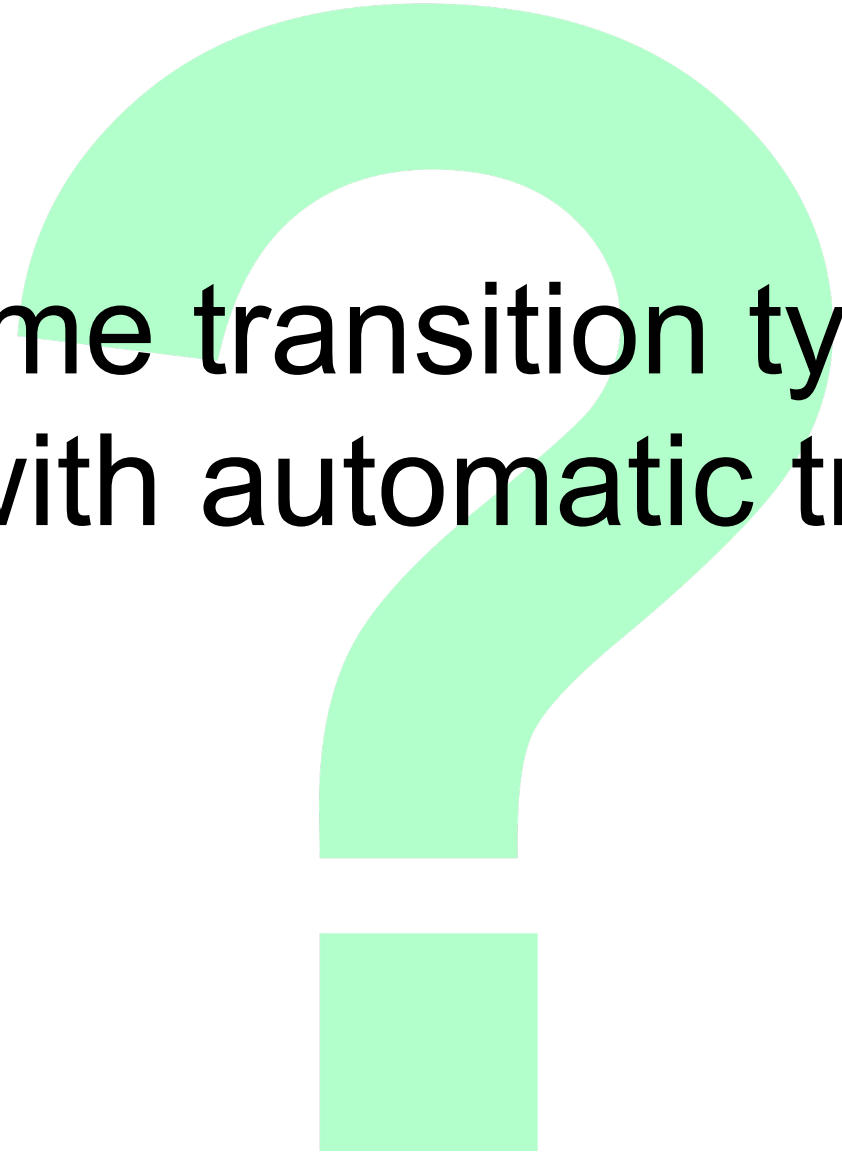
Optional standby systems (NEC Article 702)

- supply power to loads with no direct bearing on health or life safety and are not required to function automatically during power failures.

Supports functions such as

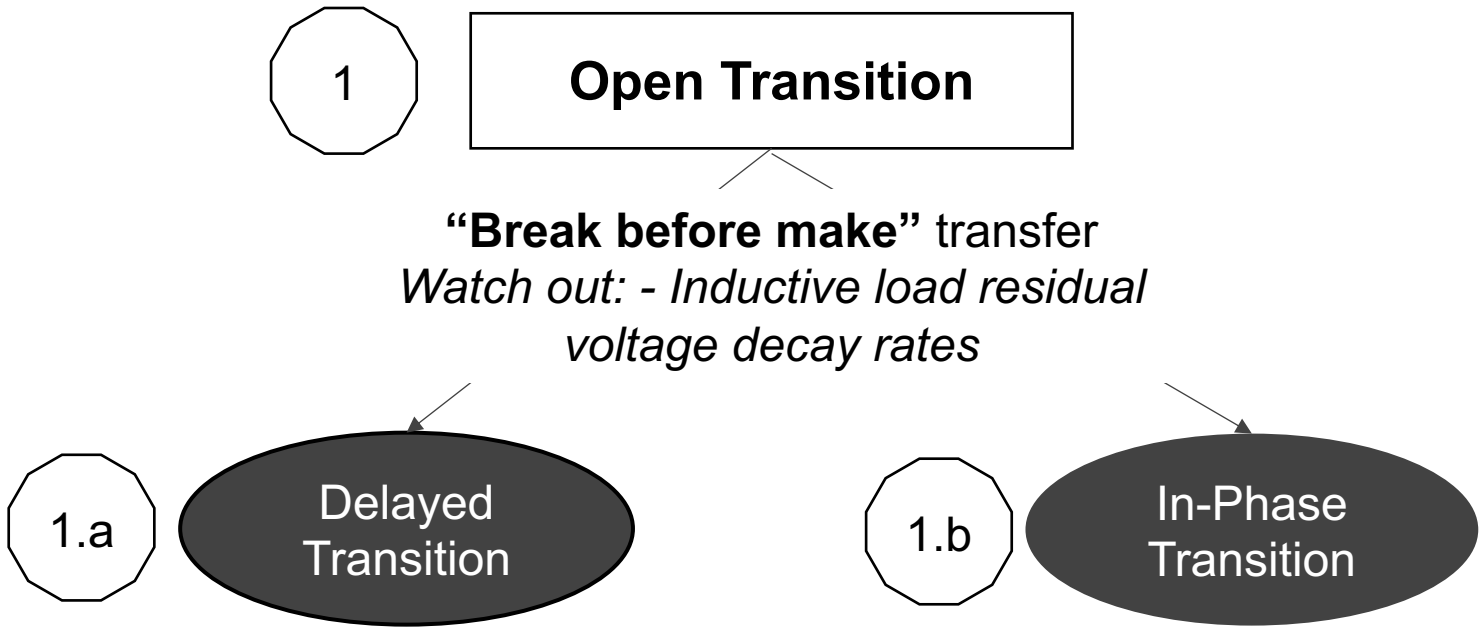
- Communication
- Signaling
- Security
- Lighting

What are some transition types associated with automatic transfer switches?



Transition Types

There are two ways to transition the loads:



- Adjustable neutral position delay
- Flexible, simple, reliable
- Best option for large motors
- Step loading generators possible

- Passive synchronization of sources
- “Fast” – typically 30ms – 50ms delay
- Okay for resistive loads and small inducive loads

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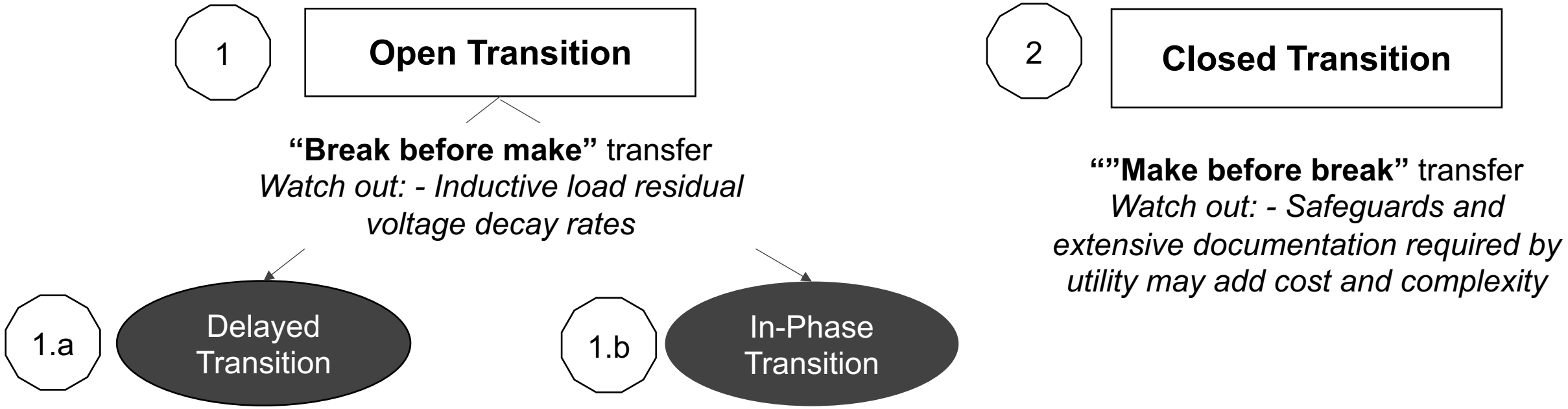

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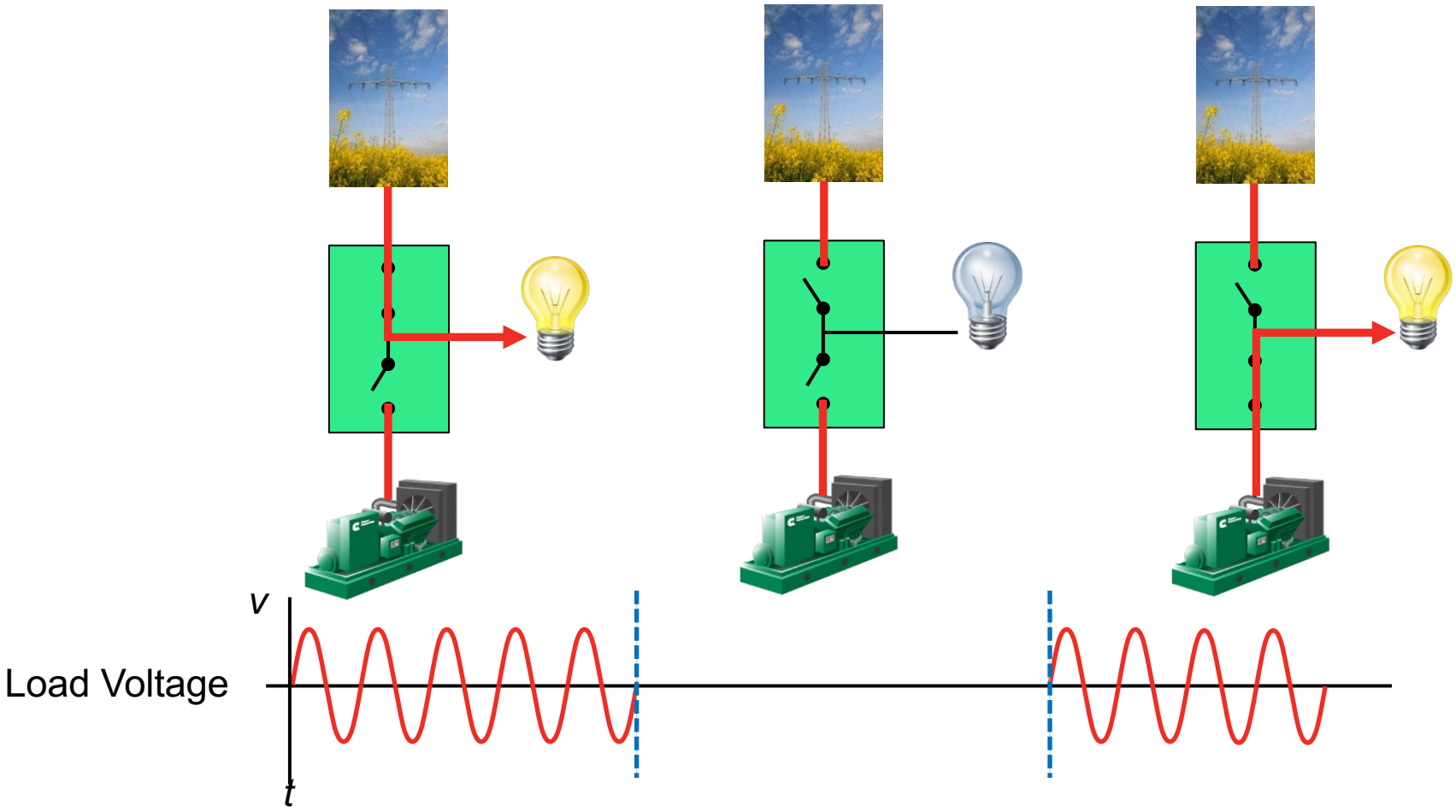
In-Phase Transition

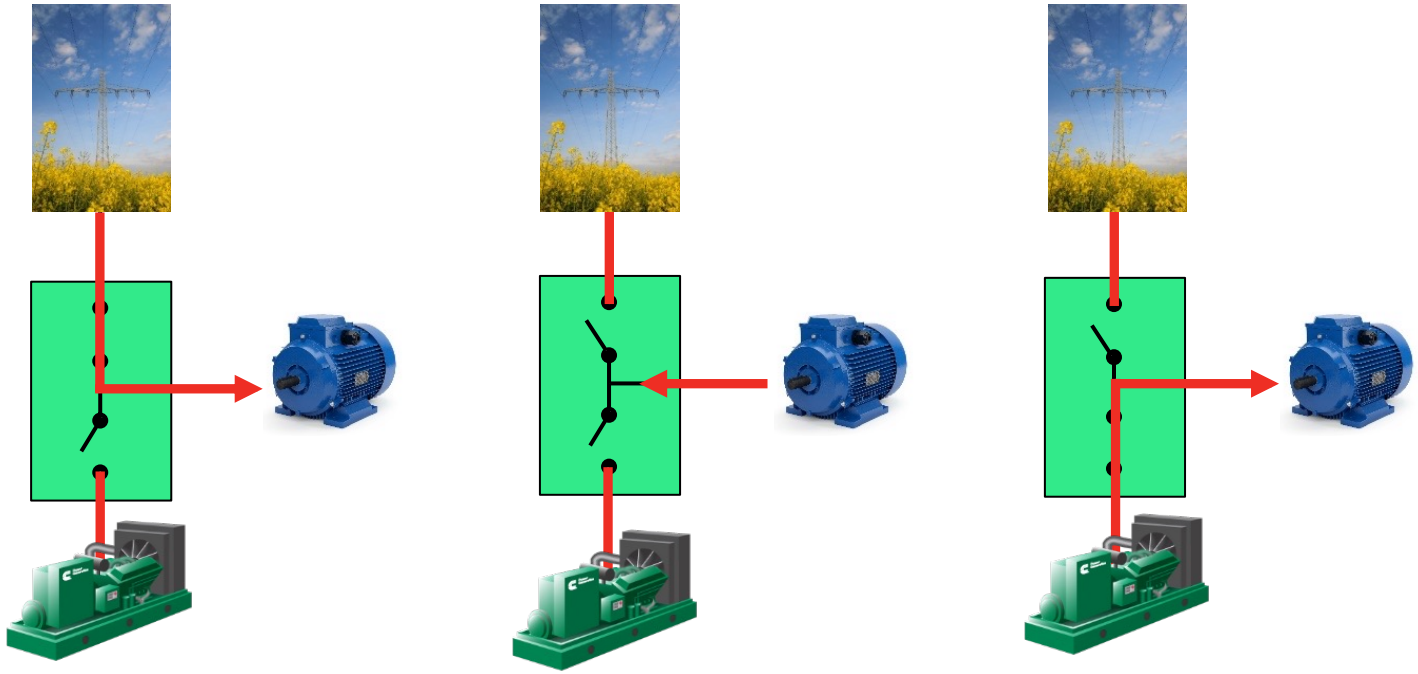


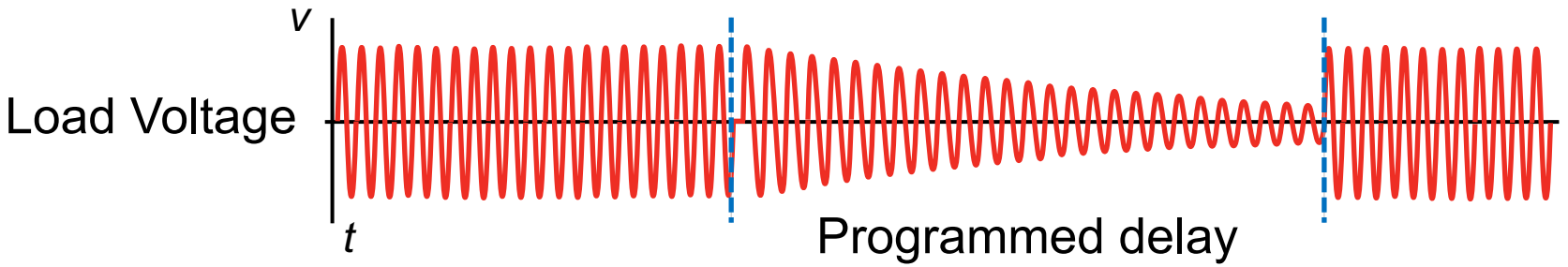
In-Phase Transition

Things to note:

- Okay for resistive loads and small inducive loads (<20hp)
- There will be a break in power during the transfer and re-transfer of sources

Delayed Transition



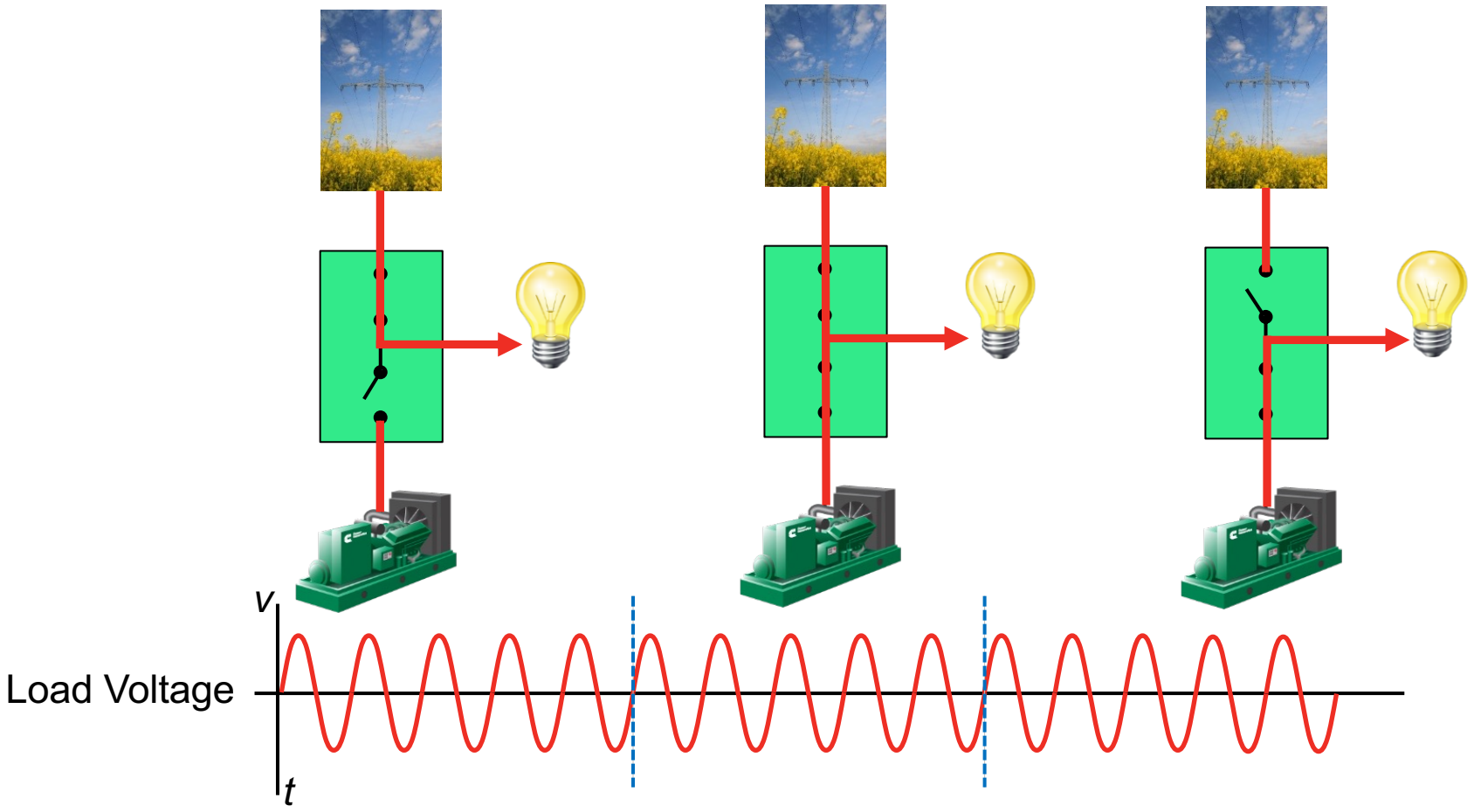


Delayed Transition

Things to note:

- No appreciable power interruption to loads
- Best option for large motors
- Step loading generators possible
- 3-position switch is required

Closed Transition



Closed Transition

Things to note:

- Make-before-break - uninterrupted power transfer **when both sources are available**
- Seamless transfer of the load by momentarily paralleling both sources (<100 milliseconds)

Closed Transition

Things to note:

- Make-before-break - uninterrupted power transfer **when both sources are available**
- Seamless transfer of the load by momentarily paralleling both sources (<100 milliseconds)

Related Content

Transfer Switches What to Specify and Why
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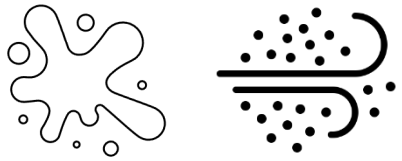
Transfer Switches Made Easy
PowerHour

Enclosure Types – Indoor

Indoor



Dust Light/Indirect Splashing	Ingress of solid foreign objects (Dust, fibers, etc.)
NEMA Type 1	NEMA Type 12
Not dust-tight	Knockout free

Enclosure Types – Outdoor

Outdoor

Falling rain & ice formation	Weather tight (weatherproof)	Type 4 + corrosion resistance
NEMA Type 3R	NEMA Type 4	NEMA Type 4X
Not rain-tight Not water-tight		Stainless steel is best

Codes and Standards

- NFPA 70, National Electrical Code. Equipment suitable for use in systems in compliance with Articles 700, 701, 702 and 708
- NFPA 110, Level 1, Type 10 Standard for Emergency and Standby Power Systems (Note: this is for the entire system)
- NFPA 99 Standard for Health Care Facilities

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- NFPA 99 Standard for Health Care Facilities

Related Content

NFPA 110 Time-to-Readiness Overview
White Paper
PowerHour

Codes and Standards

UL 1008 is the leading standard for safety with transfer switch equipment

stringent testing requirements for:

- Temperature rise test
- Dielectric voltage-withstand test
- Overload test
- Contact opening test
- Endurance test
- Short-circuit test
- Dielectric voltage-withstand test (following short-circuit withstand/closing test)
- Short-time current test (optional)

Related Content

Transfer Switches What to Specify and Why
PowerHour

Understanding and Applying UL 1008 Transfer Switch Withstand and Close Rating (WCR)
PowerHour

Considerations for Selecting an ATS

- ❑ Application (Utility-Gen, Gen-Gen, Utility-Utility)
- ❑ Service-entrance or non-service-entrance
- ❑ Switch type (Transfer Switch, Bypass Isolation Switch)
- ❑ Transition type (Open, Closed, Non-Automatic)
- ❑ Grounding schemes (Separately Derived, Non-Separately Derived)
  - Drives 4-Pole or 3-Pole Transfer Switches
- ❑ Switch positions (2-Positions, 3-Positions)
  - 3-positions are ideal for load shedding and stored energy loads
- ❑ Cable sizes and entry requirements (Top Entry, Bottom Entry)
- ❑ Enclosures (NEMA Type 1, 3R, 4, 4x, 12)
- ❑ Voltage/Frequency (600VAC, 480VAC / 50Hz, 60Hz)
- ❑ Current rating (3000A, 2000A, 800A)
- ❑ Fault current capability (WCR: 65kA, 85kA, 100kA)
- ❑ Codes/standards (UL/CSA, NFPA, NEMA, ISO, EN)

Course Summary

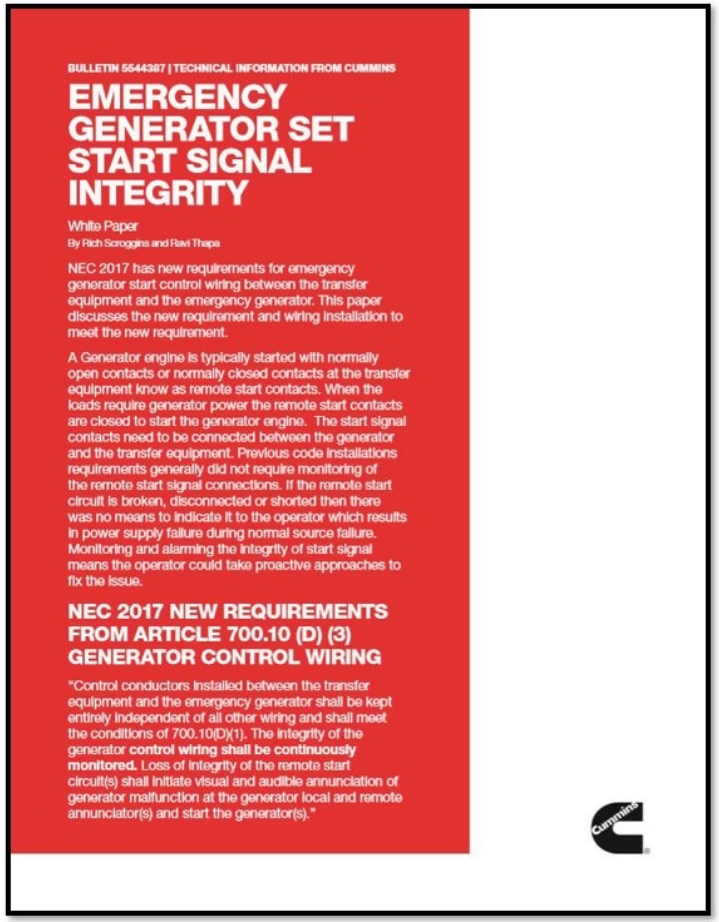
After completing this course, participants will be able to:

- Describe the basic operational features and functions of a working transfer switch.
- Recognize the different installation types associated with transfer switch applications.
- Identify the codes and standards associated with transfer switch operation.

Additional Resources

Cummins PowerHour On-Demand Webinars

- Transfer Switches What to Specify and Why
- Understanding and Applying UL 1008 Transfer Switch Withstand and Close Rating (WCR)
- NFPA 110 Time-to-Readiness Overview
- Transfer Switches What to Specify and Why


BULLETIN 5544387 | TECHNICAL INFORMATION FROM CUMMINS

EMERGENCY GENERATOR SET START SIGNAL INTEGRITY

White Paper

By Rich Scroggins and Ravi Thapa

NEC 2017 has new requirements for emergency generator start control wiring between the transfer equipment and the emergency generator. This paper discusses the new requirement and wiring installation to meet the new requirement.

A Generator engine is typically started with normally open contacts or normally closed contacts at the transfer equipment know as remote start contacts. When the loads require generator power the remote start contacts are closed to start the generator engine. The start signal contacts need to be connected between the generator and the transfer equipment. Previous code installations requirements generally did not require monitoring of the remote start signal connections. If the remote start circuit is broken, disconnected or shorted then there was no means to indicate it to the operator which results in power supply failure during normal source failure. Monitoring and alarming the integrity of start signal means the operator could take proactive approaches to fix the issue.

NEC 2017 NEW REQUIREMENTS FROM ARTICLE 700.10 (D) (3) GENERATOR CONTROL WIRING

"Control conductors installed between the transfer equipment and the emergency generator shall be kept entirely independent of all other wiring and shall meet the conditions of 700.10(D)(1). The integrity of the generator **control wiring shall be continuously monitored.** Loss of integrity of the remote start circuit(s) shall initiate visual and audible annunciation of generator malfunction at the generator local and remote annunciator(s) and start the generator(s)."

Q&A

Please type your questions, comments and feedback in the **Zoom Q&A** window.

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Chad Hale
Technical Marketing Advisor

Mariano Rojas
Senior Sales Application Engineer

Brian Pumphrey
Director - Sales Application Engineering

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Upcoming Live PowerHour:
04/28/2022 – Transfer Switches Features and Functions


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