Ask the Experts: Transfer Switch Fundamentals

PowerHour webinar series for consulting engineers

Experts you trust. Excellence you count on.

September 17th, 2020
Start Time: 2:00 EST / 11:00 PST

(1PDH issued by Cummins)

Welcome!

Cummins PowerHour webinar series is designed to help our engineer partners to…

- Keep up to date on products, technology, and codes and standards development
- Interact with Cummins experts and gain access to ongoing technical support
- Participate at your convenience, live or on-demand
- Earn Professional Development Hours (PDH)

Technical tips:

- Audio is available through teleconference or Zoom application.
- Attendees are in “listen only” mode throughout the event.
- Use the Zoom Q&A Panel to submit questions, comments, and feedback throughout the event. Time is allotted at the end of the PowerHour to address Q&A.
- If the audio connection is lost, disconnected or experiences intermittent connectivity issues, please check your audio connection through the "Join Audio" or "Audio Connectivity" button at the bottom left of the Zoom application.
- Report technical issues using the Zoom Q&A Panel.

Course Objectives

Ask the Experts: Transfer Switch Fundamentals

Transfer switches come in a variety of types for use in a wide array of applications. Sizing to meet the needs of a power system, coordination with overcurrent protective devices, optimizing communication and controls, and accurately specifying for performance and reliability can be a complicated job. Our experts at Cummins are here to help! This roundtable webinar will center around a set of questions we commonly see from Consulting Engineers, as well as an opportunity for live questions.

After completing this course, participants will be able to:

- Identify key design attributes to automatic transfer switches and their role in a power system.
- Develop a better understanding of some of the common pitfalls in the ATS selection process and how to avoid them.
- Identify UL 1008 requirements for transfer switch withstand and closing ratings.

Asking a Question:

Q&A Button:

- For technical questions on today's topic
- Ask at anytime
- Not all questions may get answered but we'll do our best!

Chat Button:

- For general PowerHour or Zoom questions

Disclaimer

The views and opinions expressed in this course shall not be considered the official position of any regulatory organization and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Participants are encouraged to refer to the entire text of all referenced documents. In addition, when it doubt, reach out to the Authority Having Jurisdiction.

Meet your panelists

Cummins instructors:

Brian Pumphrey
Director of Sales Application Engineering – Western USA
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Hassan Obeid
Global Technical Advisor, Systems and Controls
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Munir Kaderbhai
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What are the Components in a Power System?

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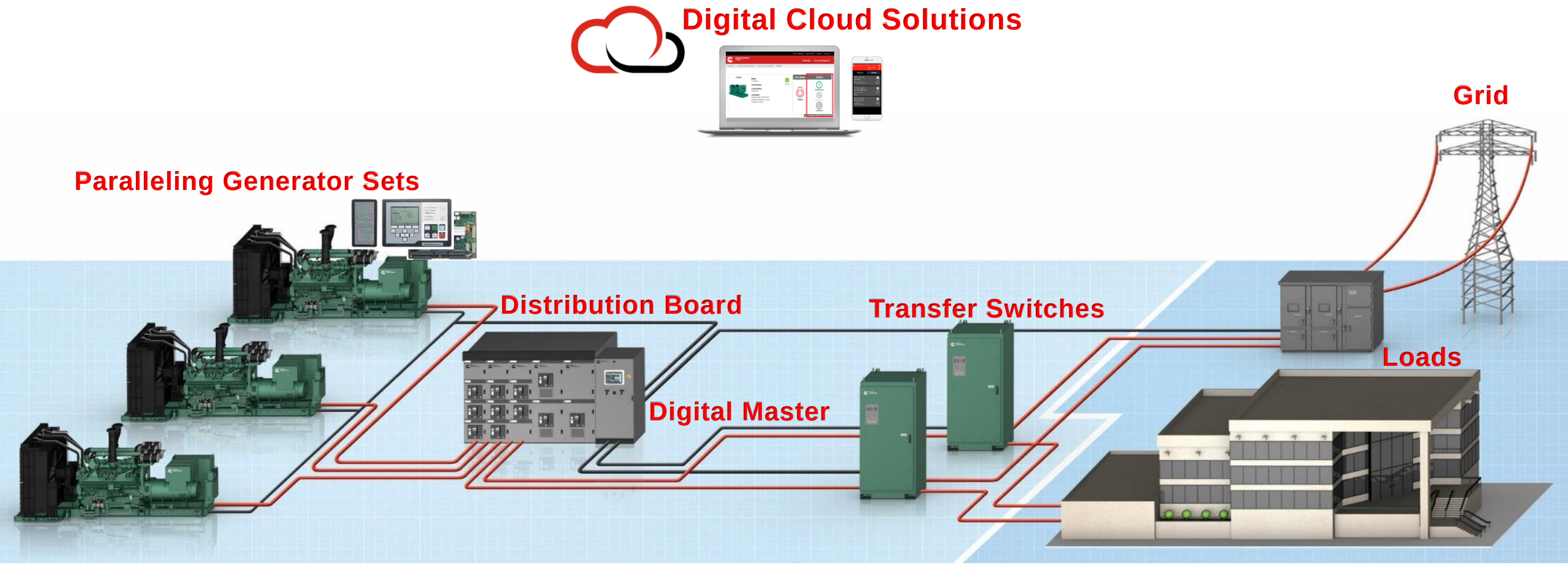

What is a Transfer Switch?

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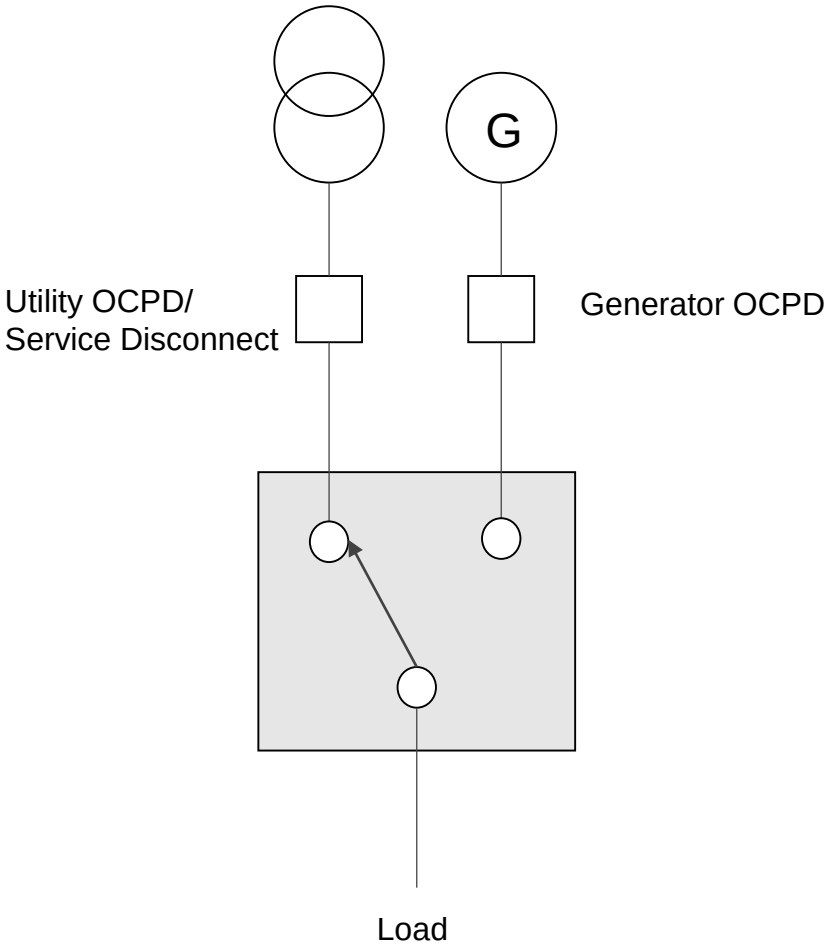

- Monitors the availability and quality of two connect power sources
- Transfers power consumed by electrical loads connected to the transfer switch output between two sources based on source availability

Overcurrent Protection Device

What are the Key Considerations When Selecting a Transfer Switch?

What are the Key Considerations When Selecting a Transfer Switch?

- *Switch type*
- *Transition type*
- *Application*
- *Grounding schemes*
- *Cable sizes and entry requirements*
- *Enclosures*
- *Voltage*
- *Current*
- *Fault current*
- *Selective coordination*
- *Type of load in the systems per Codes & Standards*

What Applications Should I Consider the Different Types of ATSs?

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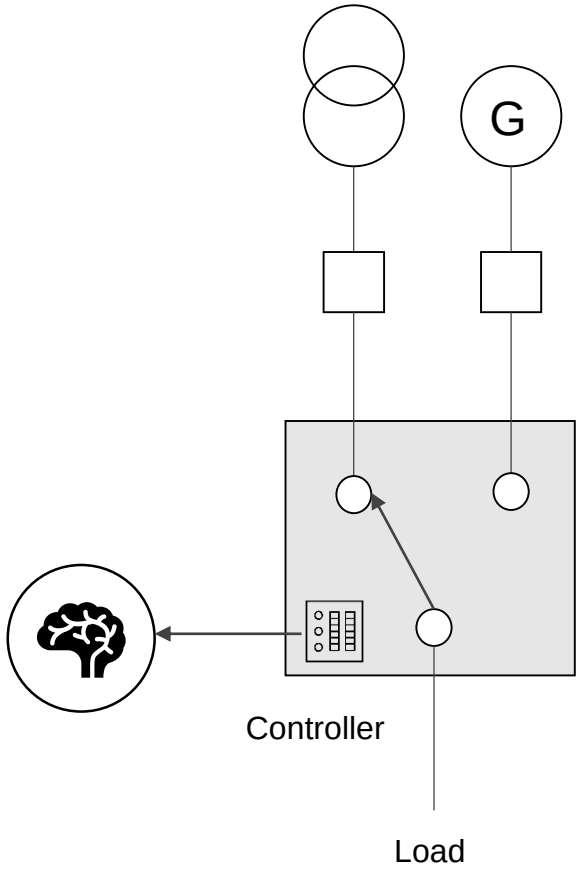
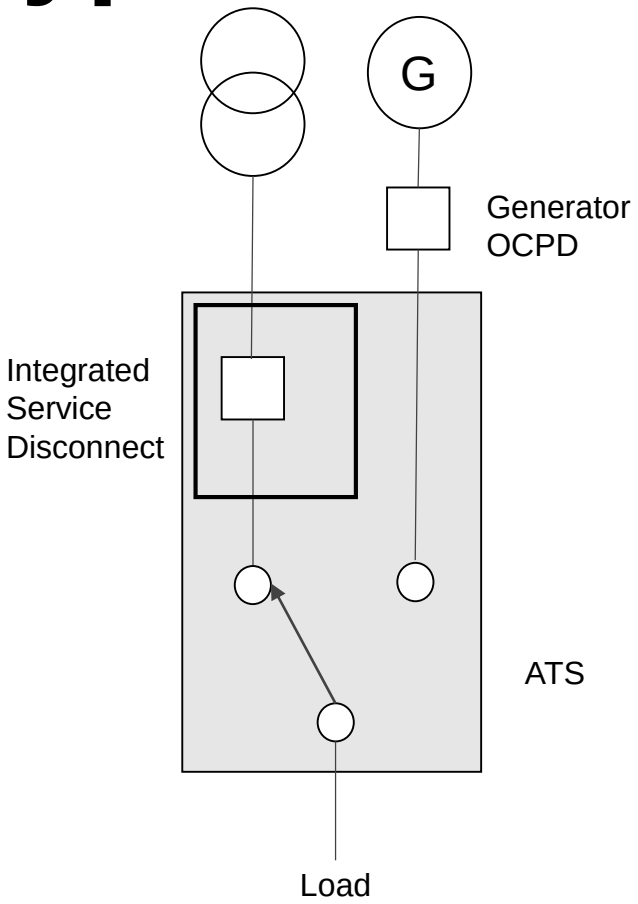
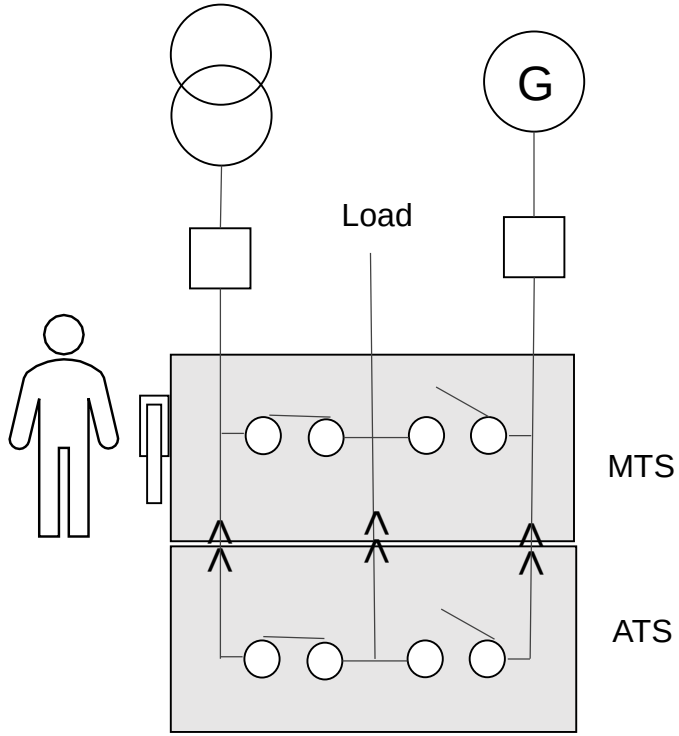


Automatic Transfer Switch



Service Entrance Rated Transfer Switch

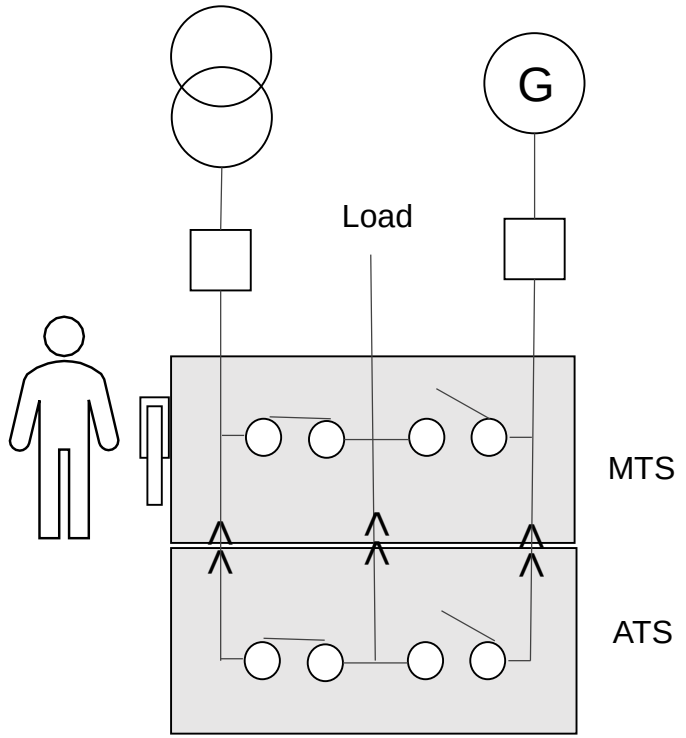


Bypass Isolation Transfer Switch

What Benefits / Requirements Lead to Bypass Transfer Switches in Mission Critical Applications?

What Benefits / Requirements Lead to Bypass Transfer Switches in Mission Critical Applications?

- Code compliance!
  - NEC (Mission Critical Facilities)
  - NFPA 99 Health Care Facilities Code
  - Joint Commission (Healthcare)
  - OSHPD (California Office of Statewide Health Planning and Development)
- Utmost reliability and redundancy
  - Facilitate system maintenance



Bypass Isolation Transfer Switch

How Should I Choose Between the Main Transition Types?

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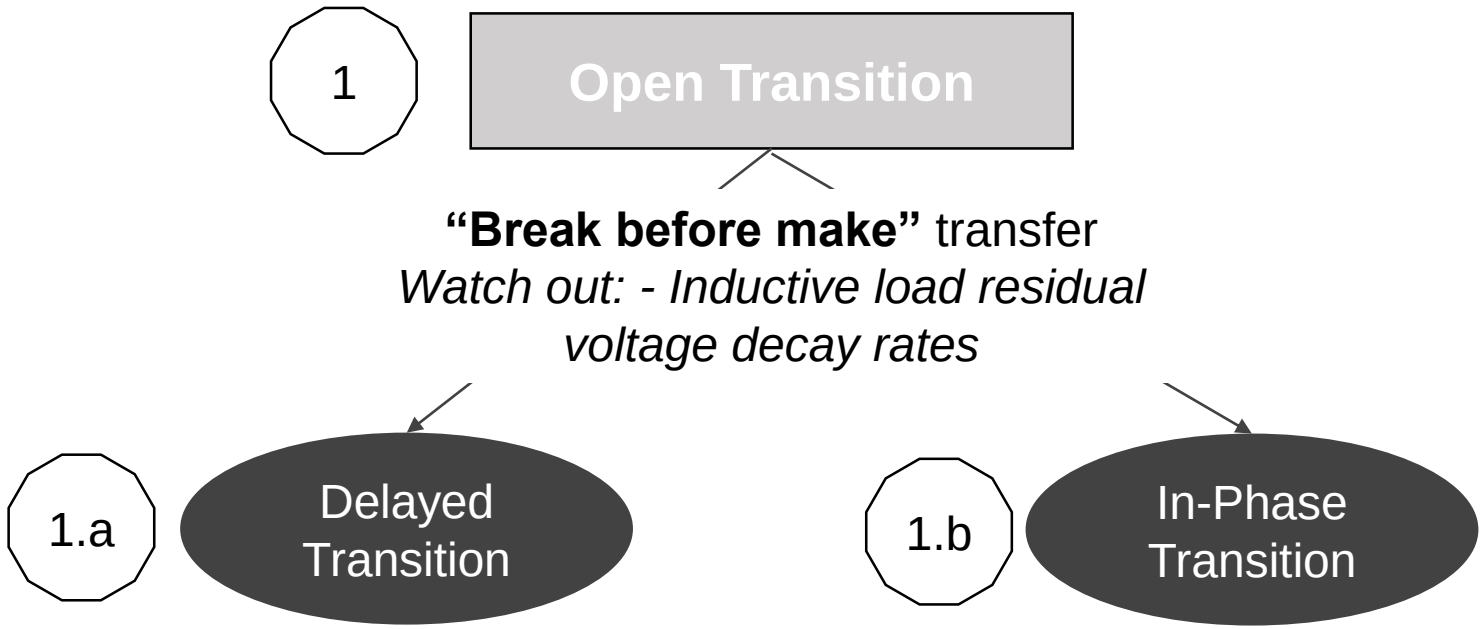


“Break before make” transfer
Watch out: - Inductive load residual voltage decay rates

“Make before break” transfer
Watch out: - Safeguards and extensive documentation required by utility may add cost and complexity

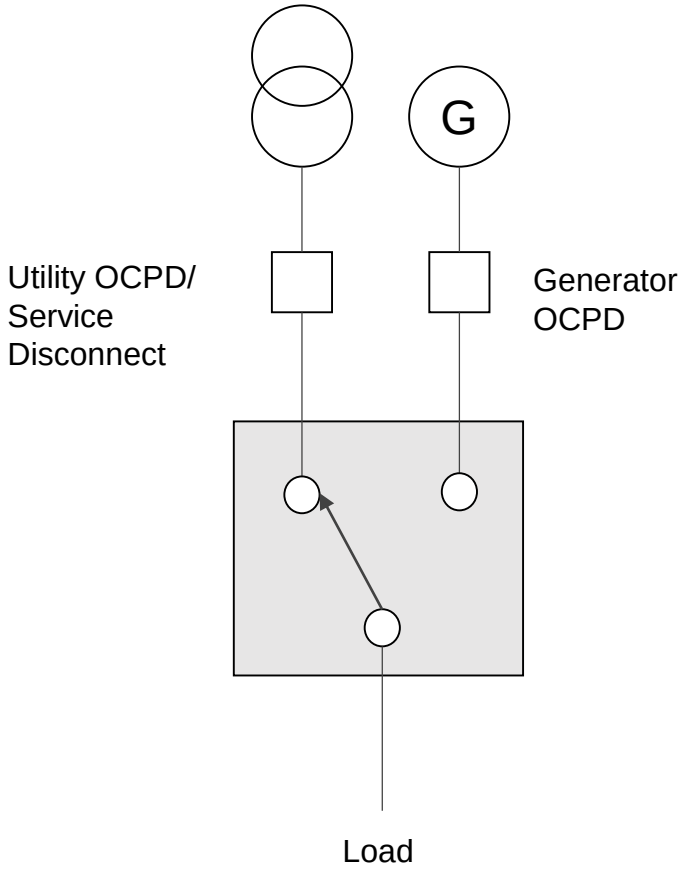
- Adjustable neutral position delay
- Flexible, simple, reliable
- Best option for large motors
- Step loading generators possible

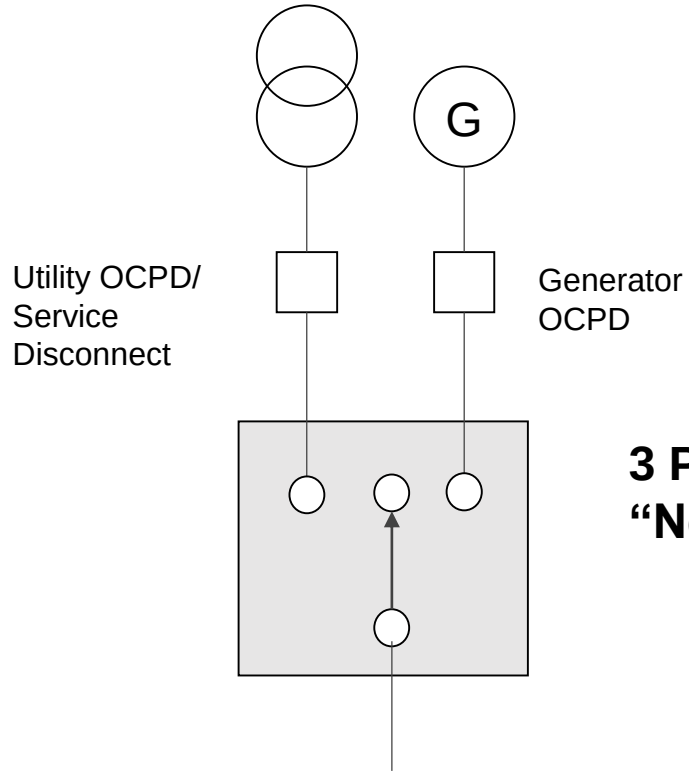
- Based on synchronization of sources
- “Fast” – typically 30ms – 50ms delay
- Okay for resistive loads and small inducive loads

When Should I Consider Two Position vs. Three Position Switches?

When Should I Consider Two Position vs. Three Position Switches?

2 Position
“Double Throw”





3 Position
“Neutral Position Delay”

Good choice for switches requiring:

- Delayed Transition
- Load shed – won’t transfer to “dead” source

What are some of the Common Time Delay Settings for Emergency Standby?

What are some of the Common Time Delay Settings for Emergency Standby?

1) ATS control detects failure of normal source
2) ATS programmed time before start signal
3) ATS control sends start signal to generator set control
4) Generator set control initiates engine start sequence
5) Generator set engine starts
6) Generator set reaches “Ready to Load”
7) ATS transitions from normal to neutral position
8) ATS transfer time delay
9) ATS transitions from neutral to emergency position

0 – 1 Seconds based on application

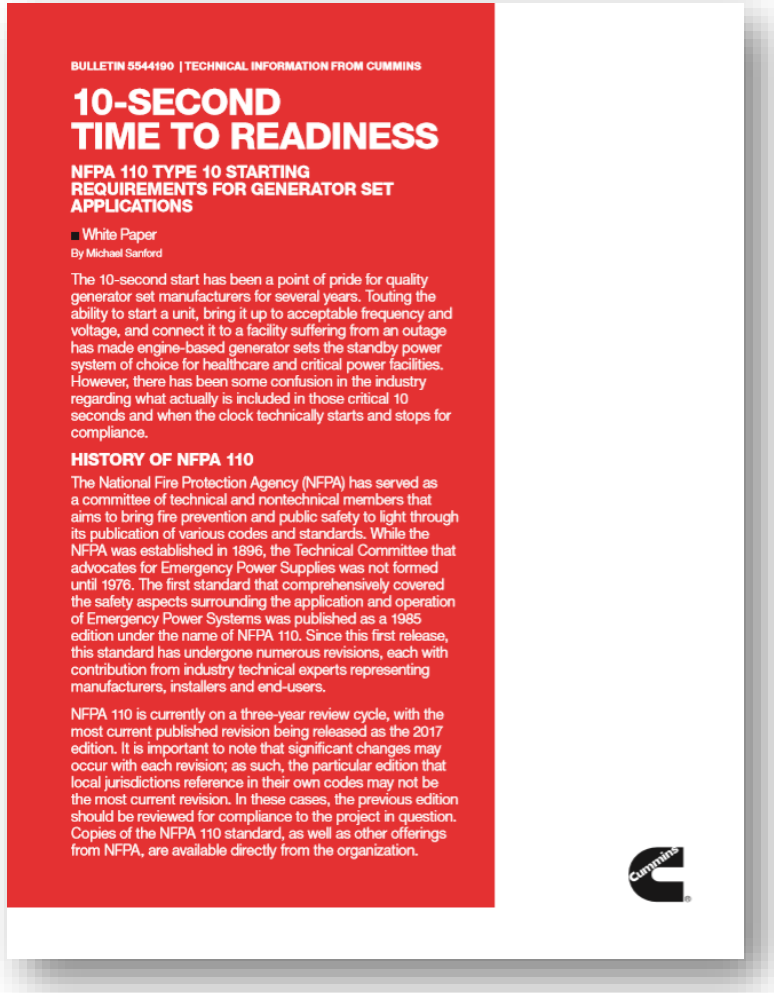
4 – 8.5 Seconds based on generator set configuration

0.5 – 1.5 Seconds based on transfer switch and application

More on NFPA 110 Time to Readiness:

Related Content

NFPA 110 Time to Readiness
White Paper
PowerHour Recording



BULLETIN 5544190 | TECHNICAL INFORMATION FROM CUMMINS

10-SECOND TIME TO READINESS

NFPA 110 TYPE 10 STARTING REQUIREMENTS FOR GENERATOR SET APPLICATIONS

White Paper

By Michael Sanford

The 10-second start has been a point of pride for quality generator set manufacturers for several years. Touting the ability to start a unit, bring it up to acceptable frequency and voltage, and connect it to a facility suffering from an outage has made engine-based generator sets the standby power system of choice for healthcare and critical power facilities. However, there has been some confusion in the industry regarding what actually is included in those critical 10 seconds and when the clock technically starts and stops for compliance.

HISTORY OF NFPA 110

The National Fire Protection Agency (NFPA) has served as a committee of technical and nontechnical members that aims to bring fire prevention and public safety to light through its publication of various codes and standards. While the NFPA was established in 1896, the Technical Committee that advocates for Emergency Power Supplies was not formed until 1976. The first standard that comprehensively covered the safety aspects surrounding the application and operation of Emergency Power Systems was published as a 1985 edition under the name of NFPA 110. Since this first release, this standard has undergone numerous revisions, each with contribution from industry technical experts representing manufacturers, installers and end-users.

NFPA 110 is currently on a three-year review cycle, with the most current published revision being released as the 2017 edition. It is important to note that significant changes may occur with each revision; as such, the particular edition that local jurisdictions reference in their own codes may not be the most current revision. In these cases, the previous edition should be reviewed for compliance to the project in question. Copies of the NFPA 110 standard, as well as other offerings from NFPA, are available directly from the organization.

Review: What is a WCR Rating?

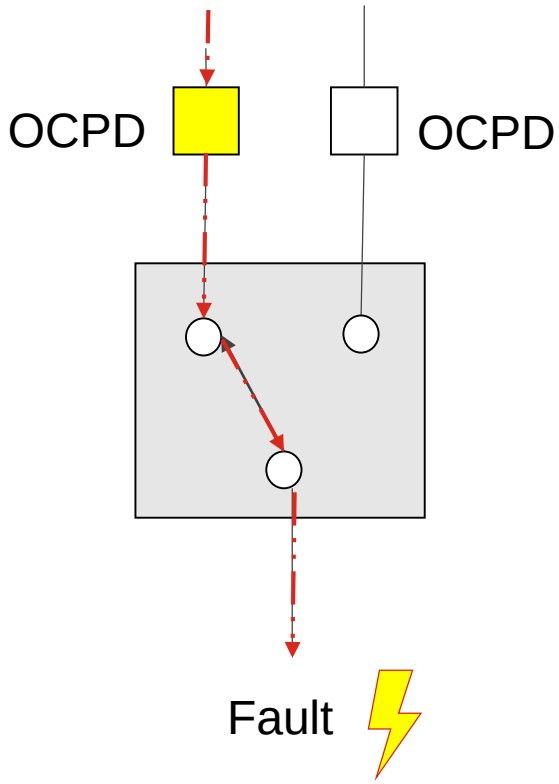
Review: What is a WCR Rating?

- **Withstand** test (starts with contacts closed):
  - A specified fault current is applied for either:
    - A specific duration

      OR

    - Until a specific OCPD trips

- **Closing** test (starts with contacts open then close):
  - The same transfer switch must close onto the fault current under the same conditions used in the withstand test
- **Rating** is per UL 1008; which sets the pass/fail standards
  - The same set of contacts are used for both tests: withstand and closing



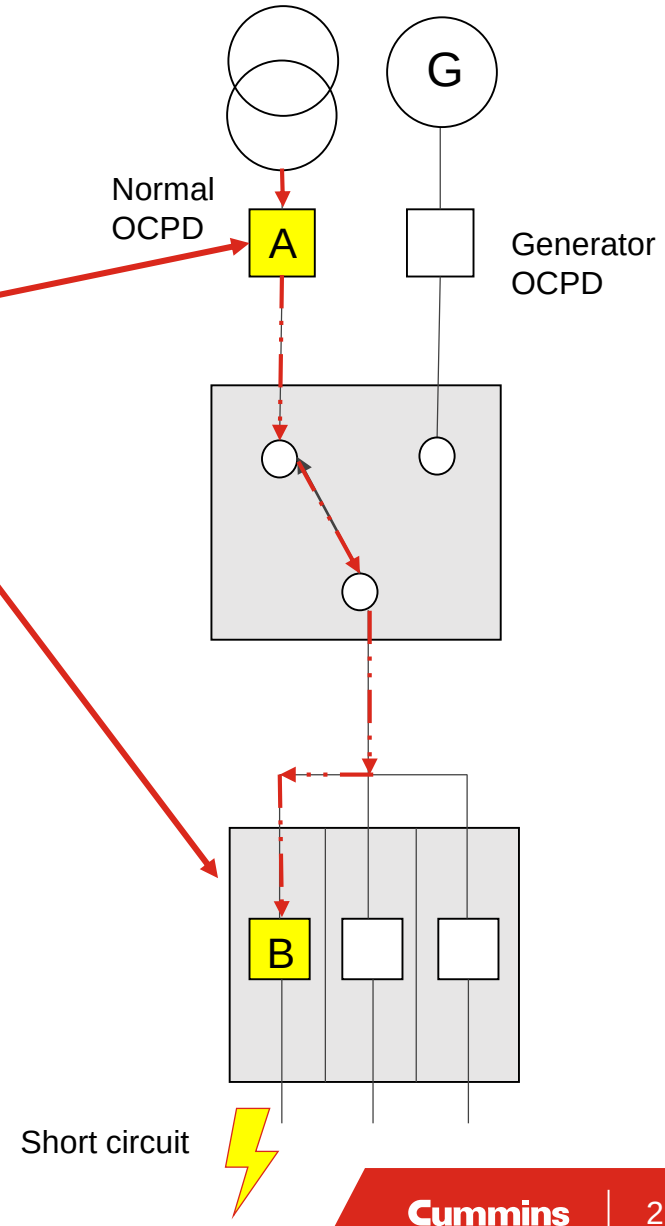
Review Coordination Challenges from an ATS Perspective?

Review Coordination Challenges from an ATS Perspective?

Selective Coordination is required for emergency, legally required standby and critical operations power systems circuits

- **NEC-2017, 700.32, 701.27, and 708.54** "…over-current devices shall be selectively coordinated…"

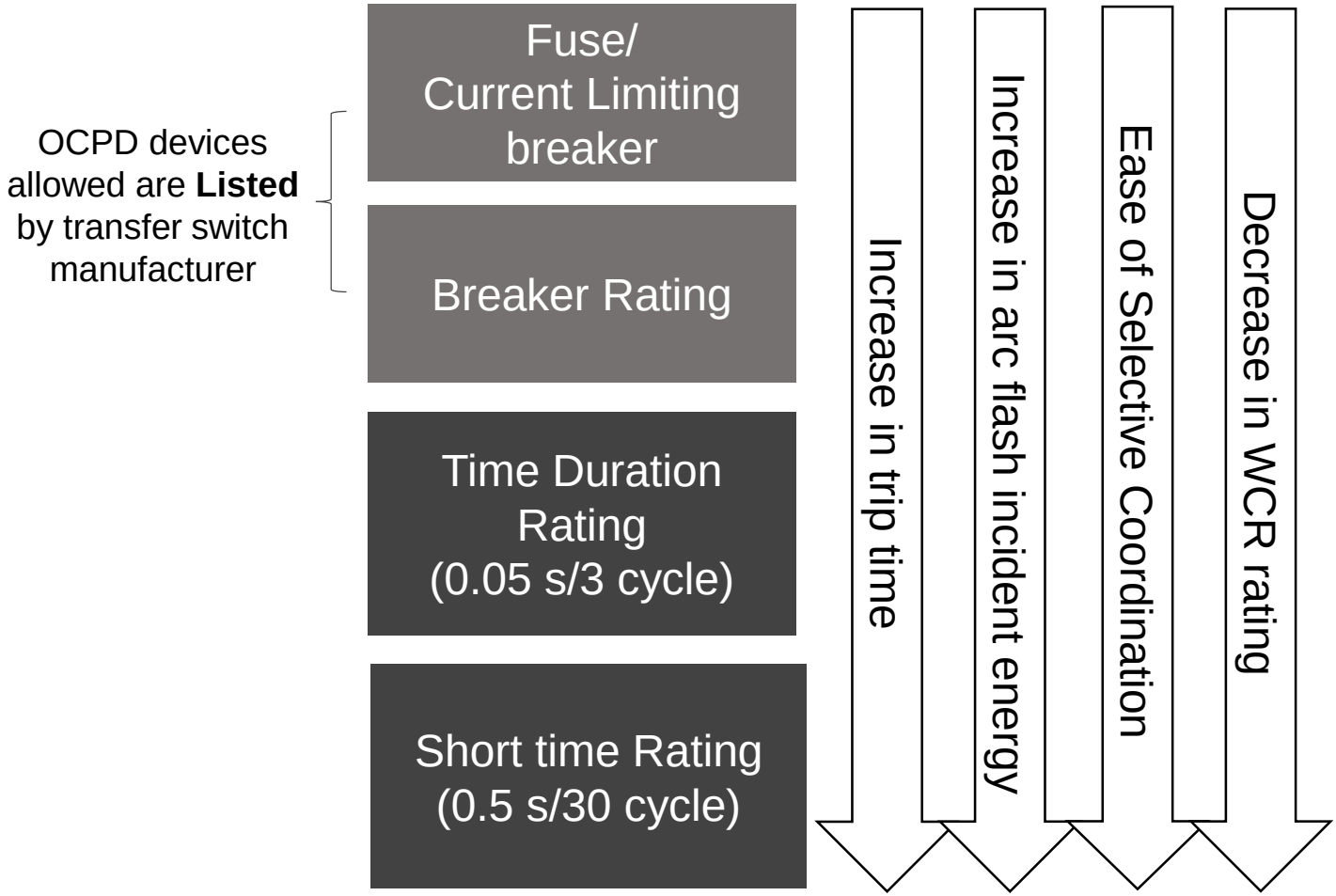
- Selective coordination will require time delays to be set on OCPDs
  - In the example shown, A ***must*** trip after B → Time delay on A
- Time delay setting of OCPD A will depend on the available fault current from either source & the device B trip curve characteristic
- For the duration of the OCPD A time delay, the ATS must be able to:
  - Withstand the fault
  - Close into the fault
- Transfer switches manufacturer will publish a **Withstand and Close** rating



Help me Decide: Which Rating Should I Select?

Help me Decide: Which Rating Should I Select?

- UL 1008 requires all ATS to have a withstand and closing rating (WCR)
- Rating can either be time based or specific OCPD (breaker/fuse) based
- OCPD based ratings allow for higher WCR ratings but requires the ATS to be protected by a “listed” breaker or fuse
- Allowing for either time based or specific breaker based ratings enables flexibility for a cost effective design



More on WCR and Selective Coordination:

Related Content

Withstand and Close Ratings
White Paper
PowerHour Recording

Related Content

Selective Coordination
White Paper

Power topic #5410785 | Technical information from Cummins

UL 1008 Withstand and Close On Ratings

White Paper

By Rich Scroggins, Technical Advisor

Electrical distribution system design requires sizing equipment so that it can safely withstand any level of fault current to which it may be exposed. In the case of transfer switches this involves an evaluation of the transfer switch's short circuit withstand and close on rating (WCR), the available fault current at the line terminals of the transfer switch and the fault clearing time of the overcurrent protection device. This creates a challenge for engineers when specifying transfer switches as the available fault current and the overcurrent protection device are usually not known at the time specifications are written.

Engineers often take a conservative approach and specify high fault clearing time based ratings however this can result in oversizing and limiting choices of transfer switches. Not specifying fault duration times and specifying only that transfer switch and overcurrent protection devices be coordinated at the available fault current allows contractors and transfer switch and circuit breaker manufacturers the flexibility to design a cost effective system that meets fault withstand requirements.

What is the Difference between a Separately and Non-Separately Derived System?

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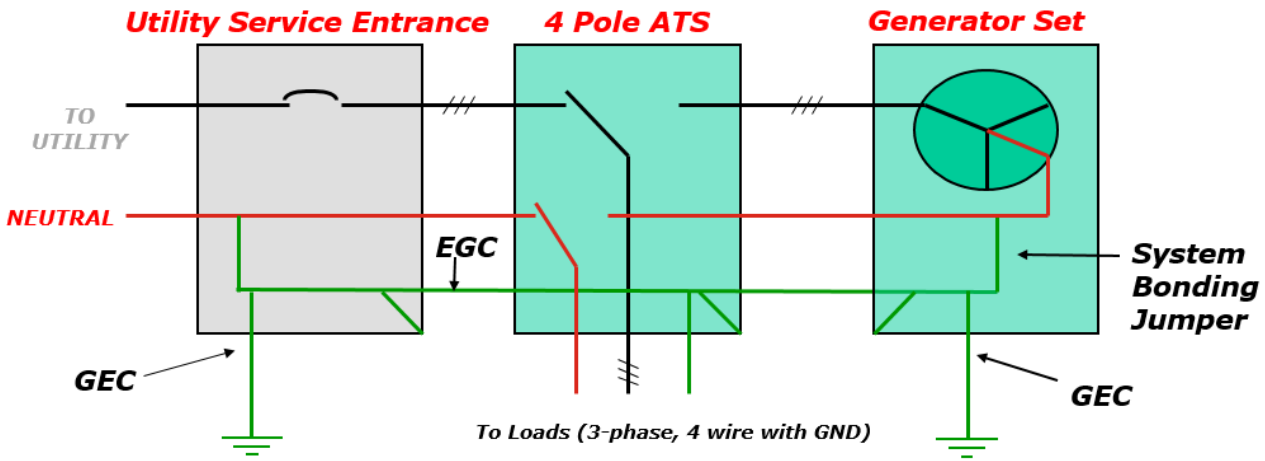
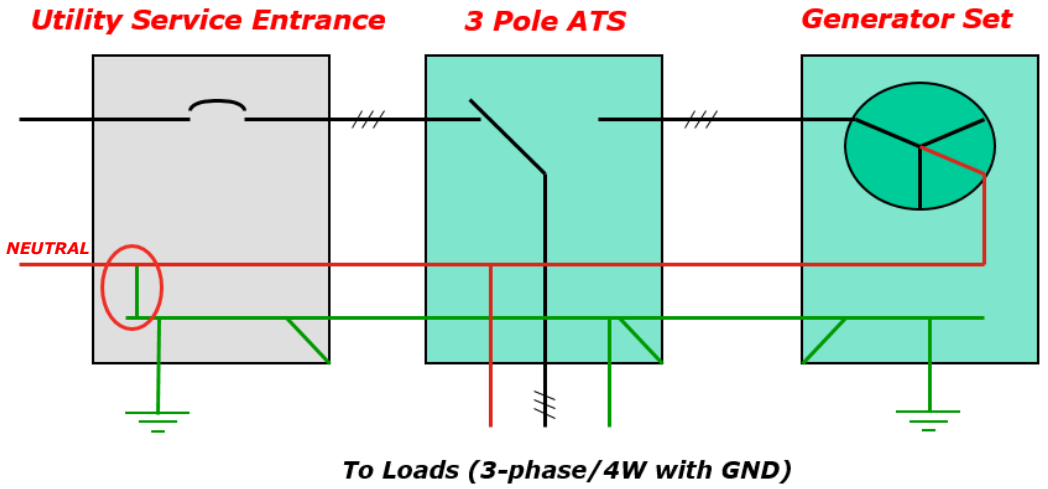
Separately Derived System



- **No direct electrical connection between sources** (Neutrals are not connected)
- **Generator Neutral is solidly bonded to Ground - Jumper**

Non-Separately Derived System

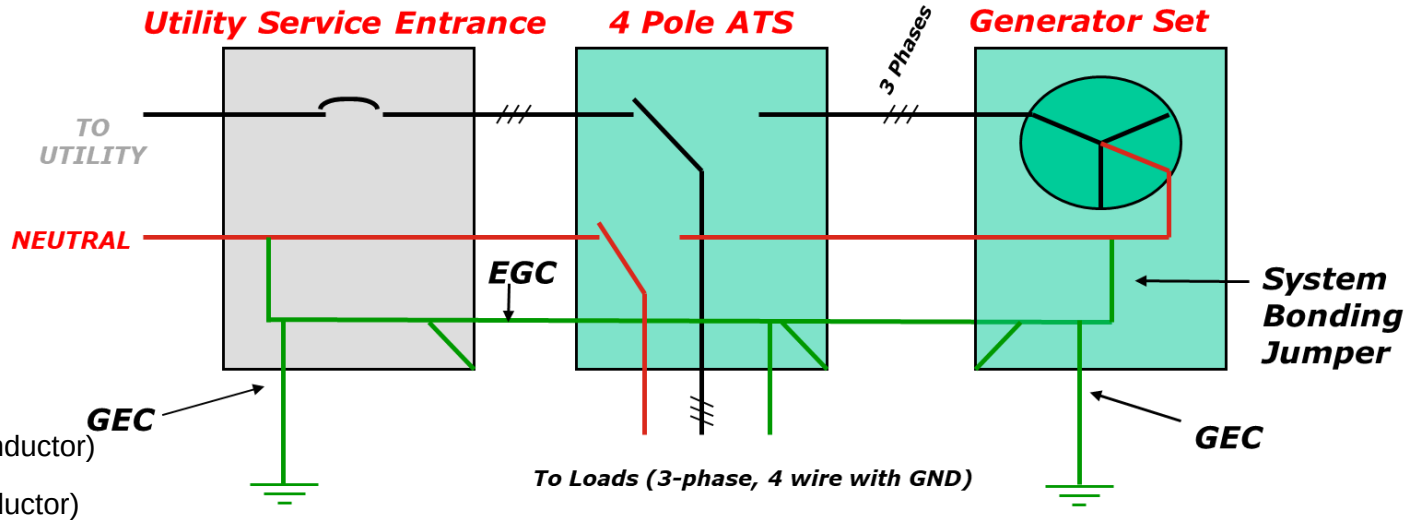


- **Common Neutral for entire system**
- **Neutral is connected to ground at the Service**, Not at the generator set

When Should I Consider a 3 Pole vs. 4 Pole ATS?

When Should I Consider a 3 Pole vs. 4 Pole ATS?

- Choice depends on grounding scheme of the system
- NFPA70 (NEC) requires some systems to have ground fault protection (GFP)
  - E.g. ≥1000 A; Solidly grounded wye; >150 V L-N
- Two rules for proper ground fault sensing:
  - Rule #1: There must be only one neutral to ground connection on any neutral bus at one time
  - Rule #2: Ground fault sensors must be downstream from the bonding connect



EGC (Equipment Grounding Conductor)

GEC (Grounding Electrode Conductor)

More on Grounding and Protection:

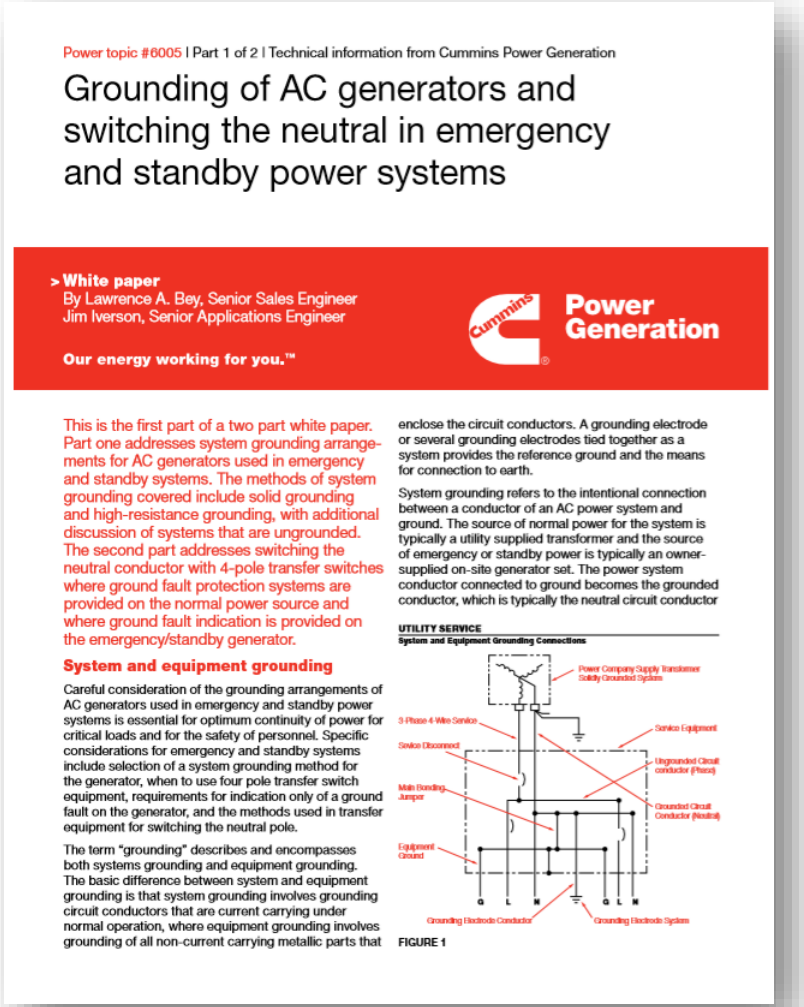
Related Content

Grounding and Neutral Switching

White Paper

White Paper

White Paper



Power topic #6005 | Part 1 of 2 | Technical information from Cummins Power Generation

Grounding of AC generators and switching the neutral in emergency and standby power systems

> **White paper**

By Lawrence A. Bey, Senior Sales Engineer
Jim Iverson, Senior Applications Engineer

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Cummins Power Generation

This is the first part of a two part white paper. Part one addresses system grounding arrangements for AC generators used in emergency and standby systems. The methods of system grounding covered include solid grounding and high-resistance grounding, with additional discussion of systems that are ungrounded. The second part addresses switching the neutral conductor with 4-pole transfer switches where ground fault protection systems are provided on the normal power source and where ground fault indication is provided on the emergency/standby generator.

System and equipment grounding

Careful consideration of the grounding arrangements of AC generators used in emergency and standby power systems is essential for optimum continuity of power for critical loads and for the safety of personnel. Specific considerations for emergency and standby systems include selection of a system grounding method for the generator, when to use four pole transfer switch equipment, requirements for indication only of a ground fault on the generator, and the methods used in transfer equipment for switching the neutral pole.

The term "grounding" describes and encompasses both systems grounding and equipment grounding. The basic difference between system and equipment grounding is that system grounding involves grounding circuit conductors that are current carrying under normal operation, where equipment grounding involves grounding of all non-current carrying metallic parts that enclose the circuit conductors. A grounding electrode or several grounding electrodes tied together as a system provides the reference ground and the means for connection to earth.

System grounding refers to the intentional connection between a conductor of an AC power system and ground. The source of normal power for the system is typically a utility supplied transformer and the source of emergency or standby power is typically an owner-supplied on-site generator set. The power system conductor connected to ground becomes the grounded conductor, which is typically the neutral circuit conductor

UTILITY SERVICE
System and Equipment Grounding Connections

FIGURE 1

Q&A

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

After the PowerHour, a complete list of questions and answers will be published on powersuite.cummins.com.

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Q&A

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Please complete the brief survey before exiting the webinar!

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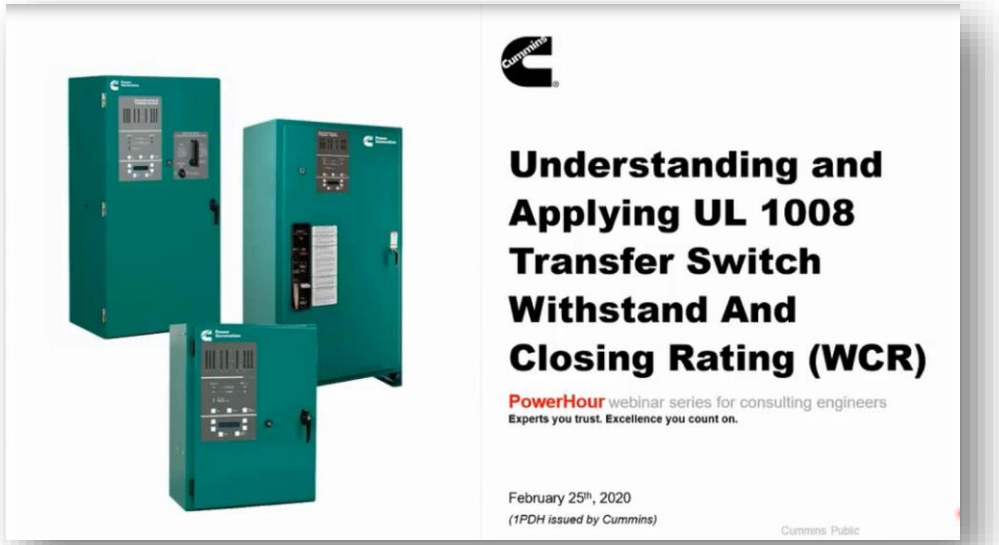
Additional Resources

Cummins White Papers

- White Paper (NFPA 110 Time to Readiness)
- White Paper (WCR Ratings)
- White Paper (Selective Coordination)
- White Paper (Protective Relays)
- White Paper (Grounding and Switching of Neutral)
- White Paper (Grounding and Switching of Neutral)
- White Paper (Start Signal Integrity)

Cummins PowerHour On-Demand Webinars

- PowerHour Recording (NFPA 110 Time to Readiness)
- PowerHour Recording (WCR Ratings)
- PowerHour Recording (NEC 2017 changes)



Closing

Watch out for a follow-up email including:

- A link to the webinar recording and copy of the presentation
- A certificate issuing one professional development hour (1 PDH)

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Upcoming PowerHour Webinars:

October: Healthcare Power System Installations and Case Studies

November: Overcurrent Protection for NEC Life Safety Emergency Power Systems

December: Standby Power Systems Service Requirements for Life-Safety Applications

Please contact Michael Sanford if you have any questions related to the PowerHour webinar (michael.sanford@cummins.com)


Cummins