Understanding and Applying UL 1008 Transfer Switch Withstand And Closing Rating (WCR)

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February 25th, 2020

(1PDH issued by Cummins)

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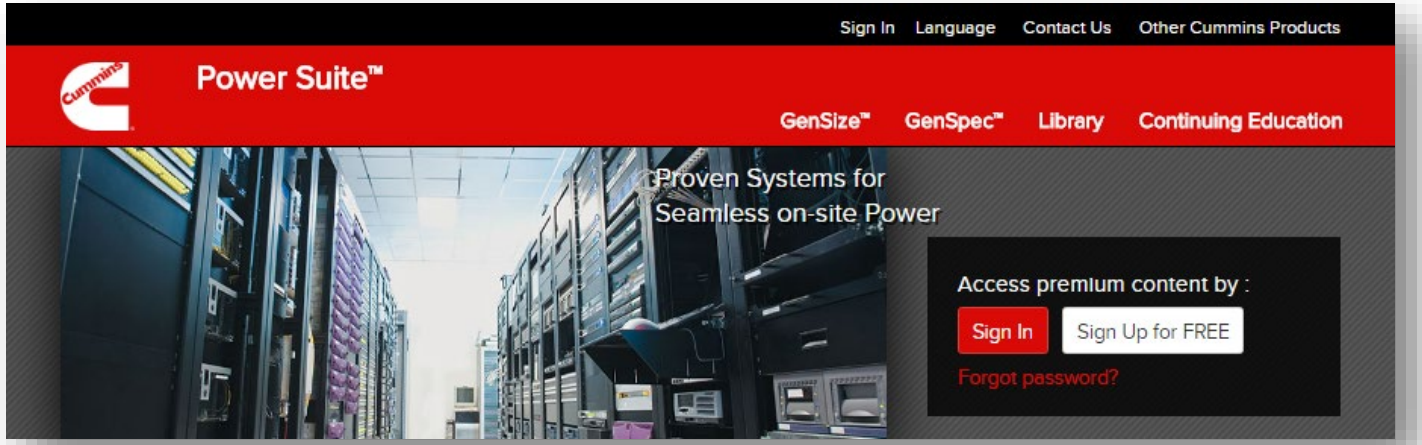

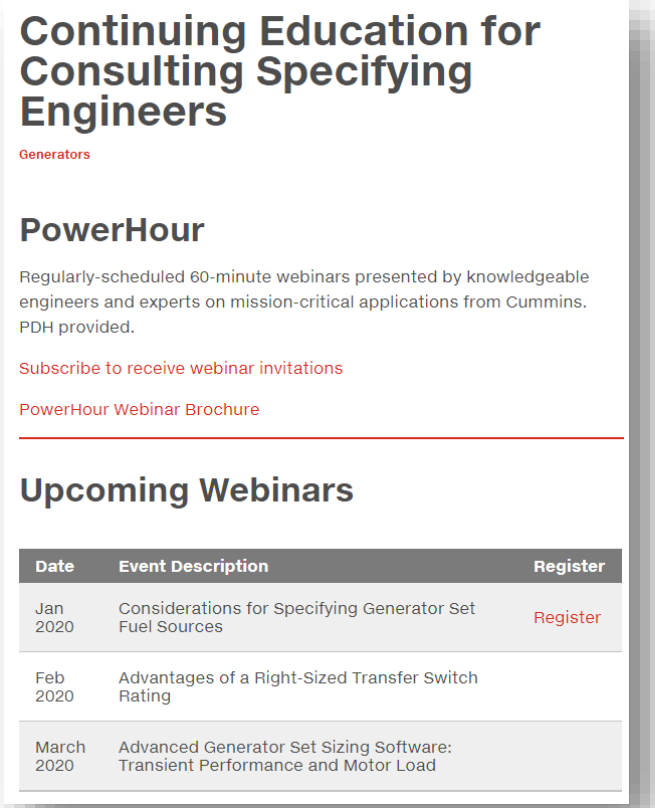

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Course Objectives

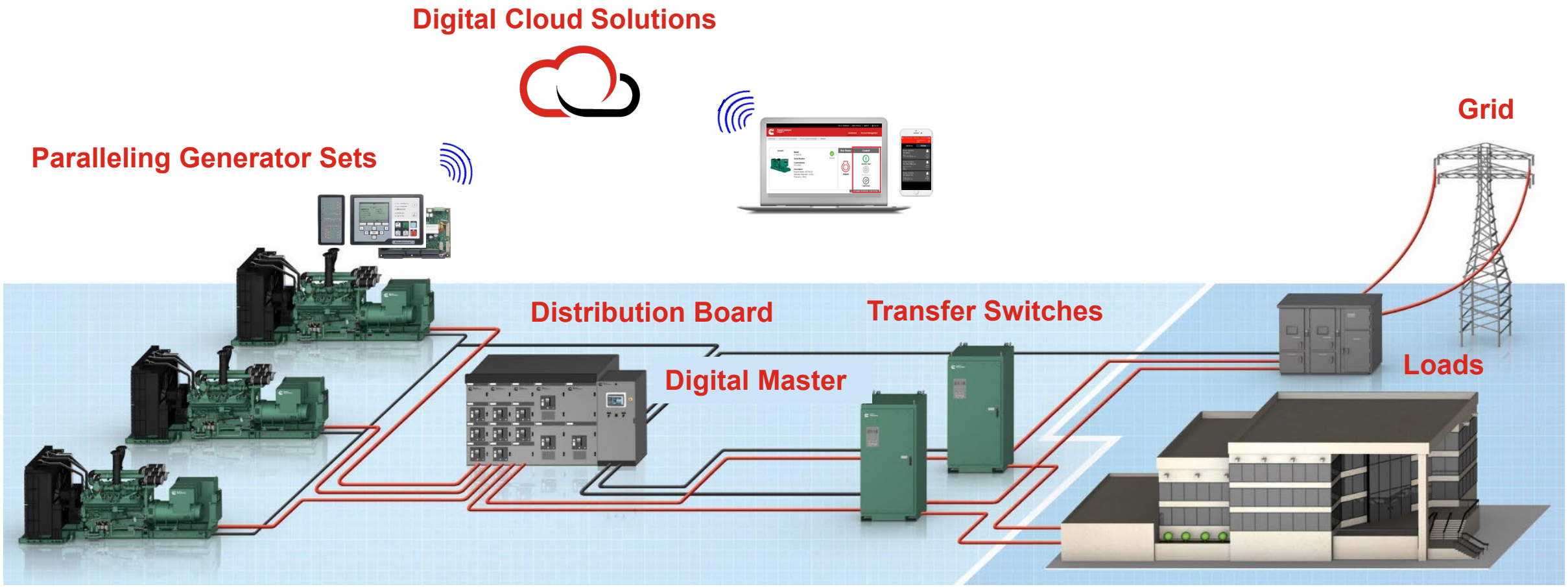
Understanding and Applying UL 1008 Transfer Switch Withstand And Closing Rating (WCR)

Transfer switches come in a variety of types for use in a wide array of applications and are tested to meet UL 1008 Standard for Safety - Transfer Switch Equipment. This course discusses some of the UL 1008 testing criteria and specifically focuses on the required withstand and closing rating that is either time-based or specific overcurrent protection device based. In addition, this course covers the optional UL 1008 short-time rating.

After completing this course, participants will be able to:

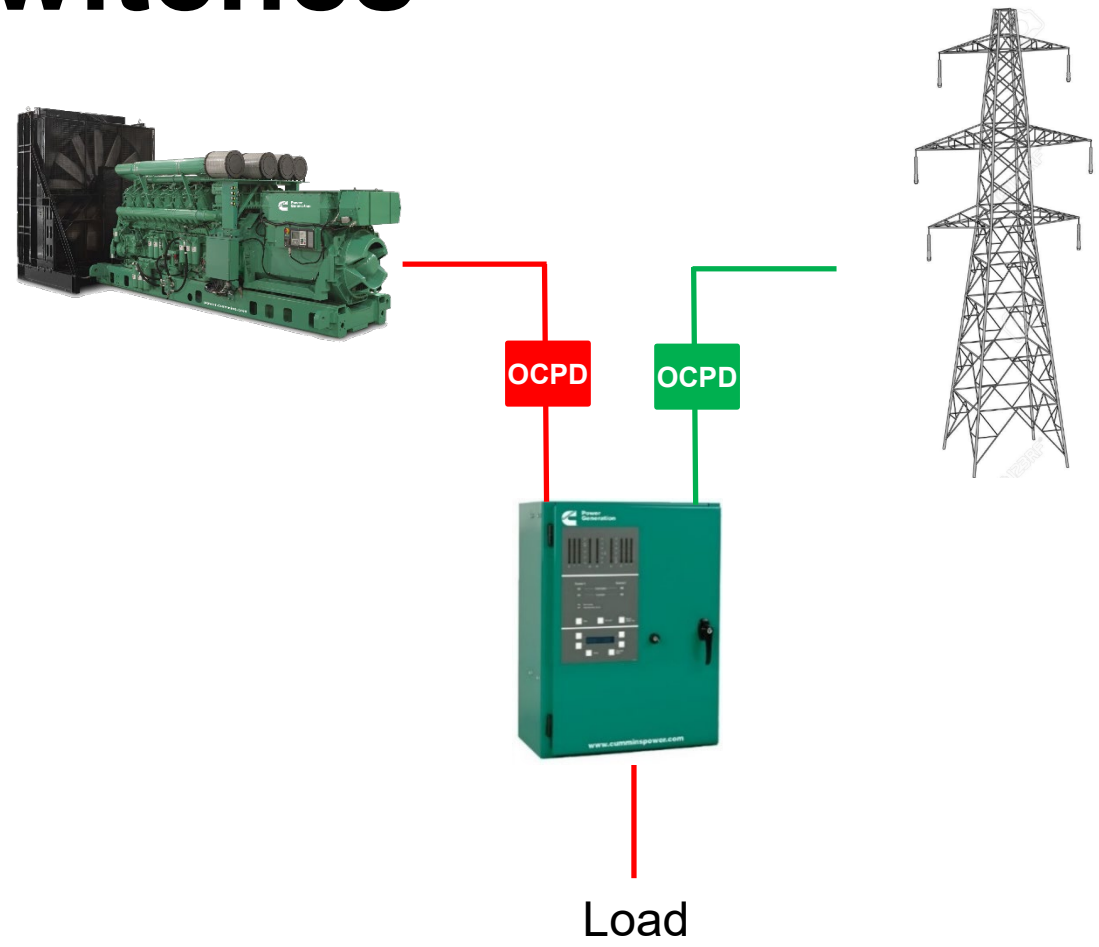
- Discuss the UL 1008 requirements for transfer switch withstand and closing ratings
- Explain the required UL 1008 withstand and closing rating which can be time-based or specific overcurrent protection device based and how that can impact the transfer switch selection
- Describe the optional UL 1008 short-time rating and review how and where it can be applied

Power System Building Blocks



The Role Of Transfer Switches

- Load transfer between power sources
  - Senses loss of normal power
  - Starts the generator set
  - Transfers the load to the generator set
  - Detects availability of normal power
  - Transfers load back to the normal source



OCPD: Overcurrent Protection Device

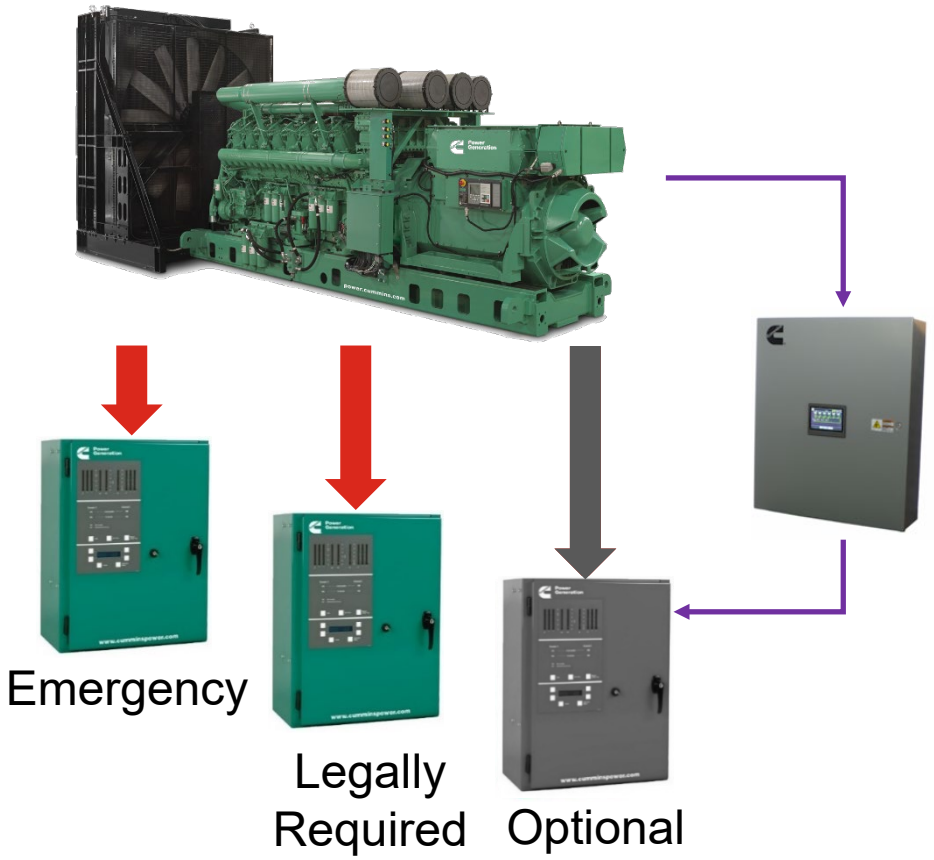
Energized

De-energized

The Role Of Transfer Switches

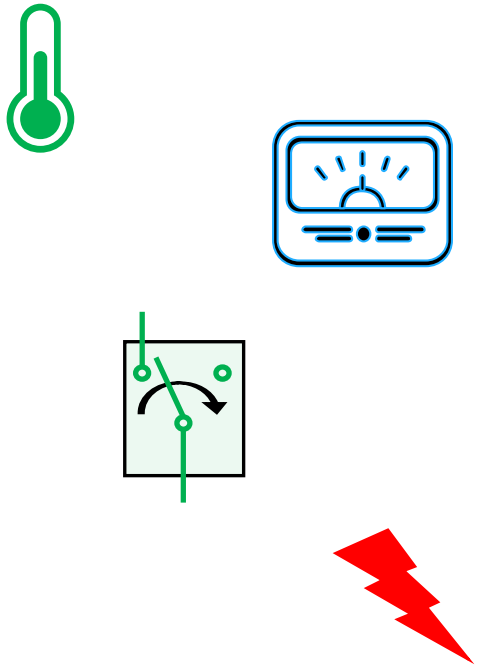
- Load transfer between power sources
  - Senses loss of normal power
  - Starts the generator set
  - Transfers the load to the generator set
  - Detects availability of normal power
  - Transfers load back to the normal source

- Load shed
  - Might be required per the National Electric Code (NEC)
    - Adequate capacity
    - Selective means to shed non-critical loads
  - Three position transfer switch is required for load shedding



UL 1008 Testing

- UL 1008 specifies stringent testing requirements
  - 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)



What Is A Short-Circuit WCR?

- One of the key items to consider when selecting a transfer switch is fault current capabilities
- Overcurrent Protection Devices (OCPD) clear faults
  - Fuses
  - Circuit breakers
- OCPDs have an Ampere Interrupting Capacity (AIC) rating
- The AIC rating is the maximum available fault current that an OCPD will safely clear when a fault is applied at the load side of the OPCD
- Transfer switches are not rated to clear faults and therefore don't have an AIC rating

What Is A Short-Circuit WCR?

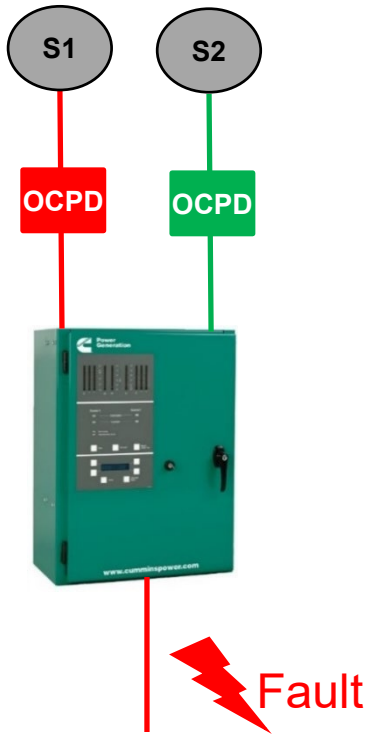
- Per UL 1008, transfer switches must:
  - Withstand the fault current
  - Close on the fault current
- Transfer switches have a short-circuit Withstand and Closing Rating (WCR)

UL 1008 Short-Circuit Test Requirements

Available Short-Circuit Current

Switch Rating (A)	Current* (A)	Power Factor*	Time Duration (s), minimum*
100 or less	5,000	0.40 - 0.50	0.008
101 - 400	10,000	0.40 - 0.50	0.025
401 - 1000	20x rating but not less than 10,000	0.25 - 0.30	0.050
1001 and greater	20x rating	0.20 or less	0.050
*Current can be higher, power factor can be lower, time durations can be different			

Data is from Table-25 of UL 1008 8th edition



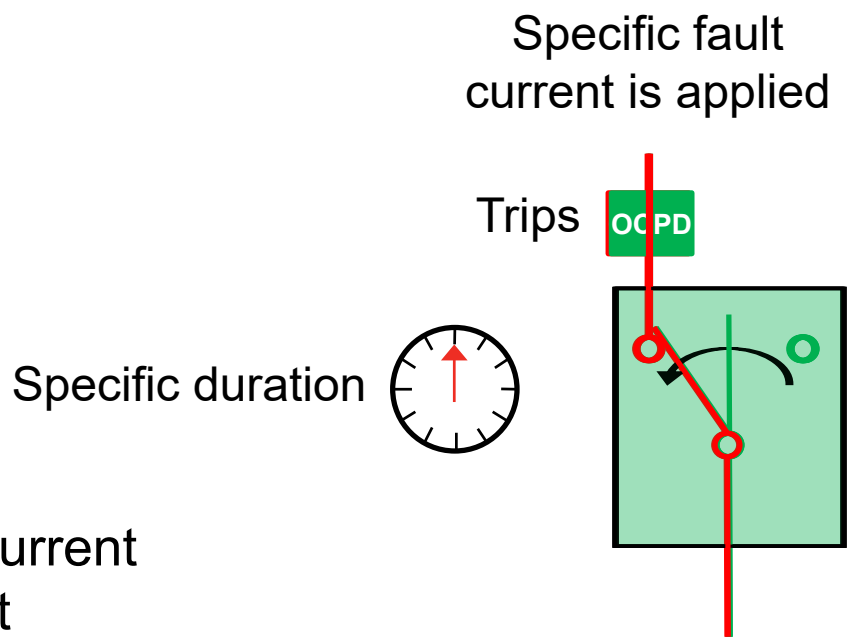
Duration:

Amount: Amperes

Transfer Switch Short-Circuit WCR Testing

- 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
- The same set of contacts are used for both tests: withstand and closing



Short-Circuit WCR Passing Criteria

- Ability to operate the switch and close to the opposite source
- No breakage of switch base or any other internal parts
- Door must stay secure
- Cables stay connected to lugs without insulation damage
- No continuity between the normal and alternate source terminals
- Pass a dielectric voltage-withstand test

Safety!

Concept Check

Which of the following statements is true?

a) Transfer switches have an AIC rating
b) Transfer switches interrupt fault current
c) Transfer switches have a WCR rating
d) Both a) AND c)

Concept Check

Which of the following statements is true?

a) Transfer switches have an AIC rating
b) Transfer switches interrupt fault current
c) Transfer switches have a WCR rating
d) Both a) AND c)

Applying The Duration Rating

SHORT-CIRCUIT WITHSTAND/CLOSING RATINGS

Circuit Breaker Time Duration Listing

When protected by a circuit breaker, this transfer switch is suitable for use in a circuit capable of delivering the short circuit current for the maximum time duration and voltage listed below.

The circuit breaker must include an instantaneous trip response and shall not include a short-time trip response.

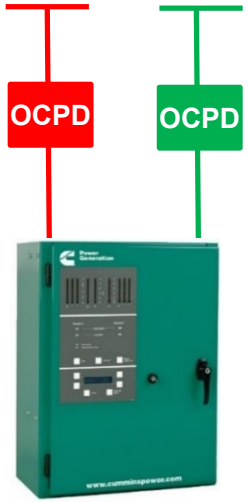
The maximum clearing time of the instantaneous trip response must be equal to or less than the time duration shown for the listed short-circuit current.

This transfer switch does not include short-time current ratings.

Short Circuit Current RMS Symmetrical Amperes	Short Circuit AC Voltage	Time Duration (Maximum Seconds)
50000	480	0.050
42000	600	0.050

- Use a generic UL 489 breaker that clears the fault current within the time specified on the label

Voltage: 480VAC
AFC: 50000A

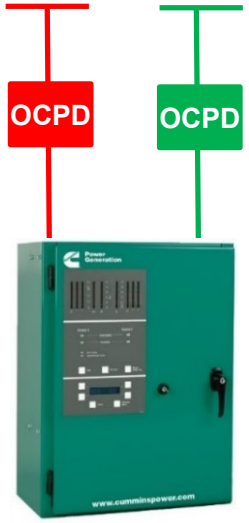


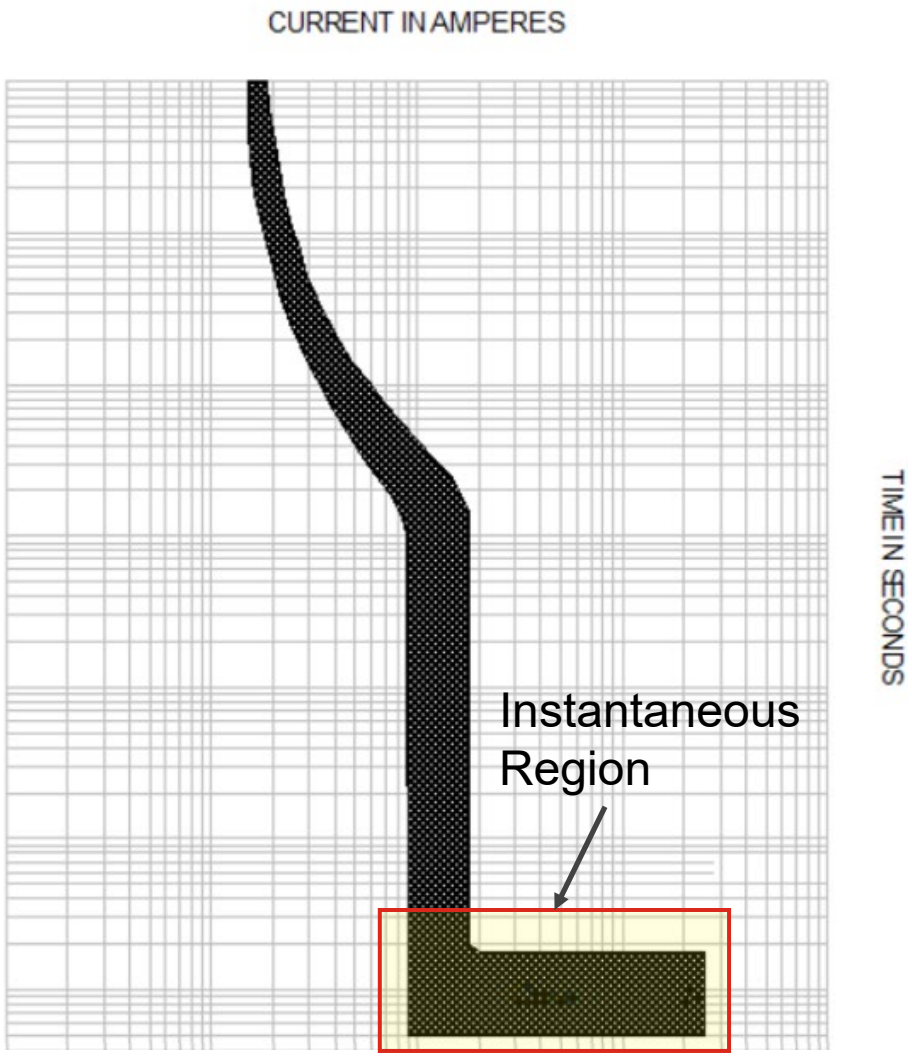
AFC: Available Fault Current

Typical Thermal-Magnetic Breaker Time-Current Curve

- Instantaneous trip setting:
  - Indicates the multiple of the full load rating at which the circuit breaker will open as quickly as possible with no intentional delay

Breakers must include instantaneous trip response





Applying The OCPD Ratings

- Specific OCPD:
  - Fuse
  - Circuit breaker
- The same transfer switch has different short-circuit withstand/closing ratings

SHORT-CIRCUIT WITHSTAND/CLOSING RATINGS

Specific Fuse Manufacturer and Type Listing

When protected by a fuse of the specific fuse class and up to the fuse amperes listed below, this transfer switch is suitable for use in a circuit capable of delivering up to the short circuit current and voltage listed below.

Short-Circuit Current RMS Symmetrical Amperes	Short Circuit AC Voltage	Fuse Class	Maximum Fuse Amperes
200000	600	L	2000
200000	600	T	1200
200000	600	J, RKI, RK5	600

A048E945.A

Circuit Breaker Protection

When protected by one of the following circuit breakers rated not more than 1400 amperes, this transfer switch is rated for use on a circuit capable of delivering not more than the indicated RMS symmetrical amperes at the voltage shown.

GE

Type	Interrupting Rating at		
	240 VAC	480 VAC	600 VAC
AKRU 1200L max	200000	200000	200000
AKU 1200L max	200000	200000	200000

Siemens

Type	Interrupting Rating at		
	240 VAC	480 VAC	600 VAC
CMD6, CND6	200000	100000	65000
CPD6	200000	85000	65000
SCLD6	200000	150000	100000
SCMD6, SCND6	200000	100000	65000

Square D

Type	Interrupting Rating at		
	240 VAC	480 VAC	600 VAC
DSL	200000	200000	200000
LD	25000	18000	14000
LG	65000	35000	18000
LJ	100000	65000	25000
LL	125000	100000	50000
LR	200000	200000	100000

Voltage: 600VAC
AFC: 200000A

AFC: Available Fault Current

Time Duration Vs. OCPD

- Which rating should be applied?
  - It depends!
- UL 1008 allows the manufacturer to test and list the transfer switch to both:
  - Time Duration
  - Specific OCPD
- The different ratings provide the designer more flexibility to select the appropriate rating depending on the available fault current without the need to apply a larger size transfer switch

SHORT-CIRCUIT WITHSTAND/CLOSING RATINGS

Circuit Breaker Time Duration Listing

When protected by a circuit breaker, this transfer switch is suitable for use in a circuit capable of delivering the short circuit current for the maximum time duration and voltage listed below.

The circuit breaker must include an instantaneous trip response and shall not include a short-time trip response.

The maximum clearing time of the instantaneous trip response must be equal to or less than the time duration shown for the listed short-circuit current.

This transfer switch does not include short-time current ratings.

Short Circuit Current RMS Symmetrical Amperes	Short Circuit AC Voltage	Time Duration (Maximum Seconds)
50000	480	0.050
42000	600	0.050

Specific Fuse Manufacturer and Type Listing

When protected by a fuse of the specific fuse class and up to the fuse amperes listed below, this transfer switch is suitable for use in a circuit capable of delivering up to the short circuit current and voltage listed below.

Short Circuit Current RMS Symmetrical Amperes	Short Circuit AC Voltage	Fuse Class	Maximum Fuse Amperes
200000	600	J, RK1, RK5	600
200000	600	T	1200
200000	600	L	2000

Specific Circuit Breaker Manufacturer and Type Listing

When protected by a circuit breaker of a specific manufacturer and type, and up to the maximum breaker amperes listed below, this transfer switch is suitable for use in a circuit capable of delivering up to the short circuit current and voltage listed below, but not more than the rating of specific circuit breaker.

Short Circuit Current RMS Symmetrical Amperes	Short Circuit AC Voltage	Maximum Breaker Amperes
85000	480	1600
65000	600	1600

GE

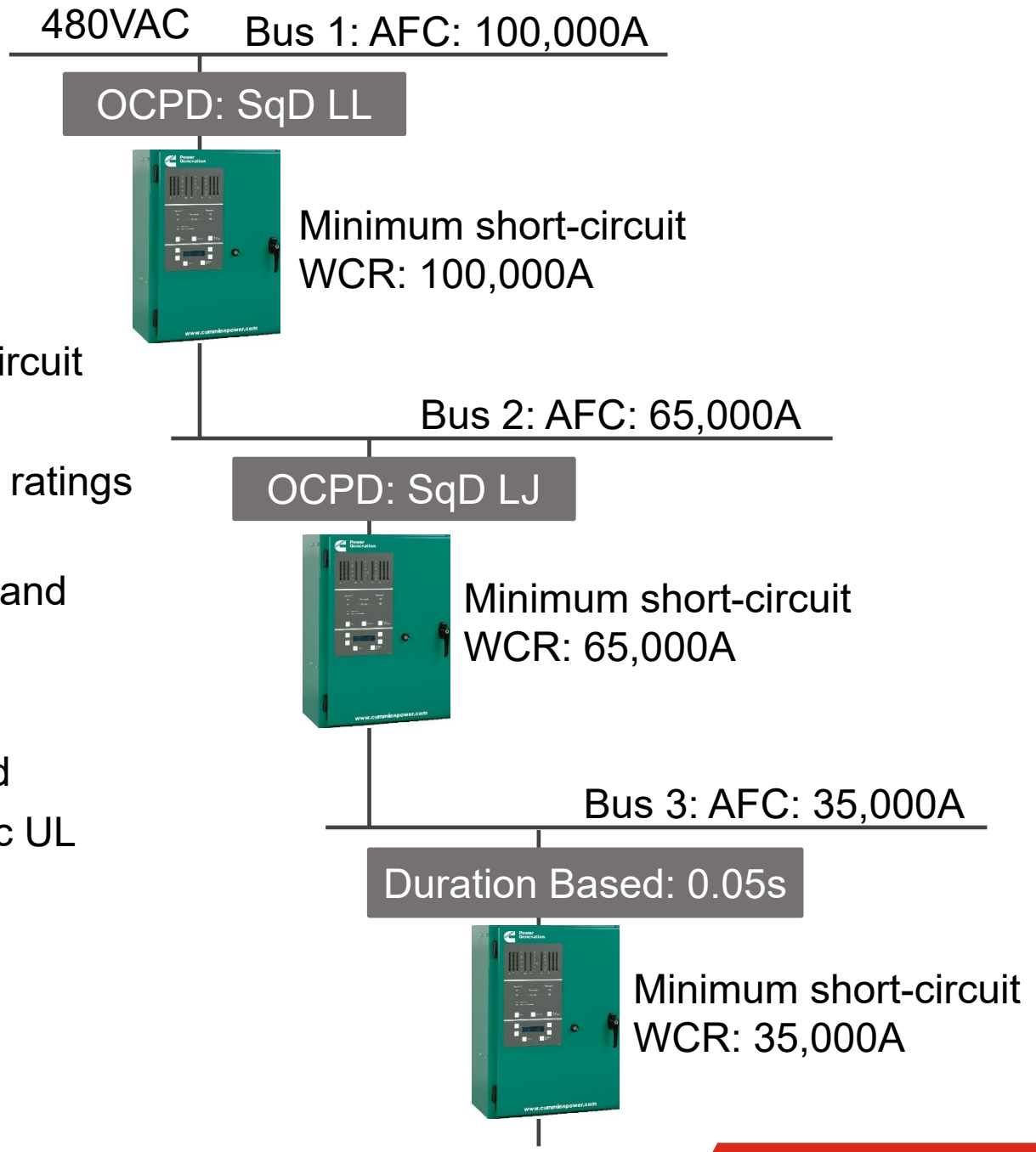
SKH SKL SKP

Siemens

HHJD6	HJXD6	HMD6	HPD6 [3]	LD6 [1]	MD6	PD6
HHJXD6	HLD6 [1]	HMG [2]	HPXD6 [3]	LMD6 [1]	MXD6	PXD6
HHLD6 [1]	HLMD6 [1]	HMXD6	JD6	LMG [2]	ND6	

Applying Specific Time & OCPD Ratings

- Determine the available fault current from the short-circuit analysis
- Select transfer switches with appropriate short-circuit ratings
  - Note that transfer switches must be rated for the available fault current at their line side terminals and protected by an OCPD selected appropriately
- Select appropriate protections
  - Bus 1 and Bus 2: specific OCPD rating is applied
  - Bus 3: specific duration rating is applied (Generic UL 489 circuit breaker)



What Is The "Any Breaker" Rating?

- The term "Any Breaker" is another way to state the Time Duration rating
- UL 489 requires Molded Case Circuit Breakers (MCCB):
  - Above 400 amps to clear a fault in no more than 0.050s
  - 400 amps and below to clear a fault in no more than 0.025s
- "Any Breaker" is not a UL 1008 rating

SHORT-CIRCUIT WITHSTAND/CLOSING RATINGS

Circuit Breaker Time Duration Listing

When protected by a circuit breaker, this transfer switch is suitable for use in a circuit capable of delivering the short circuit current for the maximum time duration and voltage listed below.

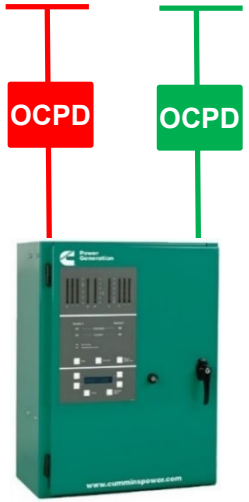
The circuit breaker must include an instantaneous trip response and shall not include a short-time trip response.

The maximum clearing time of the instantaneous trip response must be equal to or less than the time duration shown for the listed short-circuit current.

This transfer switch does not include short-time current ratings.

Short Circuit Current RMS Symmetrical Amperes	Short Circuit AC Voltage	Time Duration (Maximum Seconds)
50000	480	0.050
42000	600	0.050

Voltage: 480VAC
AFC: 50000A



AFC: Available Fault Current

Recommended Spec Language

- Should allow the transfer switch supplier to meet the short-circuit requirement with either a specific duration or a specific OCPD
- AIA MasterSpec® provides objective specification language:
  - "Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL1008."

Concept Check

What short circuit rating does UL1008 require?

a) WCR based on time duration
b) WCR based on a specific overcurrent device
c) Either a) OR b)
d) Both a) AND b)

Concept Check

What short circuit rating does UL1008 require?

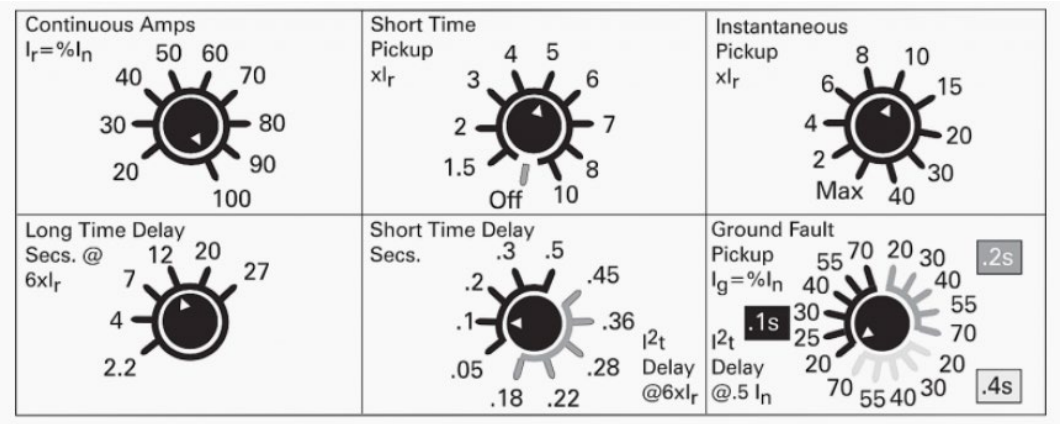
a) WCR based on time duration
b) WCR based on a specific overcurrent device
c) Either a) OR b)
d) Both a) AND b)

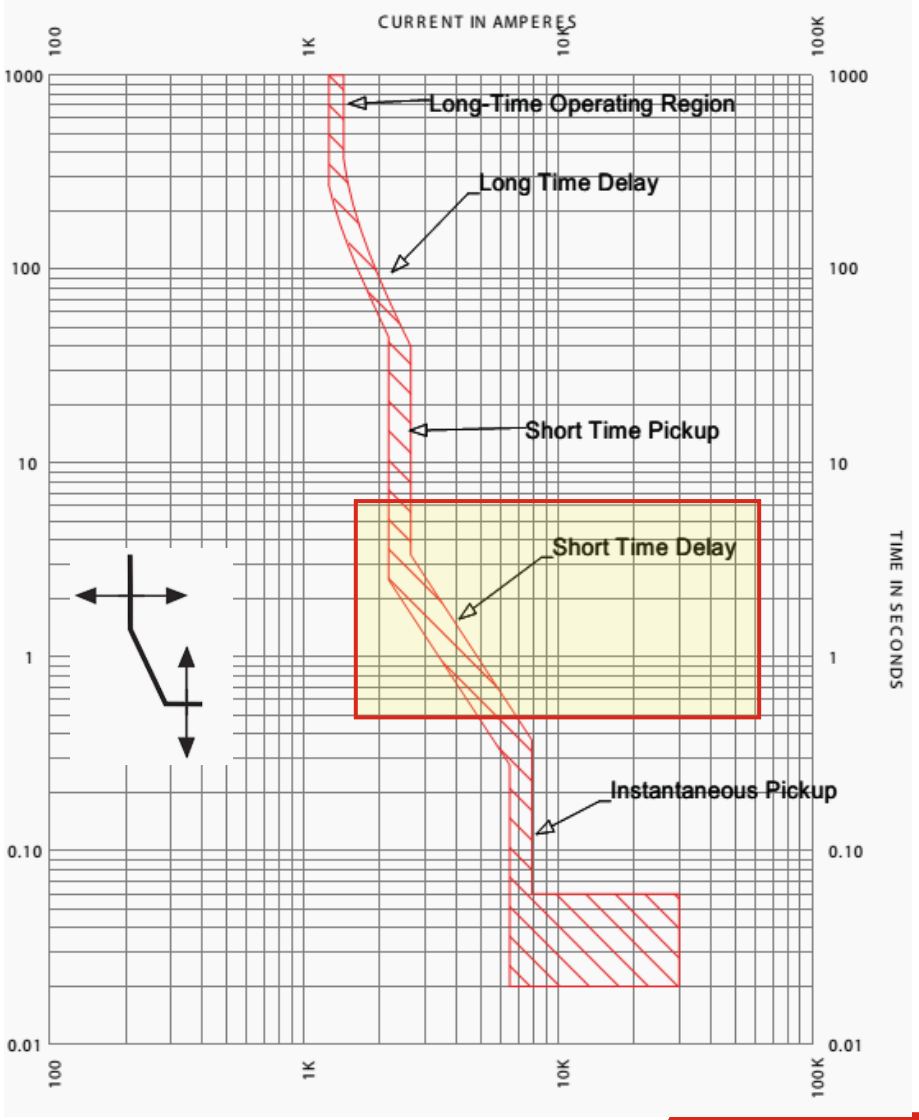
UL 1008 Testing

- UL 1008 specifies stringent testing requirements
  - 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)

Typical LSIG Breaker Time-Current Curve

- Short-Time pickup and delay:
  - Determines the amount of current the breaker will carry for a short period of time, allowing downstream protective devices to clear short-circuits without tripping the upstream device





Short-Time Withstand/Closing Rating

- It is a Time Duration short-circuit WCR test
- Durations are set by the manufacturer. For example: 0.50s
- Transfer switch must pass the same criteria outlined before:
  - Ability to operate the switch and close to the opposite source
  - No breakage of switch base or any other internal parts
  - Door must stay secure
  - Cables stay connected to lugs without insulation damage
  - No continuity between the normal and alternate source terminals
  - Pass a dielectric voltage-withstand test
  - Pass a temp-rise test
- Short-Time demonstrates that the transfer switch can still carry rated current

Safety & Performance!

Applying The Short-Time Rating

SHORT-CIRCUIT WITHSTAND/CLOSING RATINGS

Circuit Breaker and Short-Time Current Ratings

When protected by a circuit breaker, this transfer switch is suitable for use in a circuit capable of delivering the short-circuit current for the maximum time duration and voltage listed below.

The circuit breaker must include an instantaneous trip response unless the available short-circuit current is less than or equal to the short-time rating of the transfer switch and the circuit breaker includes a short-time response.

The maximum clearing time of the instantaneous trip response must be equal to or less than the time duration shown for the listed short-circuit current.

When protected by a circuit breaker with a short-time trip response, the short-time response of the circuit breaker must be coordinated with the short-time current rating of the transfer switch as listed below.

Short-Circuit Current RMS Symmetrical Amperes	Short Circuit AC Voltage	Time Duration (Maximum Seconds)
65000	600	0.050

Short-Time Current RMS Symmetrical Amperes	Short Circuit AC Voltage	Time Duration (Maximum Seconds)
42000	480	0.500

Voltage: 480VAC
AFC: 42000A
0.50 Duration

Breakers can have a short-time response

Short-Time rating allows for selective coordination

AFC: Available Fault Current

Transfer Switch Application Example

Figure-1, UL 891 Switchboard

Breaker has instantaneous trip response
AFC: 65,000A

Short-Circuit WCR:
65,000A @600 VAC
for 0.05 seconds

Figure-2 UL 1558 Switchgear

Breaker has short-time trip response.
AFC: 42,000A

Short-time WCR:
42,000A @600 VAC
for 0.5 seconds

- In Figure-1, the transfer switch is fed by a UL 891 switchboard
  - The circuit breaker must include an instantaneous trip response
  - Circuit breaker must trip in 0.05s or faster

- In Figure-2, the transfer switch is fed by a UL 1558 switchgear
  - The transfer switch must have a short-time rating
  - The short-time response of the circuit breaker must be coordinated with short-time current rating of the transfer switch

Course Summary

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

- Discuss the UL 1008 requirements for transfer switch withstand and closing ratings
- Explain the required UL 1008 withstand and closing rating which can be time-based or specific overcurrent protection device based and how that can impact the transfer switch selection
- Describe the optional UL 1008 short-time rating and review how and where it can be applied

Conclusions:

- Transfer switches have several short-circuit WCR based on durations and specific OCPD
- Specifications should require the transfer switch short-circuit WCR be coordinated with the OCPD at the fault current available on the line side of the transfer switch
- Short-time rating is a short-circuit withstand and closing rating that is duration based
- Specifying a transfer switch with a short-circuit WCR is sufficient when it is fed by a UL891 distribution board

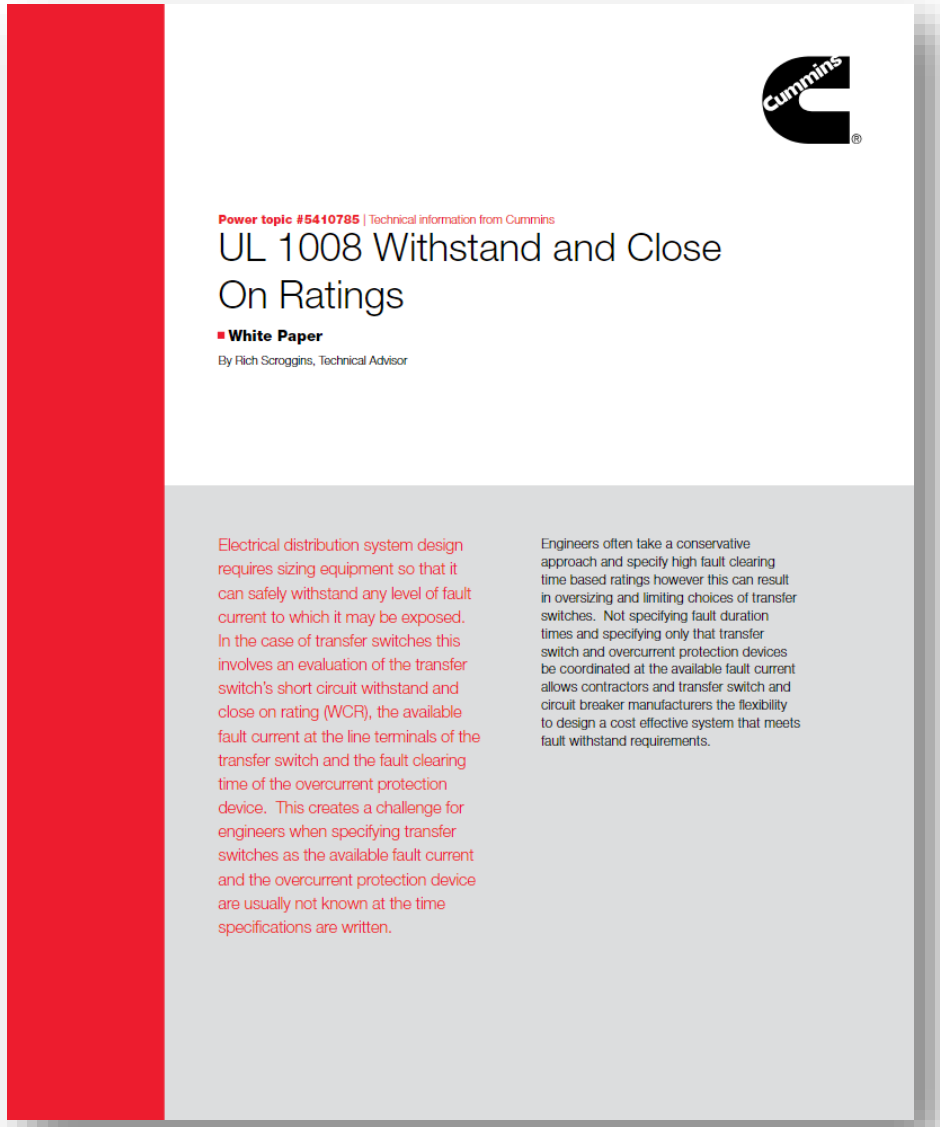
Additional Resources

Cummins White Papers

- UL 1008 Withstand and Close on Ratings
- Guidelines for ATS Selection: How to Choose the Right Transfer Solution for Your Power Application

Cummins On-Demand Webinars

- Transfer Switches Made Easy: A Step-by-Step Guide for Selecting the Right Transfer Switch for your System
- Transfer Switch Operation and Application



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.

Q&A

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