DECEMBER 12, 2021

Why Do We Need 30 Cycle ATS?

IEEE IAS Meeting – Nashville, TN

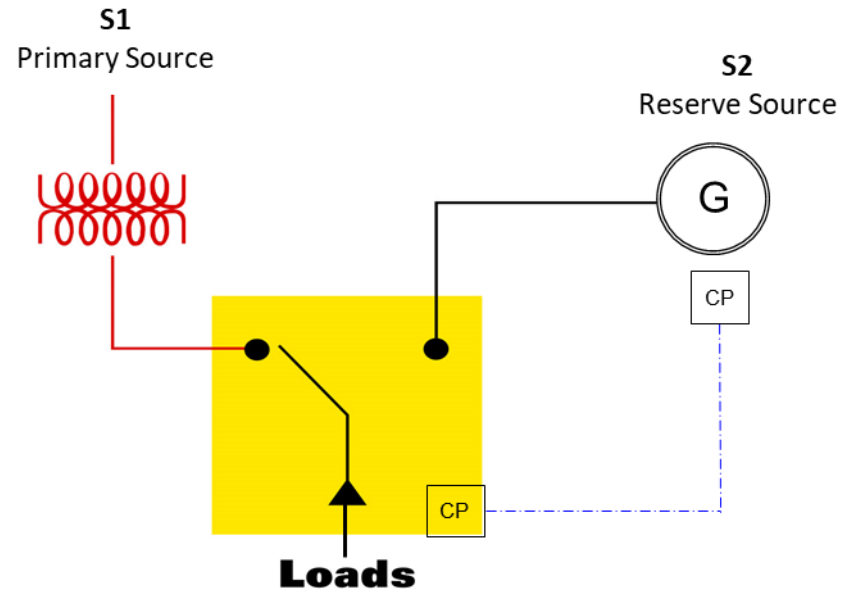Harry Handlin – Data Center Solutions Architect
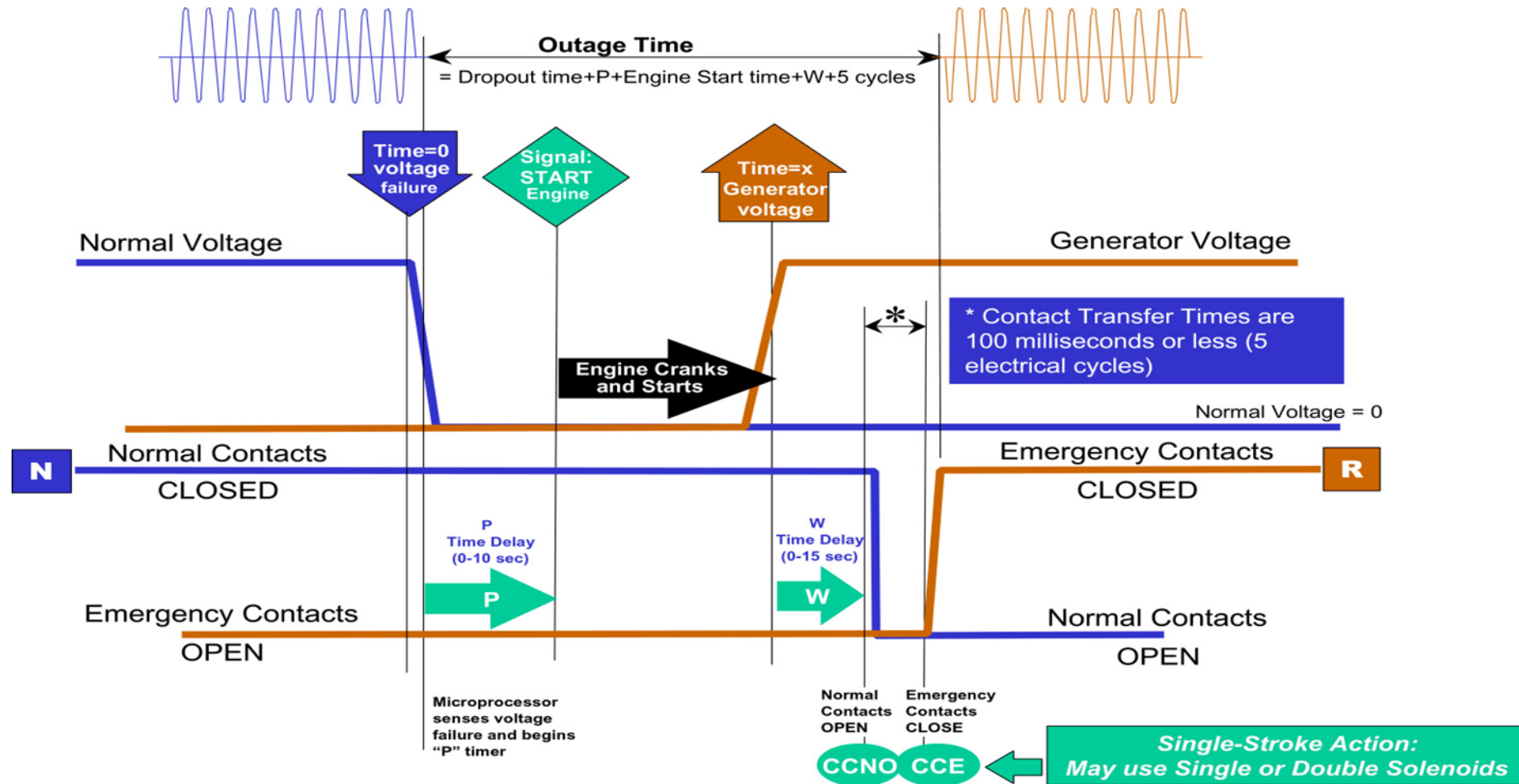
ABB

Agenda

- ATS Basics
- ATS operation as a result of a fault
- Selective Coordination
- UL1008 – Transfer Switch Equipment
- ATS Protection
- UL1008 Ratings & ***Application Requirements***

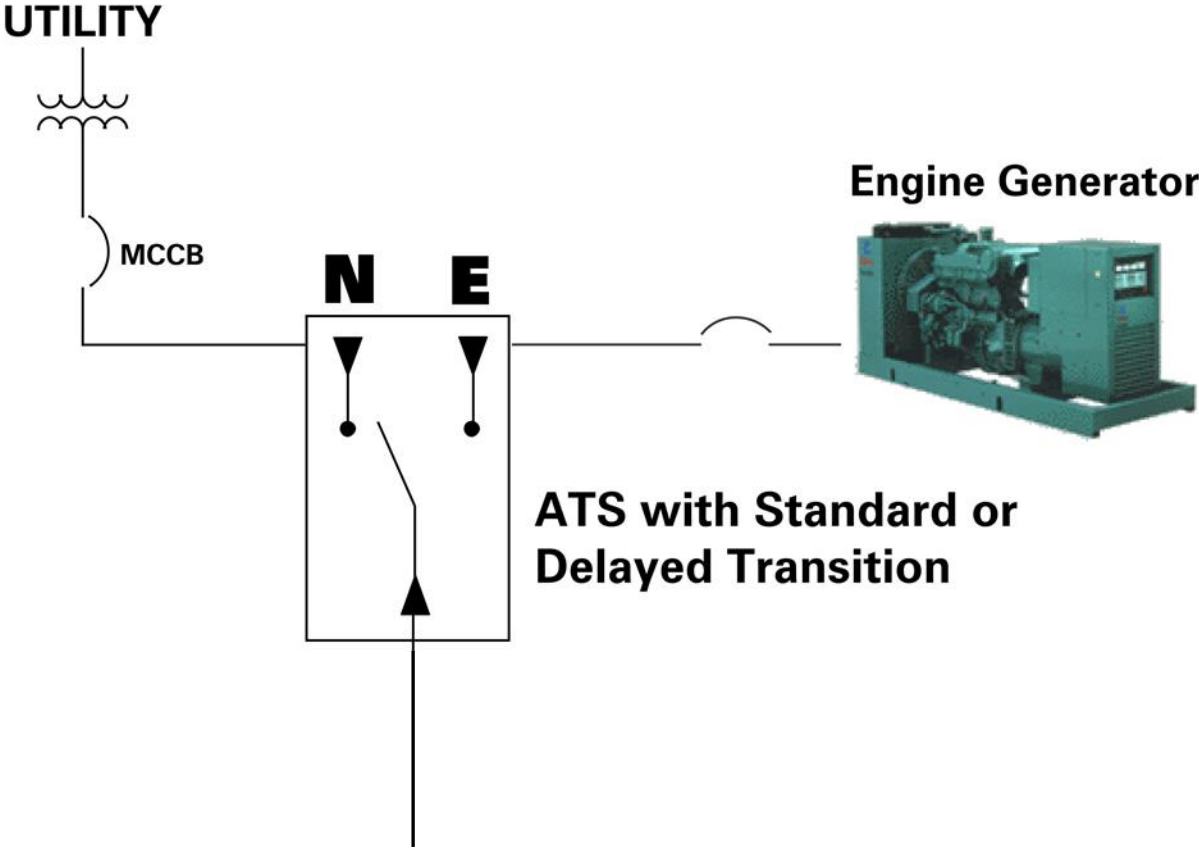# What is a Transfer Switch

Transfers Between Two Sources
It is NOT an overcurrent protective device
Can be manual or automatic

S1
Primary Source

S2
Reserve Source

G

CP

CP

Loads

ATS Sequence of Operation – Standard Transition

Typical Application

UTILITY

MCCB

N E

Engine Generator

ATS with Standard or
Delayed Transition

Fault Downstream of ATS

UTILITY

MCCB

N **E**

Engine Generator

ATS with Standard or
Delayed Transition

Fault Upstream of ATS

UTILITY

MCCB

N **E**

Engine Generator

ATS with Standard or Delayed Transition
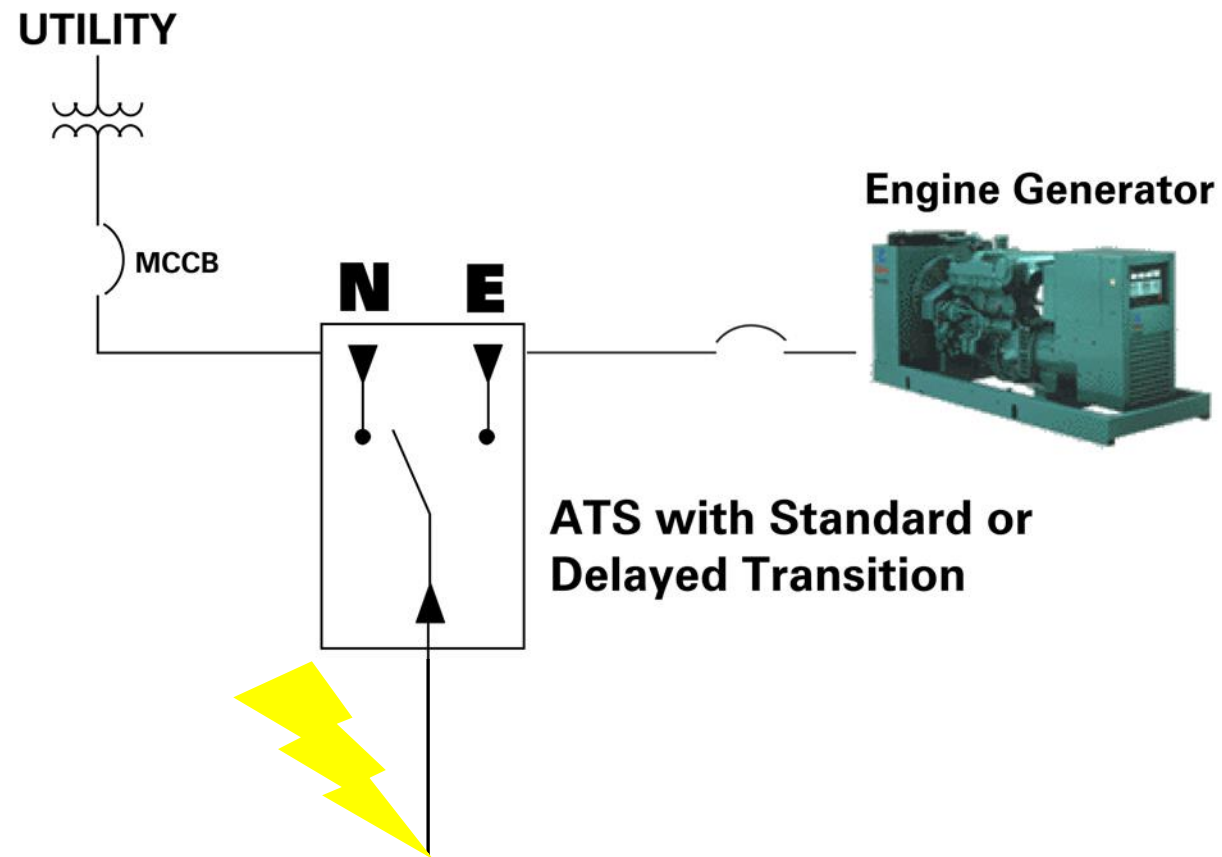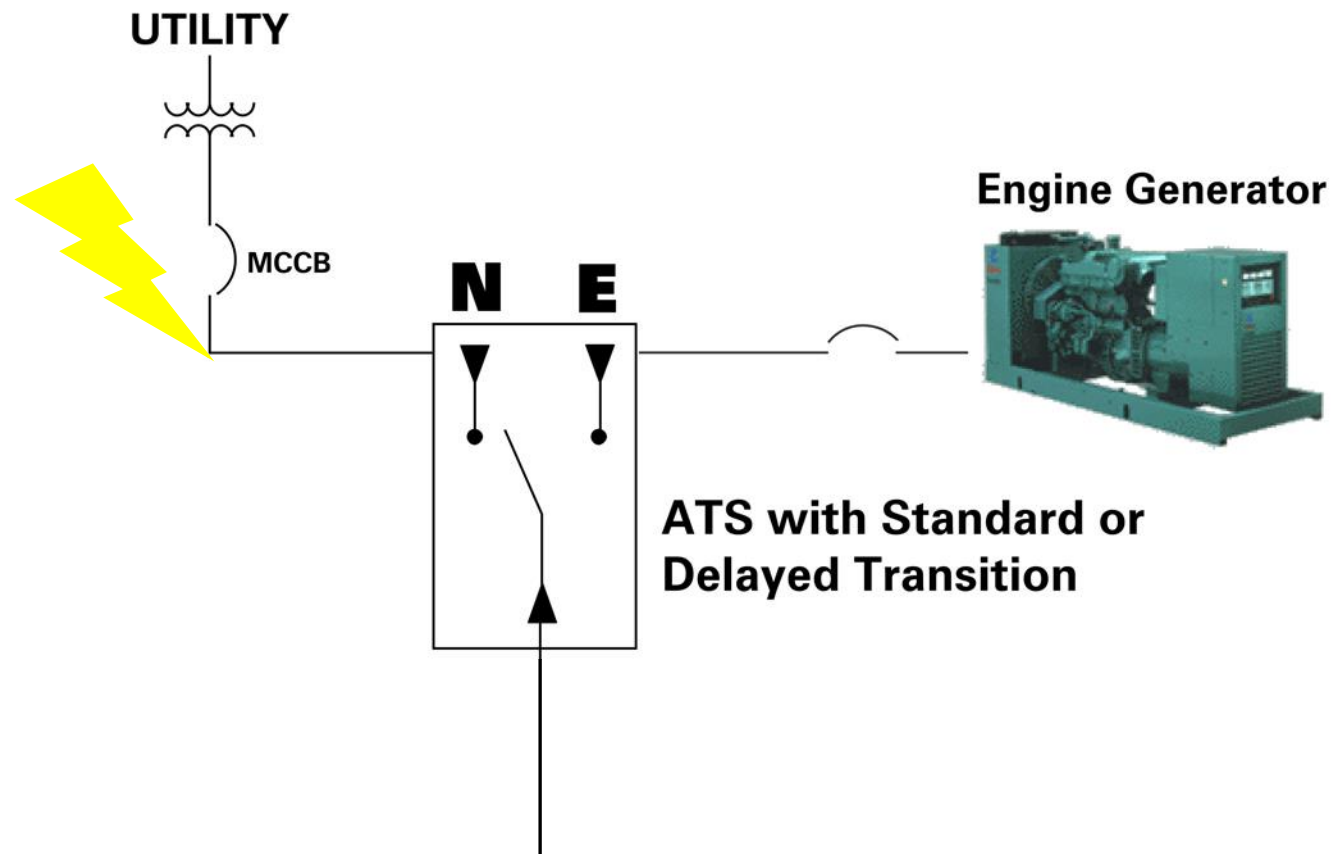
NEC Requirements for Selective Coordination

The 2005, 2008, 2011, and 2014 NEC extend the selectivity requirement to all possible fault types and magnitudes for certain critical electrical circuits, i.e., those typically fed from automatic transfer switches (ATS). These circuits and requirements are those discussed in the following NEC articles:

- Article 620: Elevators, Dumbwaiters, Escalators, Moving Walks, Platform Lifts, and Stairway Lifts, 620.62 Selective Coordination
- Article 645: Information Technology Equipment, 645.27 Selective Coordination
- Article 695: Fire Pumps, 695.3(C)(3) Selective Coordination
- Article 700: Emergency Systems (Legally Required), 700.28 Selective Coordination
- Article 701: Legally Required Standby Systems, 701.27 Selective Coordination
- Article 708: Critical Operations Power Systems, 708.54 Selective Coordination
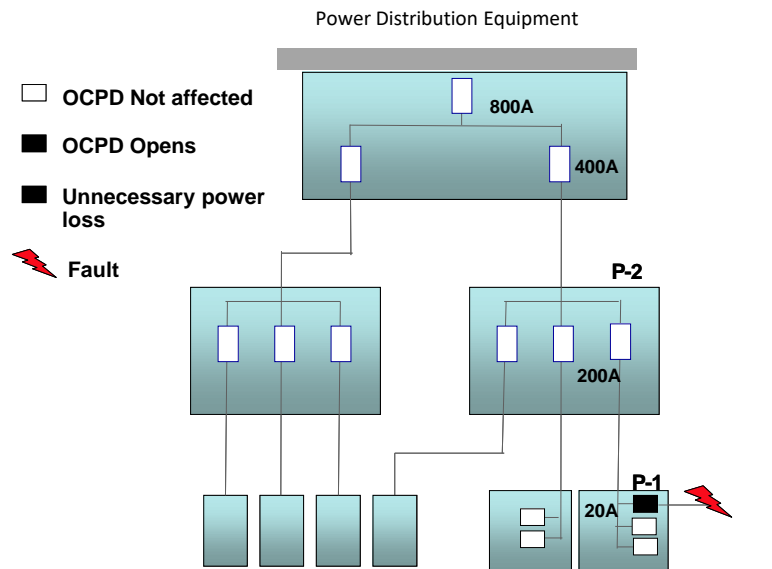
ATS Applications & UL1008

UL 1008

STANDARD FOR SAFETY

Transfer Switch Equipment

Selective Coordination

Power Distribution Equipment

OCPD Not affected
OCPD Opens
Unnecessary power loss
Fault

800A
400A
P-2
200A
P-1
20A

Selectively Coordinated
For the full range of overcurrents possible at P -1, only the 20A OCPD opens.

OCPD Not affected
OCPD Opens
Unnecessary power loss
Fault

800 A
400 A
P-2
200 A
P-1
20 A
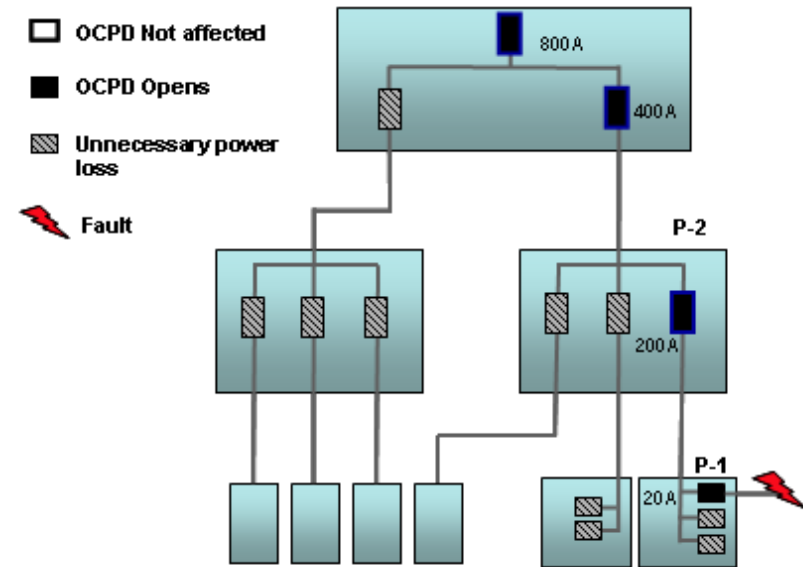
Not Selectively Coordinated
For some overcurrents possible at P -1, the 200A, 400A & 800A OCPDs opens when only the 20A OCPD should open

Why 30 Cycle ATS?

- Allow Nest Time delays on UL1558 switchgear with no instantaneous trip functions

- Not a common application:
  - Requires UL1558 Switchgear on each source and UL1558 Switchgear downstream. If the downstream equipment is a UL891 Switchboard, some manufacturers can provide a 30 cycle bus rating.
  - Elimination of instantaneous trip significantly increases the arc-flash hazard (3 cycle trip versus a 30 cycle short time trip increases the energy by a factor of 10)

So Why Use a 30 Cycle ATS?

Facilitates Selective Coordination Design

- If Fault occurs at CL1, only OCPD7 should open…all other loads should remain operational

- The ATS must withstand a fault, close on potential fault and be functional after the fault to be properly coordinated…it must have a "UL Short Time Rating"
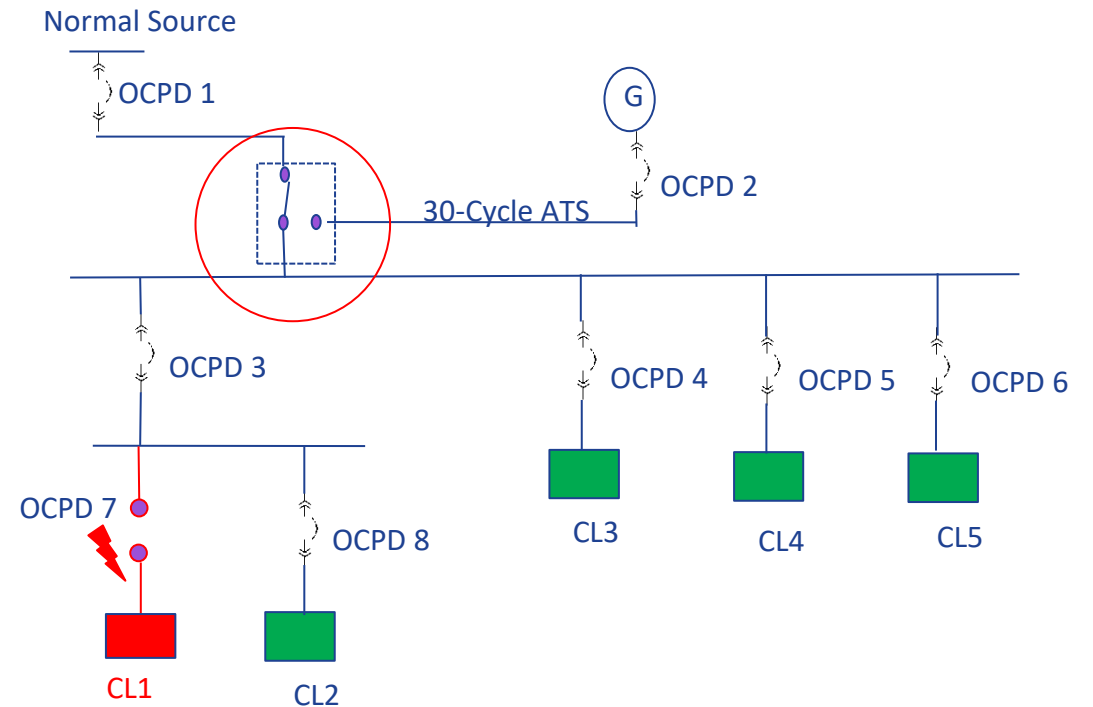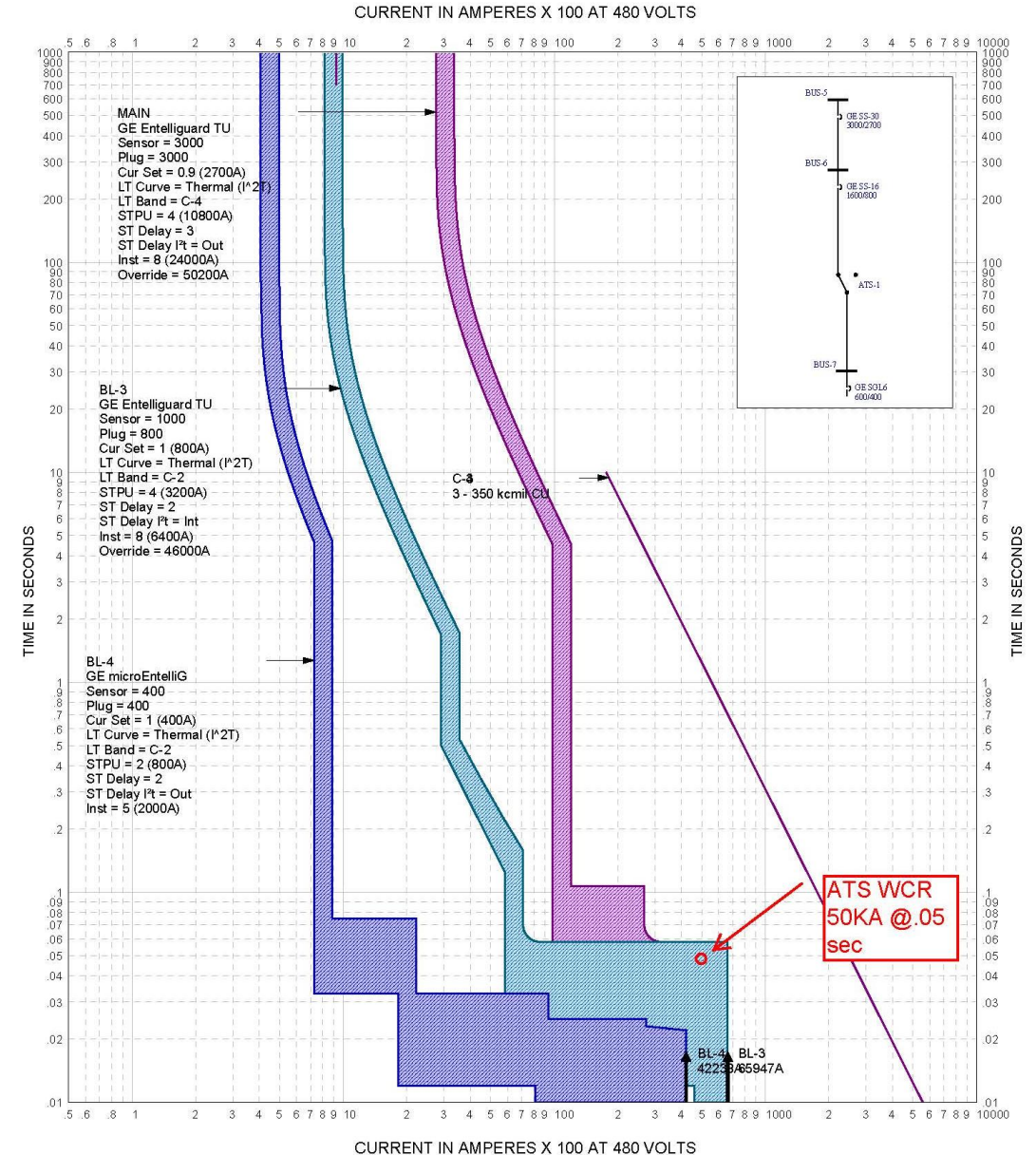
ATS Protection

Note:

Cable Withstand Curve

ATS WCR POINT

Do we know if the ATS is properly applied?

ATS **ASSUMED** to be properly applied as long as available fault current less than WCR
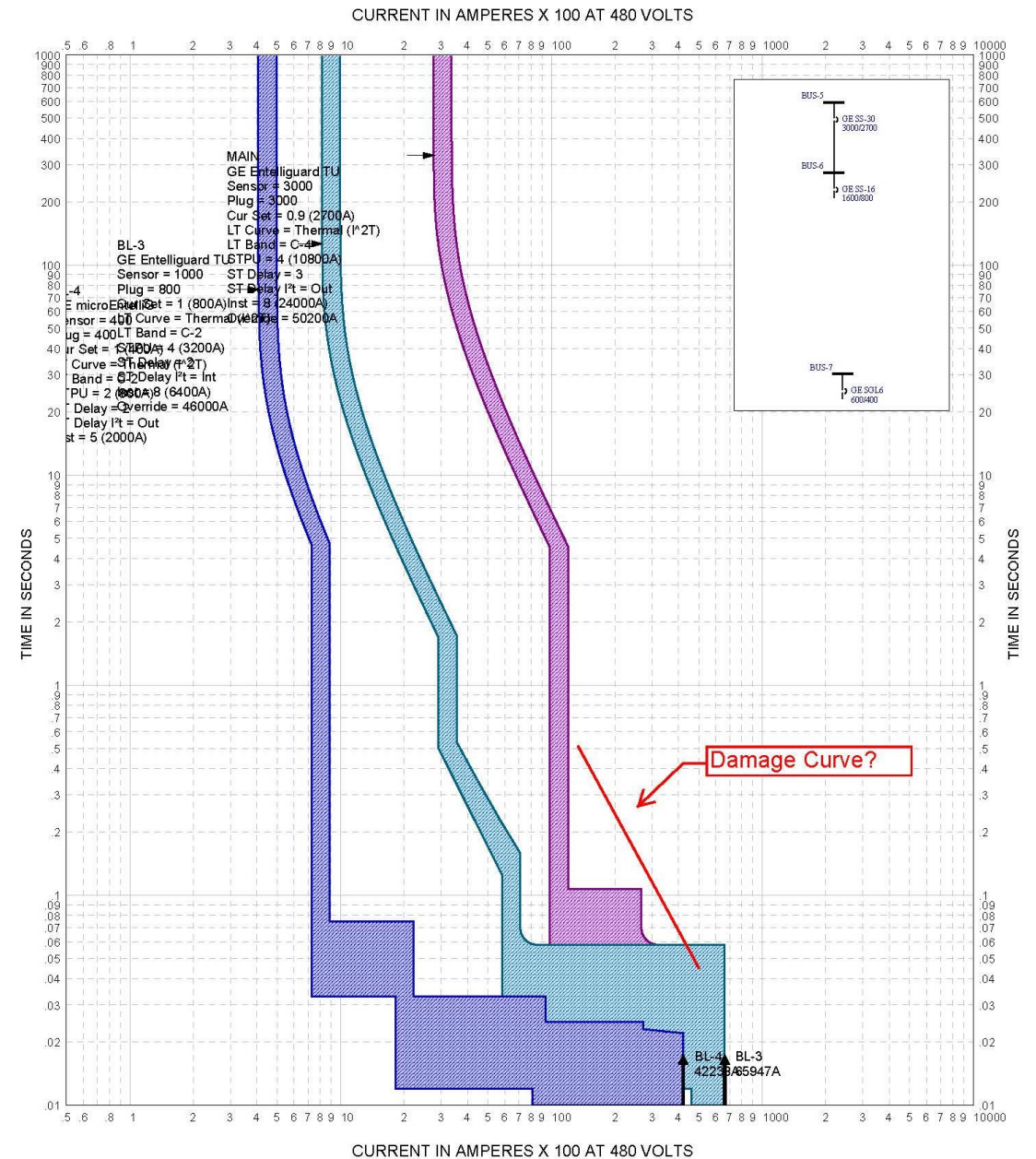
ATS Protection

Assumption:
ATS Damage Curve is an i^{2}t function based on the 50KA at .050 second WCR

Issues:
1) ATS Damage Curve Not Published or Tested
2) ATS Damage Curve not recognized by Standards
3) UL1008 WCR (required), Specific Breaker Ratings, and STR (optional) ratings are different

CURRENT IN AMPERES X 100 AT 480 VOLTS

MAIN
GE Entelliguard TU
Sensor = 3000
Plug = 3000
Cur Set = 0.9 (2700A)
LT Curve = Thermal (I^2T)
LT Band = C-4
STPU = 4 (10800A)
ST Delay = 3
ST Delay I²t = Out
Inst = 8.24000A)
Override = 50200A

BL-3
GE Entelliguard TU
Sensor = 1000
Plug = 800
microEntelliSet = 1 (800A)
Sensor = 400
Plug = 400
Cur Set = 1 (400A)
Curve = Thermal (I^2T)
Band = C-2
TPU = 2 (800A)
Delay =
Delay I²t = Out
st = 5 (2000A)

LT Curve = Thermal
LT Band = C-2
STPU = 4 (3200A)
ST Delay =
ST Delay I²t = Int
Inst = 8 (6400A)
Override = 46000A

Damage Curve?

BL-4   BL-3
42235A 65947A

TIME IN SECONDS

CURRENT IN AMPERES X 100 AT 480 VOLTS

BUS-5
GE SS-30
3000/2700

BUS-6
GE SS-16
1600/800

BUS-7
GE SG16
600/400

ATS Protection – Short Circuit Equivalent Circuit

- How long can the ATS withstand lower faults?

- What if the instantaneous pick-up of the upstream breaker is above the available fault current?

ATS

Utility:
$V=E*Sin\{2\pi f*(t-t_0)\}$

[Usually a very stiff source]

$I_{sc} = 80,000\ Amps$

$I_{sc} = V/(R+jX)$

Generator:
$V=E*Sin\{2\pi f*(t-t_0)\}$

[Usually NOT stiff source]

R   L
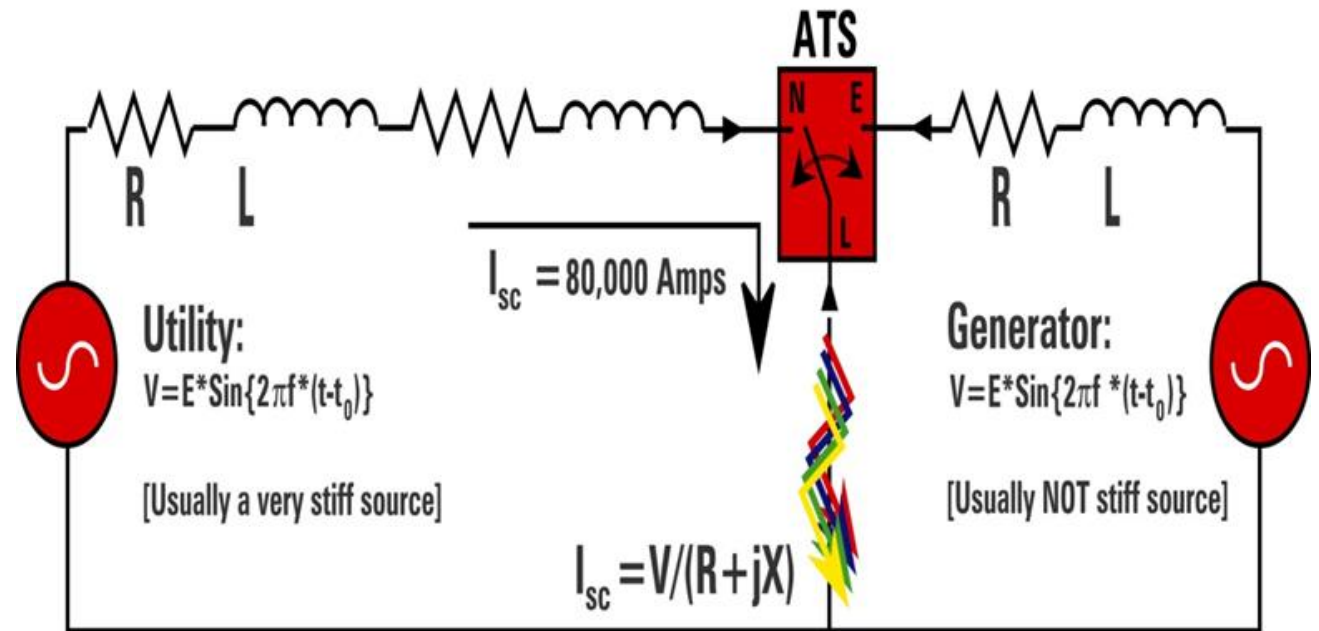
ATS Protection

- How long can the ATS with a WCR rating withstand lower faults?

  Unknown - No Published information

- What if the instantaneous pick-up of the upstream breaker is above the available fault current?

  ATS may not be protected

8th Edition of UL1008 addresses these issues

UL1008 Changes in the 8th Edition

Several Major Changes

- "Any Breaker" (WCR) Rating replaced with a time based rating
  - Current and time listed on ATS UL Label
    - ATS less than 400A WCR at .025 seconds (~1.5 Cycles)
    - ATS 400A & Above WCR at .050 seconds (~3 Cycles)
- Specific Breaker Requirements changed
  - Net result is less breakers listed
    - Based on maximum instantaneous trip setting
- Label instructions
  - Includes statements about how the ATS ratings are applied

UL1008 8th Edition

5.2.3.2 A transfer switch tested per 9.13.3.9 and 9.13.2.2 and not per 9.15, shall be marked, SHORT-CIRCUIT WITHSTAND AND CLOSING RATINGS , and the following:

This transfer switch is suitable for use in a circuit capable of delivering the short-circuit current for the maximum voltage marked below.

When protected by a circuit breaker, the circuit breaker shall not include a short-time trip response.

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

The sentences above shall be followed by a tabulation of the rated short-circuit current and voltage. See Annex I2, Example 1.

5.2.3.3 A transfer switch tested per 9.13.3.9, 9.13.2.2, and 9.15, shall be marked, SHORT-CIRCUIT WITHSTAND/CLOSING AND SHORT-TIME CURRENT RATINGS, and the following:

This transfer switch is suitable for use in a circuit capable of delivering the short-circuit current for the maximum voltage marked below.

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 shown below.

UL1008 8th Edition Coordinated Breaker

5.2.5.2 A transfer switch tested with an externally connected circuit breaker in accordance with 9.13.3.9 and 9.13.2.2 and not in accordance with 9.15, shall be marked, SHORT-CIRCUIT WITHSTAND/ CLOSING AND SHORT-TIME CURRENT RATINGSSPECIFIC CIRCUIT BREAKER MANUFACTURER AND TYPE LISTING and the following:

> When protected by a circuit breaker of the specific manufacturer, type and ampere rating as marked below, this transfer switch is suitable for use in circuits capable of delivering the short-circuit current at the maximum voltage marked.

The above sentence shall be followed by a tabulation which includes the short-circuit current and voltage ratings, manufacturer name, type designation, and current rating of the circuit breaker(s) to be used. See Annex I5, Example 4.

5.2.5.3 A transfer switch tested with an externally connected circuit breaker in accordance with 9.13.3.9, 9.13.2.2, and 9.15, shall be marked, SHORT-CIRCUIT WITHSTAND/CLOSING AND SHORT-TIME CURRENT RATINGS WHEN USING SPECIFIC CIRCUIT BREAKERS , and the following:

> When protected by a circuit breaker of the specific manufacturer, type, and ampere rating as marked below, this transfer switch is suitable for use in circuits capable of delivering the short-circuit current at the maximum voltage marked.

> When the circuit breaker has a short-time response, it shall be coordinated with the Short-Time Current rating of the transfer switch shown below.

The above sentences shall be followed by two tabulations. The first tabulation shall include the short-circuit current and voltage ratings, manufacturer name, type designation, and current rating of the circuit breaker(s) to be used. The second tabulation shall include the short-time current rating, voltage, and short-time duration. See Annex I7, Example 6. The time duration for the short-time current test shall be in seconds, is not limited, and shall not exceed the duration for which the switch was tested.

UL Required Labeling for ATS with WCR

SHORT-CIRCUIT RATING

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 marked below. The circuit breaker must include an instantaneous trip response and shall not include 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 marked short-circuit current.

Switch Amperes	Short-Circuit Current (RMS Symmetrical Amepres x 1000)	Voltage (VOLTS AC, Maximum)	Time Duration (Sec. Maximum)	Agency
600-800A	50	480	0.050	UL / IEC / CSA
600-800A	42	600	0.050	CSA

UL Stance - ATS with only a WCR

"The transfer switch has only been determined to be capable of carrying short circuit current for three electrical cycles, and has not been shown to be capable of carrying any current greater than rated current for longer than three electrical cycles. Therefore, it must be protected by circuit breakers that do not have the capability of being set such that the transfer switch will see any overcurrents for longer than three electrical cycles. Regardless of what the setting is called by the breaker manufacturer, if it allows a setting longer than 3 electrical cycles, there is no proof that the transfer switch will be properly protected."

ATS With Only a WCR Must Be Protected by Fuses or a by an "LI" Circuit Breaker

- Eliminates most molded case breakers
- Fuses and /or LI circuit breakers (thermal magnetic) may not provide the desired selective coordination

Circuit Breakers with LI Trip Units

- True LI trip units available for Power Circuit Breakers

- Molded case breakers with an adjustable instantaneous still have a short time band:

The tracking short-time function provided by Spectra RMS circuit breakers is shown in Figure 4.3. Long-time and instantaneous-trip points establish the breaker's full load and severe overcurrent trip characteristics. In feeder circuit applications, the tracking short-time function backs up downstream devices such as fuses or starter overloads with time for them to clear before the breaker opens.
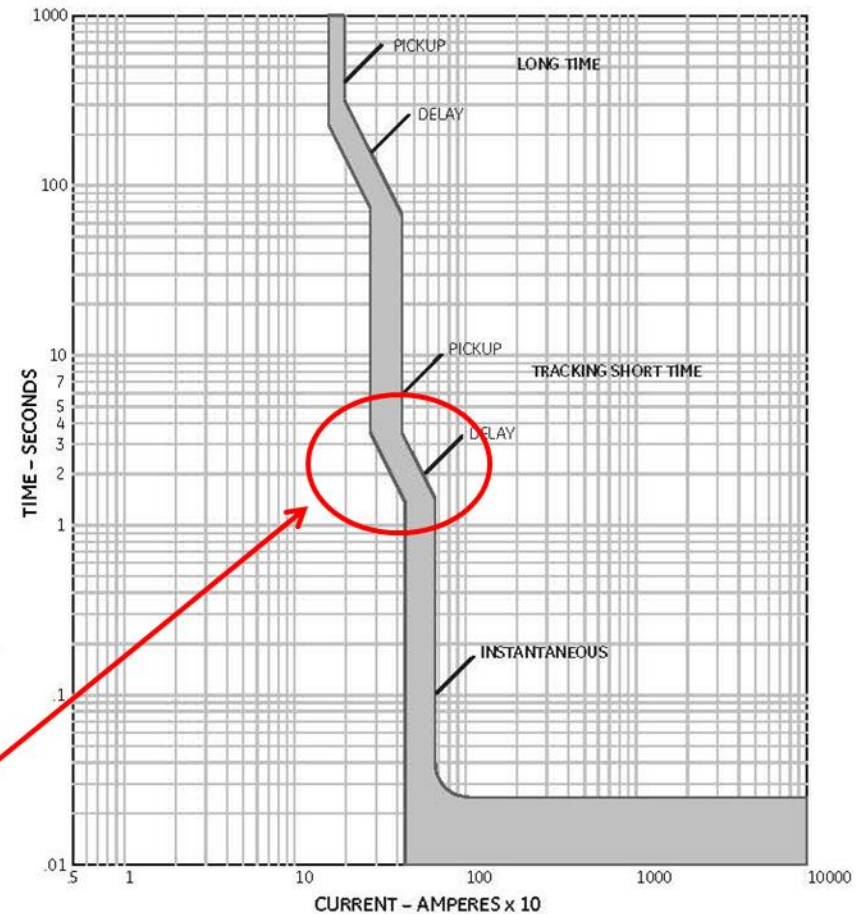
Short Time Response

Fig. 4.3 Typical time-current curve for Spectra RMS circuit breaker

UL1008 Optional STR

UL1008 requires an STR (Short Time Ratings) or a coordinated breaker rating when the ATS is protected by a breaker with a Short Time Trip

- STR test requirements exceed the WCR requirements
- STR requires ATS to carry full load after fault event
  - WCR has no requirements for the contacts which experience the fault

WCR – STR Comparison

	STR	WCR
Withstand a Fault Event	Yes	Yes
Close-on to a Fault Event	Yes	Yes
Temperature Rise Test (after fault)	Yes	No
Must be Functional after Fault Event?	Yes	No
Deliver 100% Power to Load after a Fault Event	Yes	No

ATS Application Summary

- NEC requires selective coordination for Emergency Systems, Legally Required Standby Systems, COPS, and Hospitals
- Selective Coordination is required for almost all applications which would utilize an ATS
- Selective Coordination is achieved by using circuit breakers with Short Time Trip function
- 8th Edition UL1008, effective November 2014, requires an ATS with only a WCR rating, protected by a breaker with a short time trip function, to be have the optional Short Time Rating (STR).
- Coordinated Breaker Rating in UL1008 does not require a STR when the circuit breaker has a Short Time Trip Function (Standard not consistent)
- Today ~95% of all circuit breakers sold have a Short Time Trip Function.

Market Awareness

- Most ATS Manufacturers are not raising the issue

- MEP Consultants are starting to ask questions

- Statements being made in Coordination Studies

Schneider Electric

Power System Engineering

3 SYSTEM FINDINGS

3.1 Study Analysis

Refer to each of the following sections for details. If issues are addressed by equipment, conductor, or device settings changes, the power system study results may need to be re-evaluated in a revision to this study.

3.1.1 Short-Circuit

The results of the short-circuit analysis show that the equipment considered in the study is adequately rated for the projected fault current levels except for the following:

Automatic transfer switches 'ATSH-LS1A', 'ATSH-CR1A', 'ATSH-EQ1A', and 'ATSH-EQELEV1A' are shown as inadequate for available fault current levels. This is because UL 1008 requires transfer switches to have short time current ratings when being fed from an LSI electronic trip breaker. It is recommended that the ATS manufacturer be contacted in order to obtain a short time current rating for the transfer switches being used and the system re-evaluated before the decision for equipment upgrades be finalized.

No short-circuit analysis was provided for transfer switch 'ATSL-DATA' or panel 'RPL-DATA' due to missing information from the normal circuit.

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