ASCO Power Technologies®

Codes, Standards, & TSs

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Codes & Standards Agenda

- Definitions
- How Codes and Standards effect our industry
- Interactions between Codes and Standards
- A closer look at some C&S critical to Transfer Switches
- How to recognize a Transfer Switch listed to UL1008

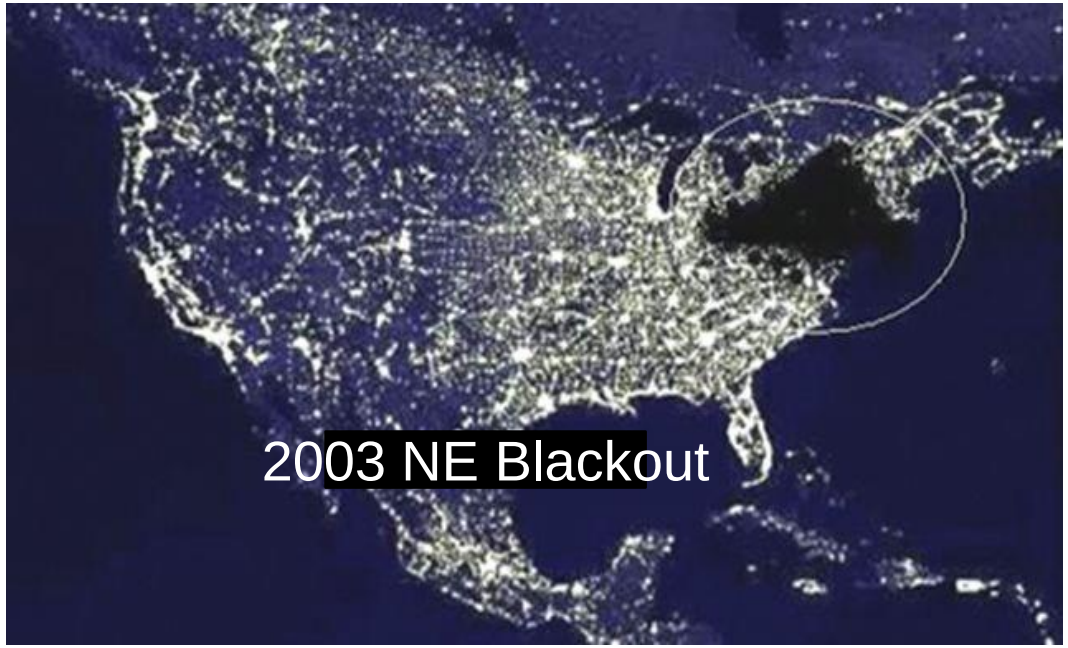
Definitions

- Standards – Industry recognized design references
- Codes – Standards that are capable of adoption into law
- AHJ –Authority Having Jurisdiction; office or individual responsible for enforcing code requirements and approving equipment and installation
- Listed, labeled – Approved by an agency to meet performance requirements (typically UL, but some use ETL)
- Labeled – Equipment with a label indicating compliance to an appropriate standard

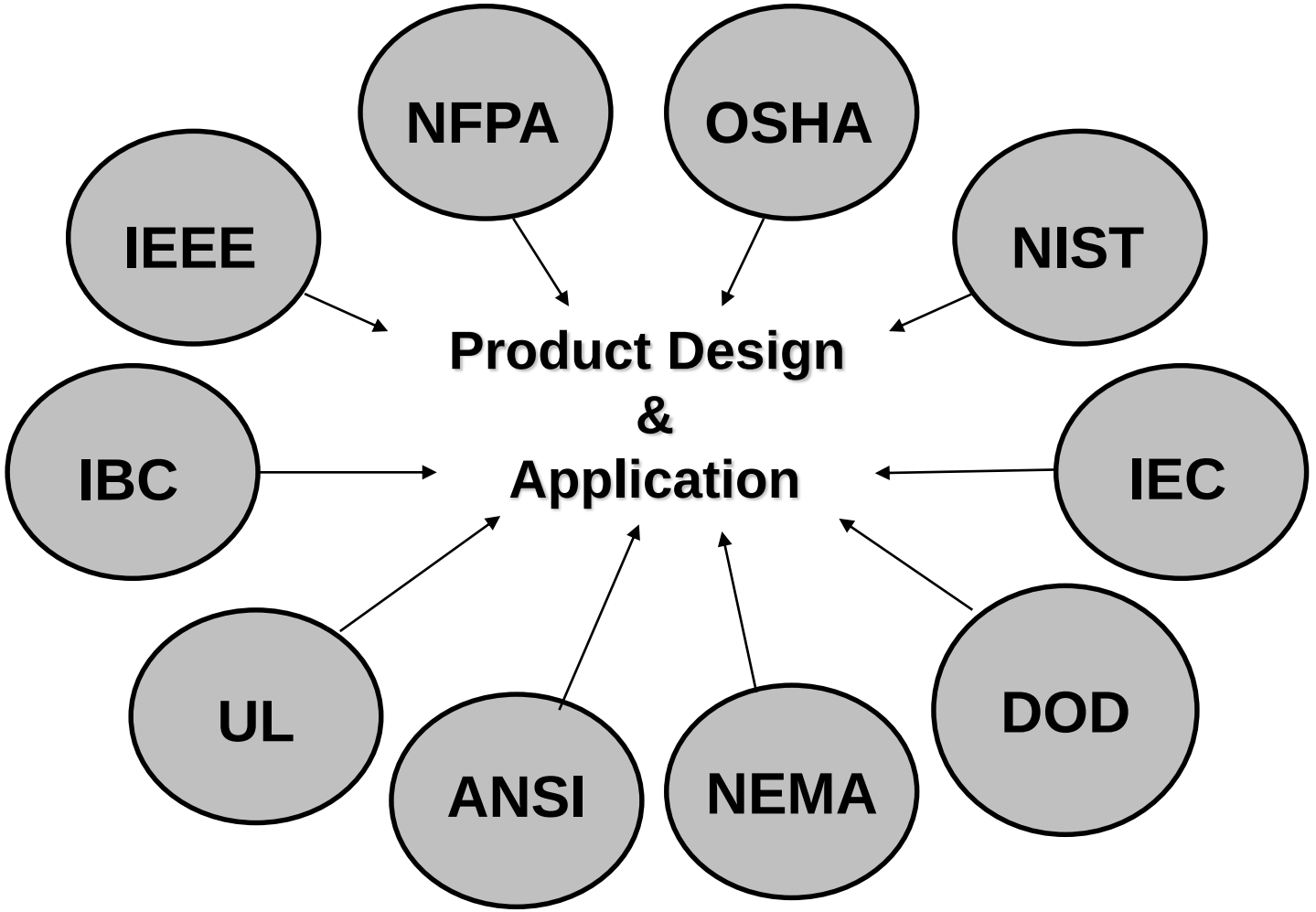
Definitions (cont.)

- Shall – Indicates a mandatory requirement
- Should – Indicates recommendation, but is not mandatory (advised, but not required)
- Emergency Power Supply (EPS) –Source of Power
- Emergency Power Supply System (EPSS) – The complete EPS system including controls, conductors and everything up to, and including the load terminals of the ATS

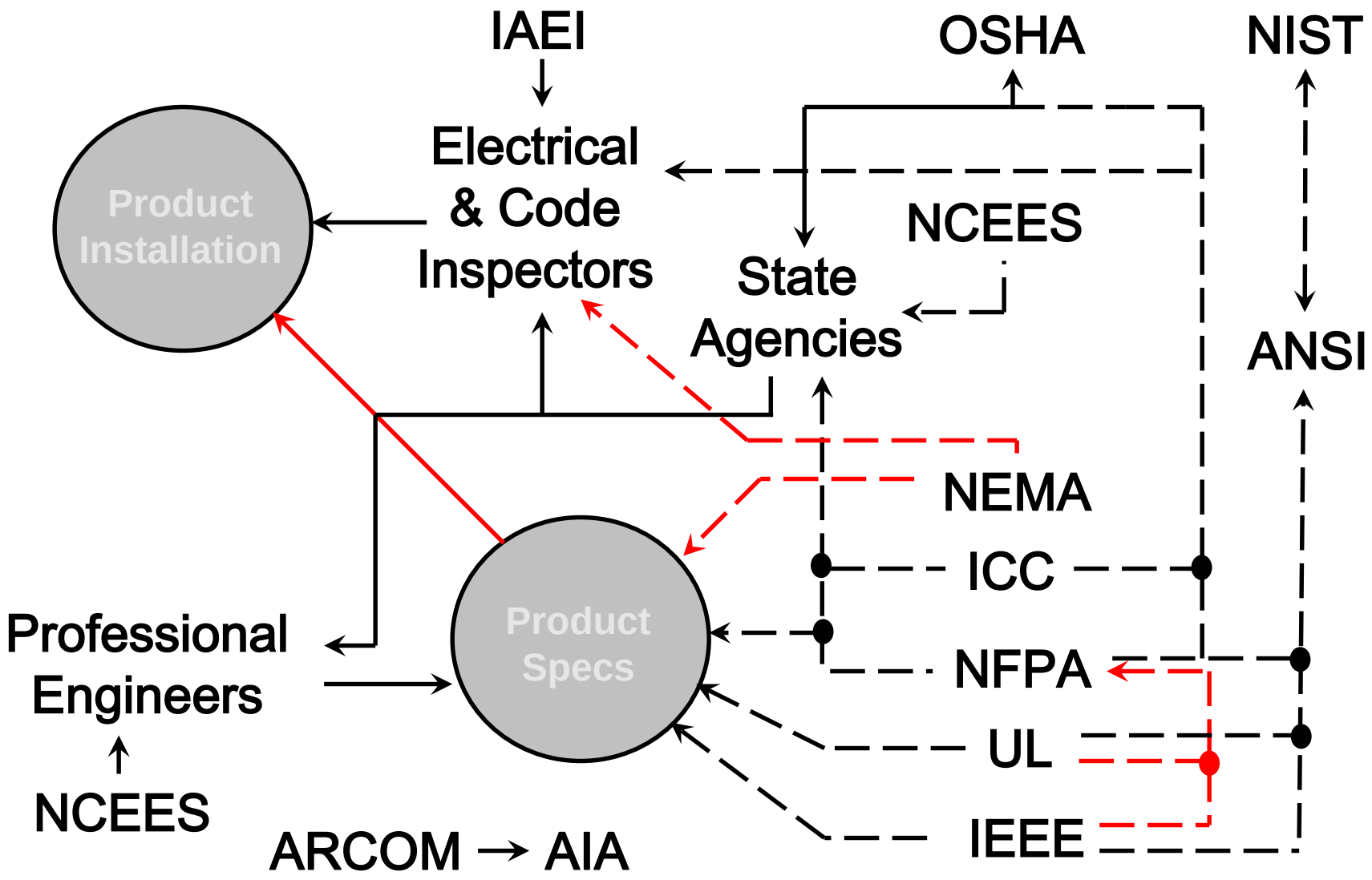
Codes and Standards: Why?



Codes & Standards



US Standards – Direct & Indirect Relationship



Codes and Standards

1.02 Codes and Standards

The service entrance automatic transfer switches and controls shall conform to the requirements of:

A. UL 1008 - Standard for Transfer Switch Equipment

B. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment

C. NFPA 70 - National Electrical Code

D. NFPA 99 - Essential Electrical Systems for Health Care Facilities

E. NFPA 110 - Emergency and Standby Power Systems

F. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

G. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches

H. UL 508 Industrial Control Equipment

I UL 891 According to this UL standard the equipment shall be labeled “Suitable for use only as service Entrance.”

Applicable to EPSS NFPA Documents :

- NFPA 110 – Emergency & Standby Power Systems (EPSS)
- NFPA 99 – Health Care Facilities, Chapter 6 (Electrical Systems)
- NEC - National Electrical Code, Article 700 (Emergency Systems)
- IEEE Orange Book

Applicable to EPS NFPA Documents :

- NFPA 110 – Emergency & Standby Power Systems (EPSS)
- NFPA 99 – Health Care Facilities, Chapter 6 (Electrical Systems)
- NEC - National Electrical Code, Article 700 (Emergency Systems)
- IEEE Orange Book

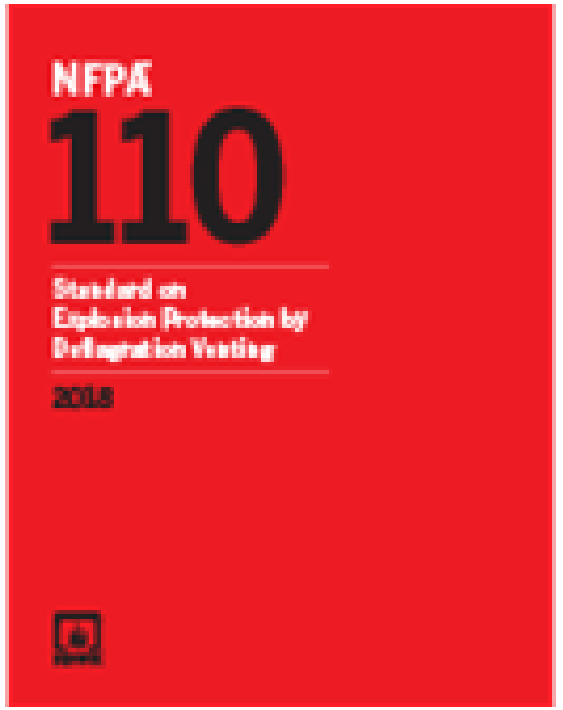
NFPA 110 : Major EPSS Standard

Covers performance requirements for EPSS providing an alternate source of electrical power in buildings and facilities:

- Installation
- Maintenance
- Operation
- Testing

Refers to:

- NFPA 70 (NEC), 2017 Edition
- NFPA 99 Standard (Health Care Facilities)



NFPA 110-Emergency & Standby Power Systems

Covers the design and use of Level 1 and Level 2 emergency power supply systems (EPSS) which is one or more emergency power supplies (EPS) and necessary auxiliary equipment that allows them to run and assume emergency loads from the main power supply

Level 1: failure of the equipment to preform could result in loss of life or serious injuries

Level 2: failure of the system is less critical to human life and safety

System classification indicates how long they can supply power. System type indicates how fast they can apply power.

NFPA 110: EPSS Minimum Run Time

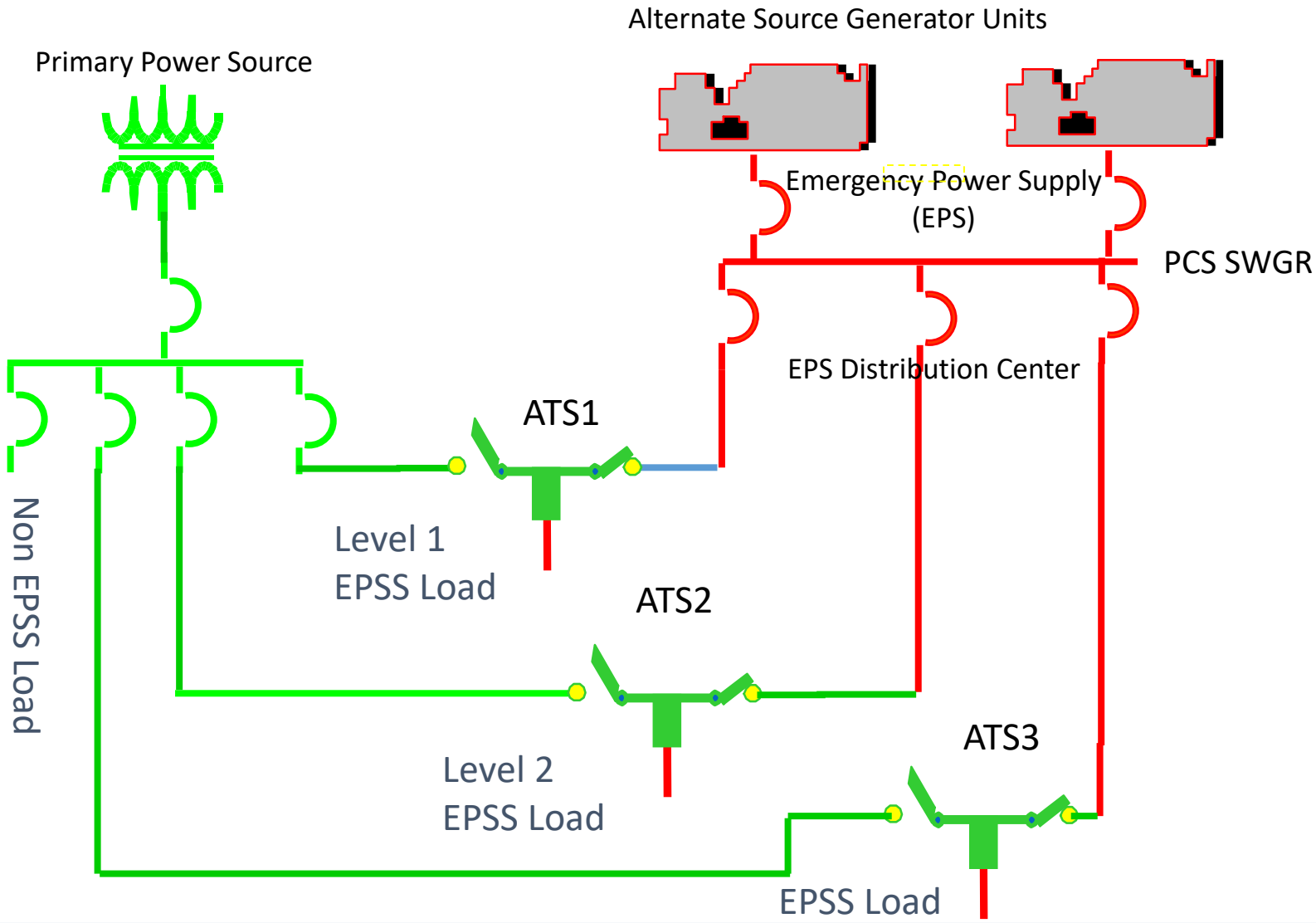
Class	Min loss/failure of the Normal Power
Class 0.083	0.083 hr (5 min)
Class 0.25	0.25 hr (15 min)
Class 2	2 hr
Class 6	6hr
Class 48	48 hr
Class X	Other time, in hours, as required by the application, code or user

NFPA 110: EPSS Types

- **Chapter 4, Paragraph 4.3:**

Designation	Max Power Restoration Time
Type U	Uninterruptible (UPS Systems)
Type 10	10 sec
Type 60	60 sec
Type 120	120 sec
Type M	Manual Stationary or non-automatic ATS –no time limit

NFPA 110 : Typical Multiple Unit Emergency Power Supply System (EPSS)



NFPA 110, Chapter 6: Transfer Switch Equipment

6.2 ATS Features.

6.2.1* General. Automatic transfer switches shall be capable of all of the following:

(1) Electrical operation and mechanical holding
(2) Transfer and retransfer of the load automatically
(3) Visual annunciation when "not-in-automatic"

▲ **6.2.3* Interlocking.** Mechanical interlocking or an approved alternate method shall prevent the inadvertent interconnection of the primary power supply and the EPS, or any two separate sources of power.

NFPA 110, Chapter 6: Transfer Switch Equipment

- Power Source Monitoring
- Time Delays
- Safe Manual Operator
- Motor Load Transfer – Protection from motor transfer damage
- Isolation of neutral conductors
- 6.4 Bypass-Isolation Switch requirements
  - 6.4.5-”reconnection of transfer switch shall be possible without load interruption”

NFPA 110: Other Product Related Requirements

- Time delay on starting of Emergency Power System (6.2.5) – to prevent nuisance starting and possible subsequent load transfer.
- Time delay on Engine Shutdowns (6.2.10) – minimum of 5 min shall be provided for unloaded running of EPS prior to shutdown for engine cooldown.
- Load Shedding (6.3) – when ≥ 2 Generator sets are parallel the PCS shall be arranged to inhibit connection of EPS-damaging loads.
- Short Circuit Current (6.5.2) – max Is.c. from both the Utility and the emergency energy source shall be evaluated to perform proper and selective overcurrent protection in the system. (ASCO Short Time Rated Transfer Switches)

NFPA 110, Chapter 8: Maintenance and Operational Testing Requirements

"Routine maintenance & operational testing shall be based on all of the following:

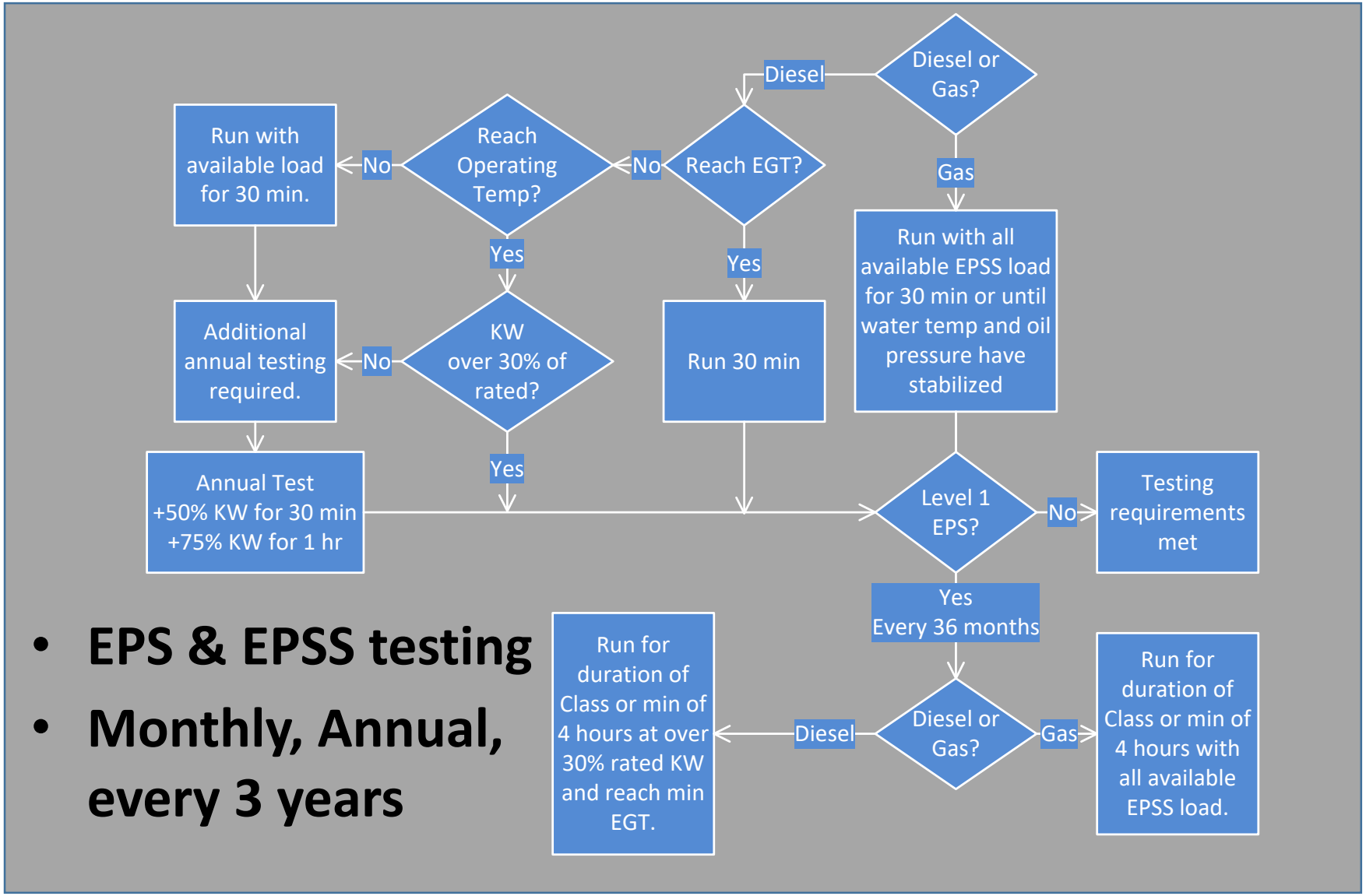
1) Manufacturer's recommendations
2) Instruction manuals
3) Minimum requirements of this chapter
4) The "AHJ"

NFPA 110, Chapter 8: Testing Requirements

Additional, important requirements to note:

- Monthly EPS testing for 30 minutes at 30% load (8.4.1 & 8.4.2)
- If 30% load can not be applied monthly, monthly testing must still be performed plus additional annual testing for 1.5 hours (50% load for 30 min, 75% load for 1 hour) (8.4.2.3)
- Level 1 EPSS systems must be tested at 30% or more of rated load for the duration of the assigned class or 4 hours (whichever is less) at least every 36 months (8.4.9)
- 8.5 Records shall be created & maintained for all EPSS inspections, operational tests……”

NFPA110: Maintenance Testing {8.4}



- **EPS & EPSS testing**
- **Monthly, Annual, every 3 years**

Codes and Standards

1.02 Codes and Standards

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NFPA 99: Health Care Facilities

- Three Year Cycle
- Current Edition 2018
- Chapter 6 Electrical Systems

NFPA 99

- Essential System divided into 3 branches:
  - Life Safety
  - Critical
  - Equipment

- Dual sources of Normal Power shall not constitute an alternate source of power

- ESPS's shall be classified as Type 10, Class X, Level 1 Generator Sets as defined in NFPA 110

NFPA 99

Testing

System must be tested 12 times a year, at intervals not less than 20, or more than 40 days

Tests are run in accordance with NFPA 110

Records must be kept

JCAHO – Joint Commission

IEEE Reference Books for Transfer Switches

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UL 1008: Transfer Switches

Testing of ATS

- Overload
- Post OL Temperature Rise
- Endurance
- Dielectric
- Withstand
- Close –on

UL 1008 Performance Testing

9.2.2.1 All tests shall be conducted on enclosed samples. One sample shall complete the overload, temperature, endurance, and dielectric voltage-withstand tests. A previously untested sample may be used for the withstand and closing tests. When multiple specific load uses are specified, additional samples may be used.

9.8 Temperature rise test

9.8.1 When tested under the conditions described in 9.8.2 – 9.8.12, transfer switches shall not attain a temperature at any point high enough to constitute a risk of fire or to damage any materials employed in the device, and shall not show temperature rises at specific points greater than those indicated in Table 16.

9.2.3 Temperature test

9.2.3.1 At the manufacturer's option, the temperature test may be conducted either after the endurance test or on a separate sample that has been previously subjected to an overload test.

UL 1008: Overload Testing

Table 18
Method of determining test current for overload tests on transfer switches
(refer to 9.10.1.2)

Device used for	Device rated in amperes	Power test current	Power factor
Motor loads or total system load	a-c	6 times rated current	0.40 – 0.50
	d-c	10 times rated current	a
Incandescent lamp control or resistive load[a]	a-c	1.5 times rated current	0.75 – 0.80
	d-c	1.5 times rated current	a
Electric-discharge-lamp control	a-c	3 times rated current	0.40 – 0.50

[a] Noninductive resistive load.

UL 1008: Overload Testing

Table 19
Overload test – Number of cycles and rate of operation

(refer to 9.10.1.3)

Switch rating, amperes	Number of cycles of operation	Rate of operation[a]
0 – 300	50	1 per minute
301 – 400	50	1 per 2 minutes
401 – 600	50	1 per 3 minutes
601 – 800	50	1 per 4 minutes
801 – 1600	50	1 per 5 minutes
1601 – 2500	25	1 per 5 minutes
2501 and above	3	1 per 5 minutes

[a] May be conducted at a faster rate if agreeable to those concerned.

9.10.3.6 During the test, both the normal and alternate source terminals shall be connected to the test source. The alternate source shall be displaced 120 electrical degrees from the normal source for a 3 phase supply or 180 electrical degrees for a single-phase supply.

UL 1008: Transfer Switches

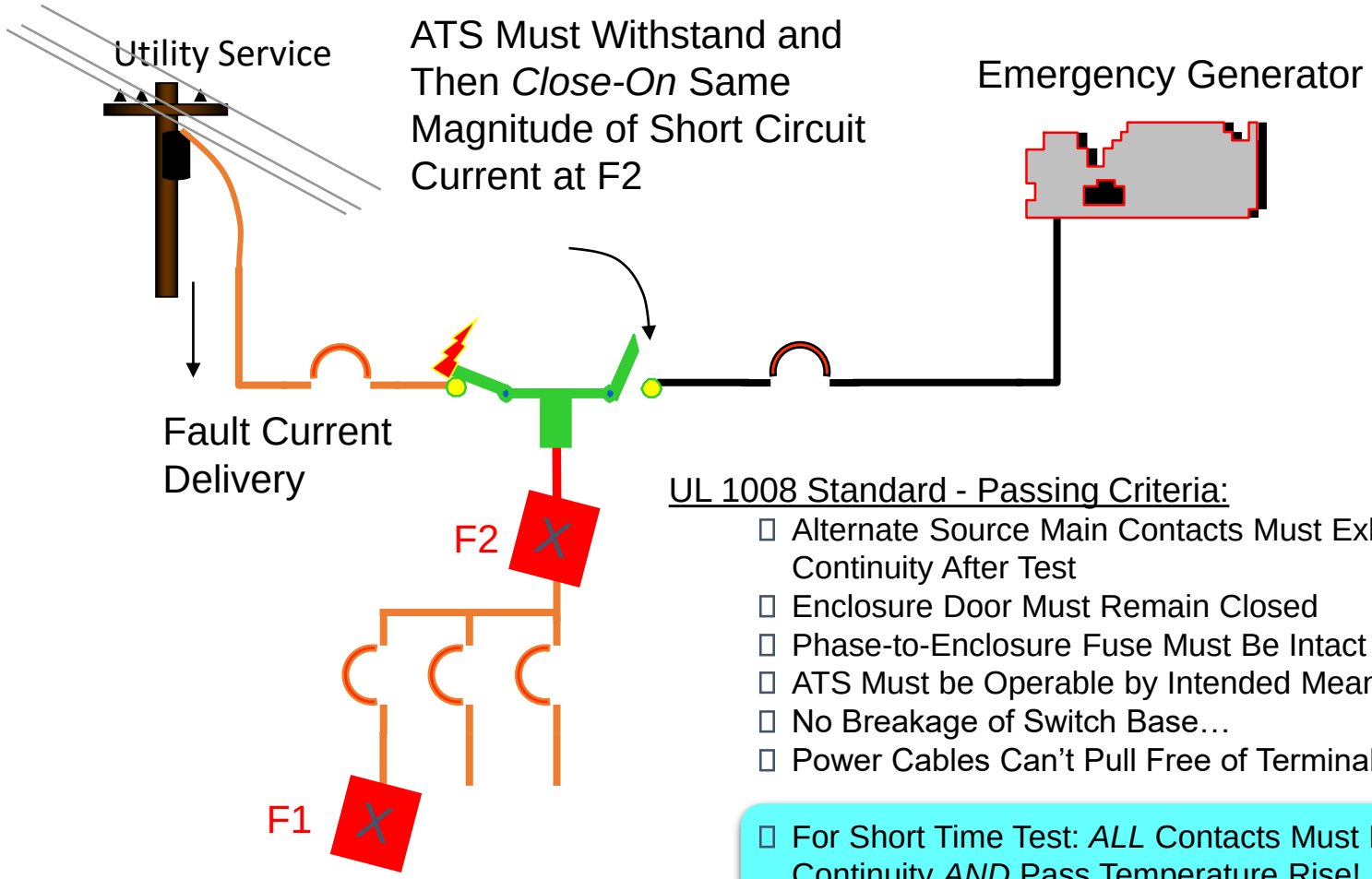
9.13.2 Rated short-circuit making capacity (closing)

9.13.2.1 The transfer switch subjected to the Rated short-circuit capacity (withstand) test in 9.13.3.1 shall also be subjected to a short-circuit closing test. The short-circuit closing test shall be conducted on same set of contacts used in the short-circuit withstand test. Test procedures and conditions for the closing test shall be as described in 9.13.3.7 – 9.13.3.34. The transfer switch shall be closed on the circuit.

9.13.2.2 When an overcurrent protective device as described in 9.13.3.7 is used to conduct the short-circuit closing test, the test circuit closing switch (see Figure 9.13.3.1) shall be used to apply the test voltage to the circuit before the transfer switch is closed and until after the overcurrent device interrupts the current.

9.13.2.3 When the short-circuit closing test is conducted for a time duration as described in 9.13.3.10, the test circuit closing switch shown in Figure 9.13.3.1 shall be used to apply the test voltage to the circuit before the transfer switch is closed. The test circuit closing switch shall remain closed until current passes through the transfer switch for the time duration marked on the transfer switch as specified in 9.13.3.12

Transfer Switch Ratings
Short Circuit Testing



UL 1008 Standard - Passing Criteria:

- Alternate Source Main Contacts Must Exhibit Continuity After Test
- Enclosure Door Must Remain Closed
- Phase-to-Enclosure Fuse Must Be Intact
- ATS Must be Operable by Intended Means
- No Breakage of Switch Base…
- Power Cables Can't Pull Free of Terminal Lugs

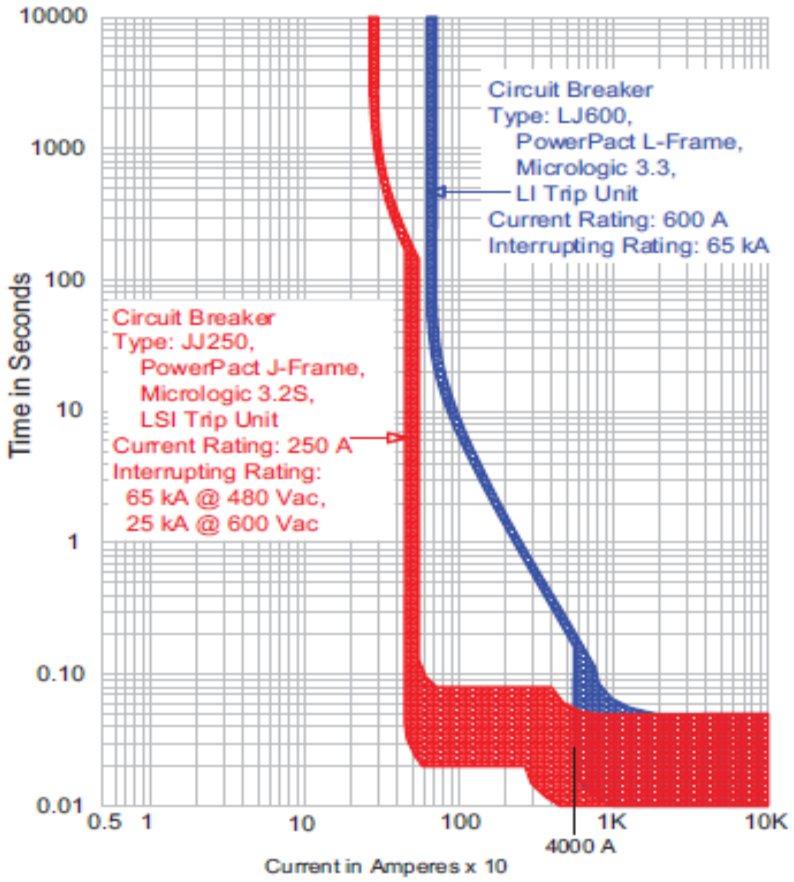
Short Circuit Test (non-short time)

- For Short Time Test: *ALL* Contacts Must Exhibit Continuity *AND* Pass Temperature Rise! Must be 'Like New'!

Short Time Test

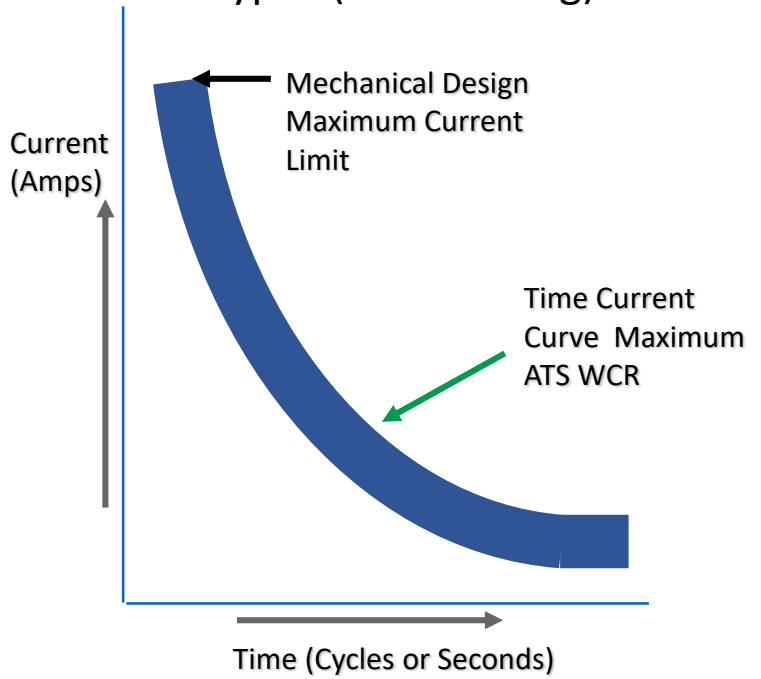
Circuit Breakers (AIC) vs. Transfer Switches (WCR)?

Ampere Interrupting Capacity (AIC) - Capability to **safely interrupt or break** short circuit currents and disconnect the power source from the load under overcurrent conditions.



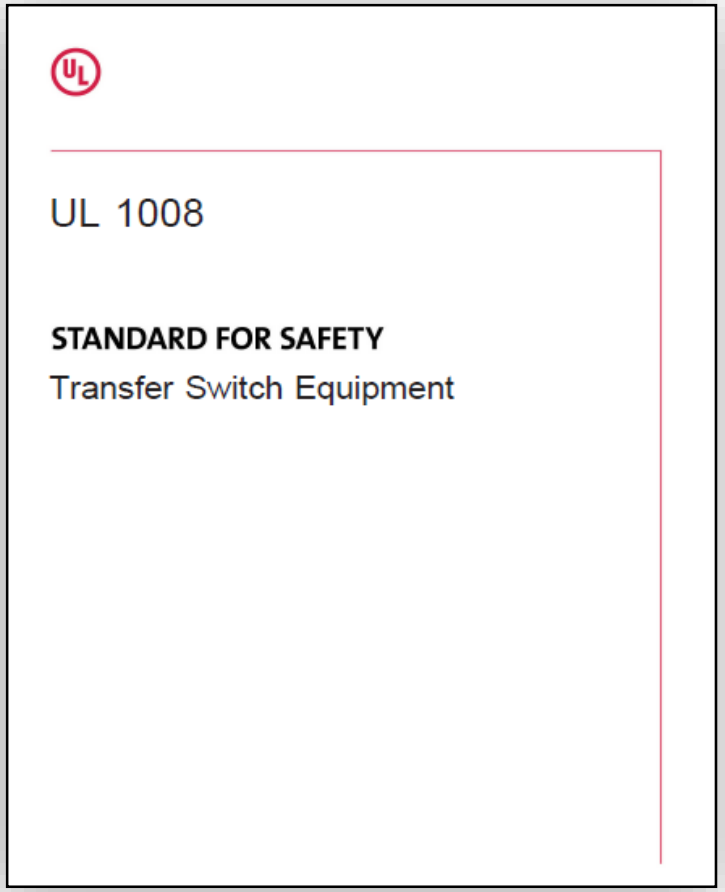
Withstand Closing Rating (WCR) - Capability to **safely endure and close-on** short circuit currents until overcurrent conditions are interrupted. These WCR ratings are based on either:

- Specific time durations (time based)
- Coordination with specific circuit breaker or fuse types (series rating)



Qualifying Specific Breakers Post UL1008, 7th Edition

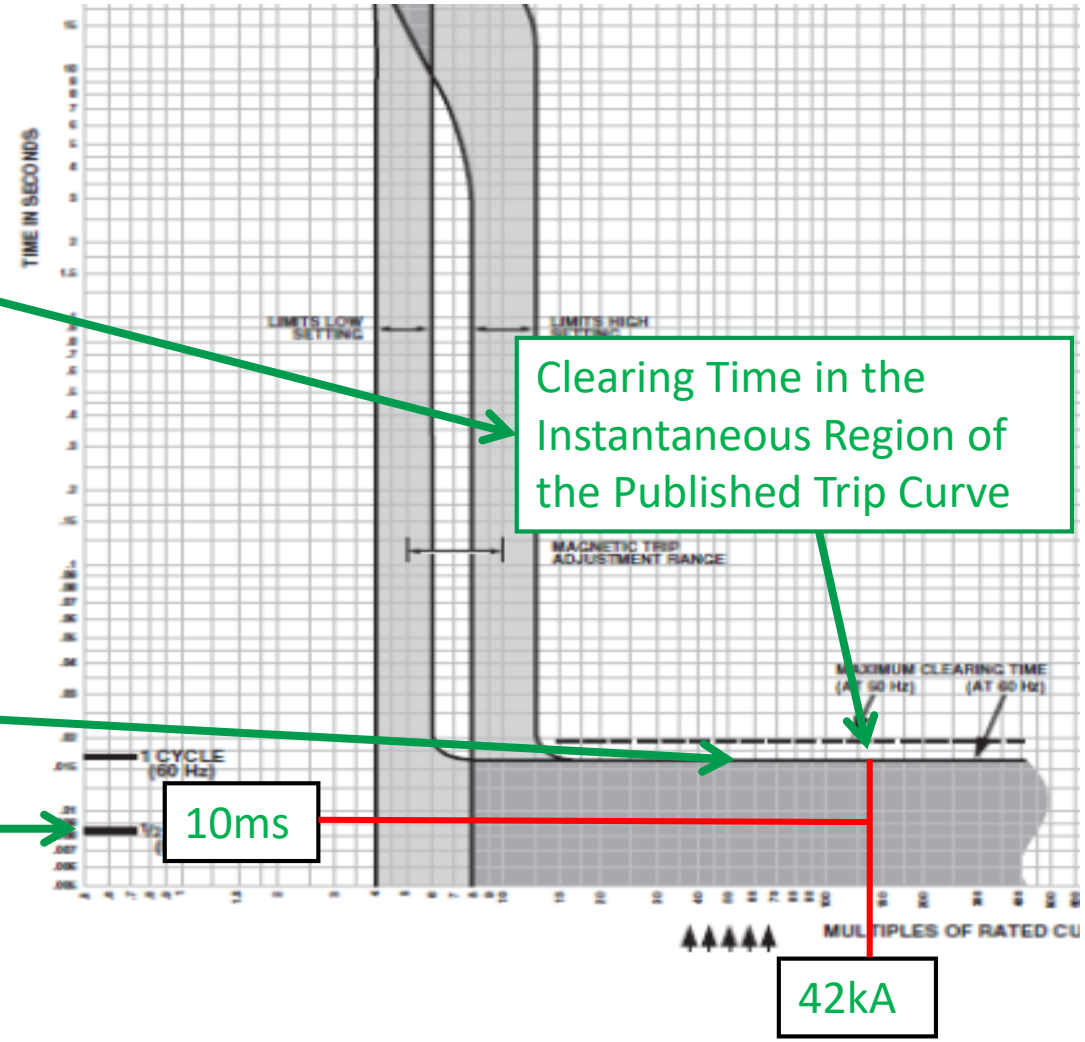
- Problem: Prior to 7th edition there was **no guarantee that all listed breakers would coordinate with the ATS WCR rating to clear the short circuit safely**
- **Method for listing specific breakers was not defined in the standard** and was based on a comparison of the ***"published"* instantaneous clearing time** between the tested breaker and non-tested circuit breakers.
- **If the non-tested circuit breaker's *published* clearing time was equal to or less than the tested circuit breaker's *published* clearing time, the non tested breaker could be listed.**
- Most switch manufacturers then documented a **formidable list of specific breaker manufacturers and types** on their WCR label at that time.
- the **most significant change in the 7th Edition** requires **comparing the publish trip time of the new breaker with actual breaker trip time from a previous short circuit test.**



Qualifying Specific Breakers to UL1008, 7th Edition

- **Old Method:**
  - Breaker cleared in 10ms, but published clearing time of tested breaker = 17ms
  - Any breaker with 17ms published clearing time or less could be listed on WCR label
- **New Rule:**
  - Breaker from previous test cleared short circuit in 10ms
  - Only non tested breakers with maximum published clearing times of 10ms could be listed on WCR label

Clearing time of tested breaker



What is ASCO's Message on Short Circuit Ratings?

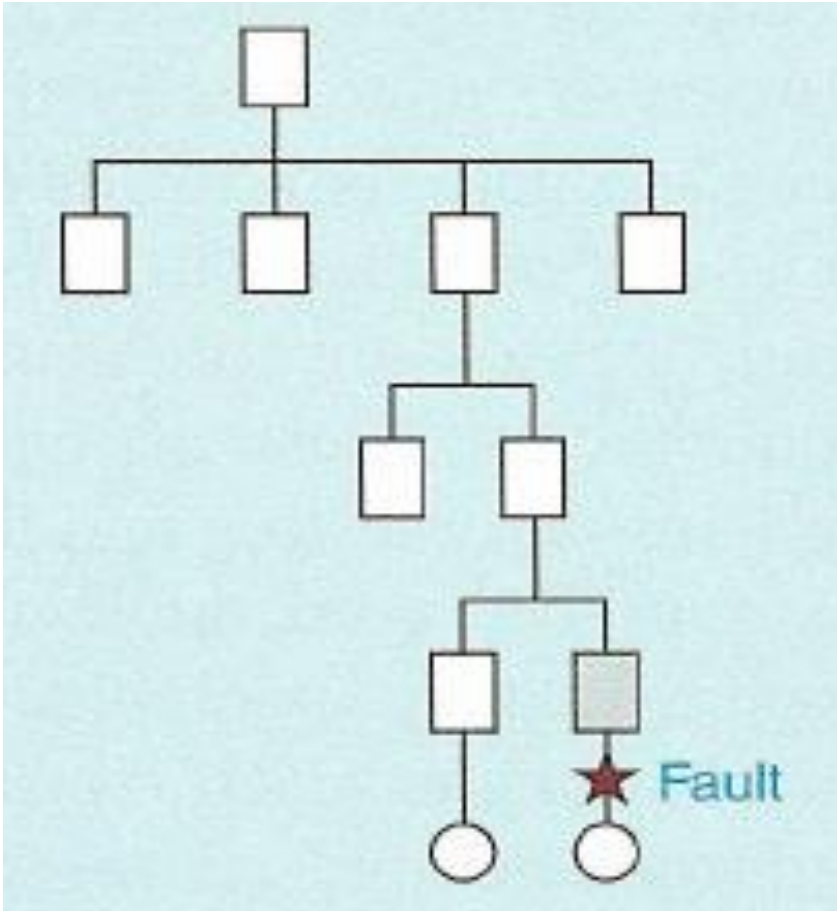
- **Question**: What WCR should I specify for the ATS at the spec stage if the coordination study is not completed?
  - **Answer**: Specify **time based ratings** since it provides more flexibility in coordinating the OC devices with the ATS and doesn't limit the selection to specific population of breakers
- **Many consultants and AHJs are not aware of these new UL1008, 7th Edition requirements** and you need to spread this news to all responsible persons.
- Remind them **not all ATS manufacturers offer short time ratings** like ASCO provides
- **ASCO 7000 Series Power Transfer Switches now offer four Withstand and Closing Ratings** to provide maximum flexibility:
  - Current Limiting Fuse Rating
  - Specific Breaker Rating
  - Time Based Breaker Rating
  - Short Time Rating (150-4000 Amp Switches)

Selective Coordination Considerations

Slow Trip

Maximize Spread

- 30 cycles (0.50s)
- 18 cycles (0.30s)
- 10 cycles (0.16s)
- 3 cycles (0.05s)



Quick Trip

- 12 cycles (0.20s)
- 9 cycles (0.15s)
- 6 cycles (0.10s)
- 3 cycles (0.05s)

Increments As Small As 2 -3 Cycles

Both approaches are common, but what about the impact on Arc Flash?