2008 National Electrical Code Overcurrent and Over Voltage Changes

Ferraz Shawmut

Peter Walsh, PE
Senior Field Engineer-Codes and Standards

- **Member – National Electrical Code Making Panel 4**
- **Member of Arc Flash & PPE Research Testing Team in Newburyport Lab**
- **Participant in Annual 2006 and 2007 4-Day IEEE Safety Workshop**
- **Member of NFPA, IAEI, and IEEE IAS**
- **Participant in NFPA 70E Safety Video**
- **Certified by New York State to give PDHs to Professional Electrical Engineers**
- **Certified by New Jersey to give CE Courses to Licensed Electricians**

CARBONE LORRAINE

Ferraz Shawmut

Overview of Topics-I

1. Short Circuit Current Ratings (SCCR)
2. Series Ratings
3. Selective Coordination
4. Engineering Analysis Permitted for Feeder Taps
5. Field Marking for Delta Mid-Point Grounding

Overview of Topics-II

6. Disconnect Requirement for Non-Removable Hardware

7. New Requirement for Stationary Battery Disconnect

8. Surge Suppressors are Re-Defined

9. Modified Arc Flash Requirements

10. Branch Circuit Overcurrent Devices Defined

1. Short Circuit Current Ratings (SCCR)

100 Definitions Short Circuit Current Rating

100 Definitions Device

100 Definitions Equipment

409.2 Definitions Industrial Control Panel

409.21(B) Scope Includes Multiple Sources

409.110 Marking

New 2008 Definition for SCCR

Short-Circuit Current Rating. The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria.

Short Circuit Current Ratings

How is SCCR Different than-

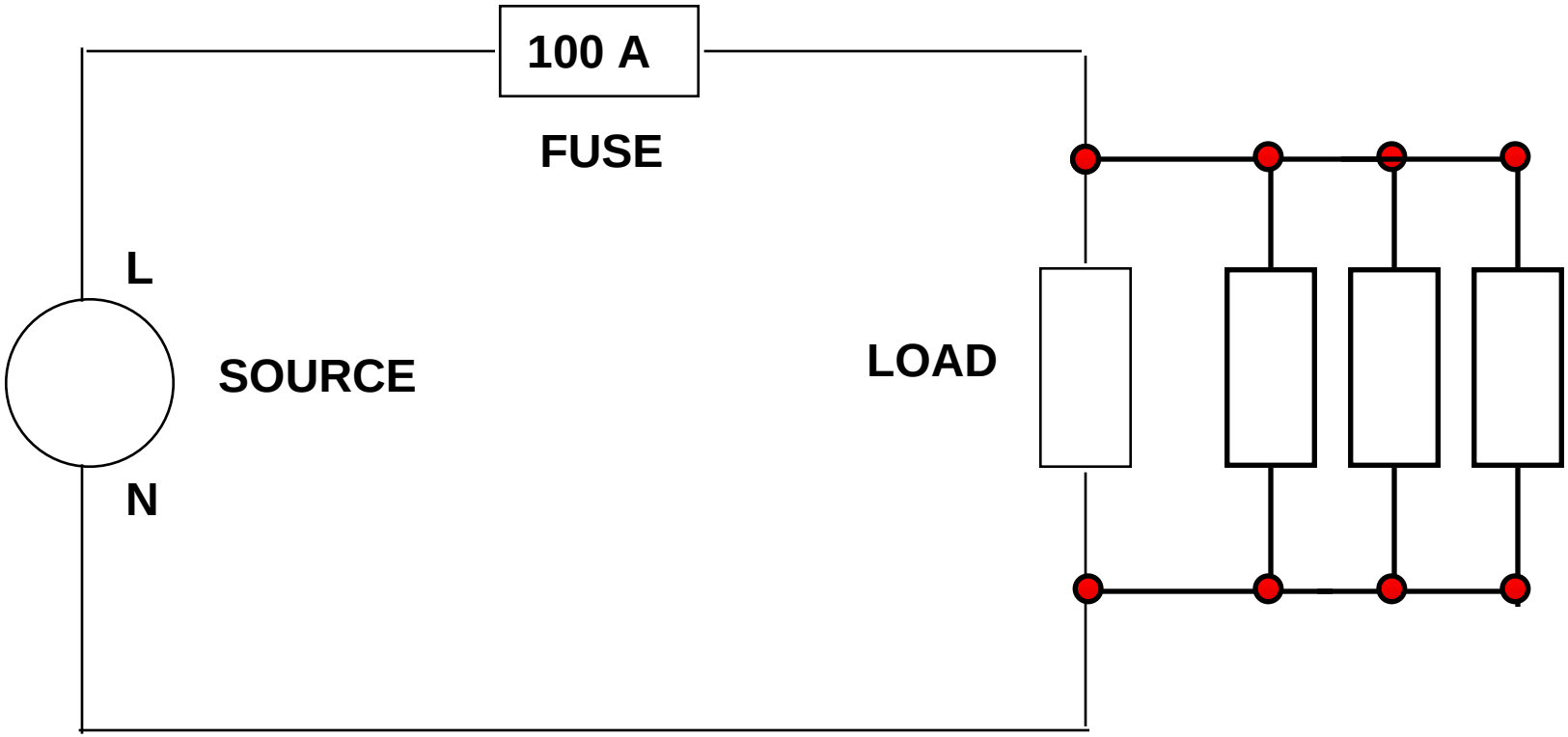
Ampere Rating?

Interrupting Rating?

Ampere Rating is only one of several ratings

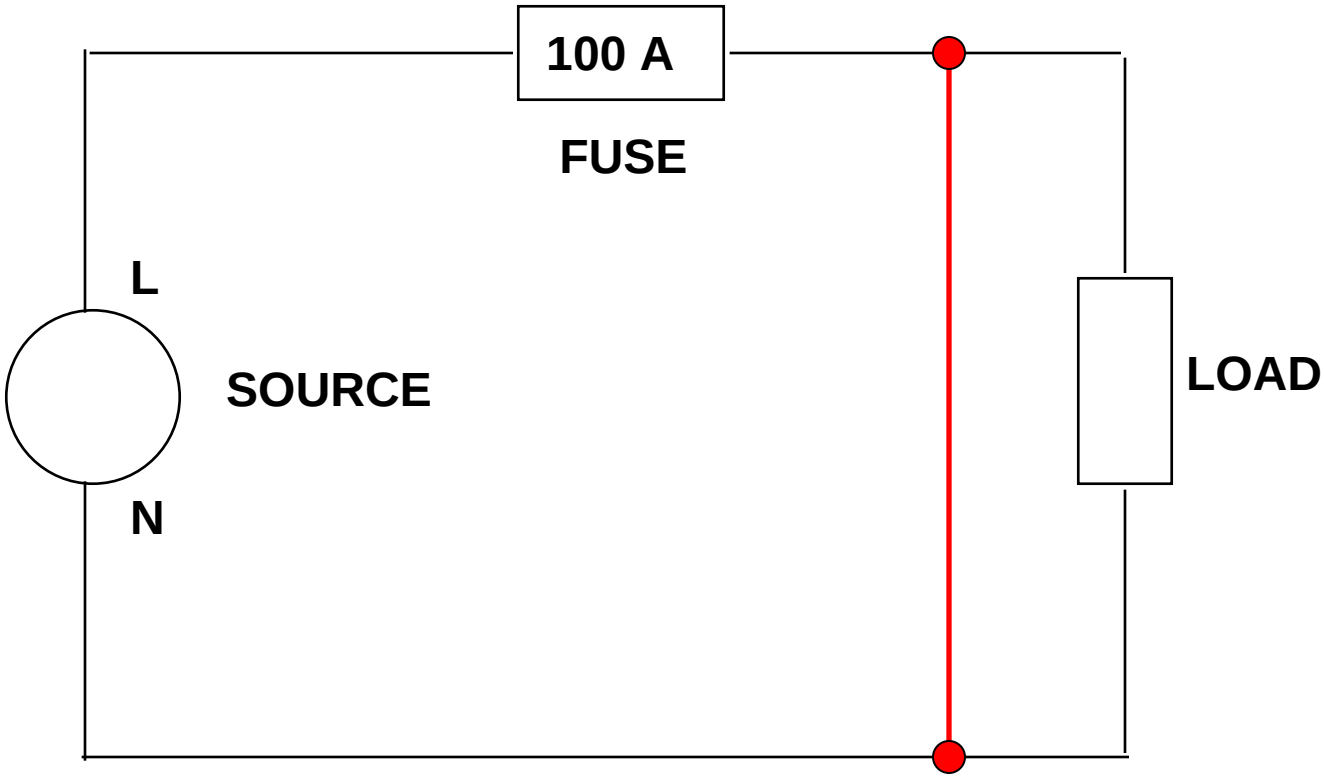
Range for Overloads 1X to 10X

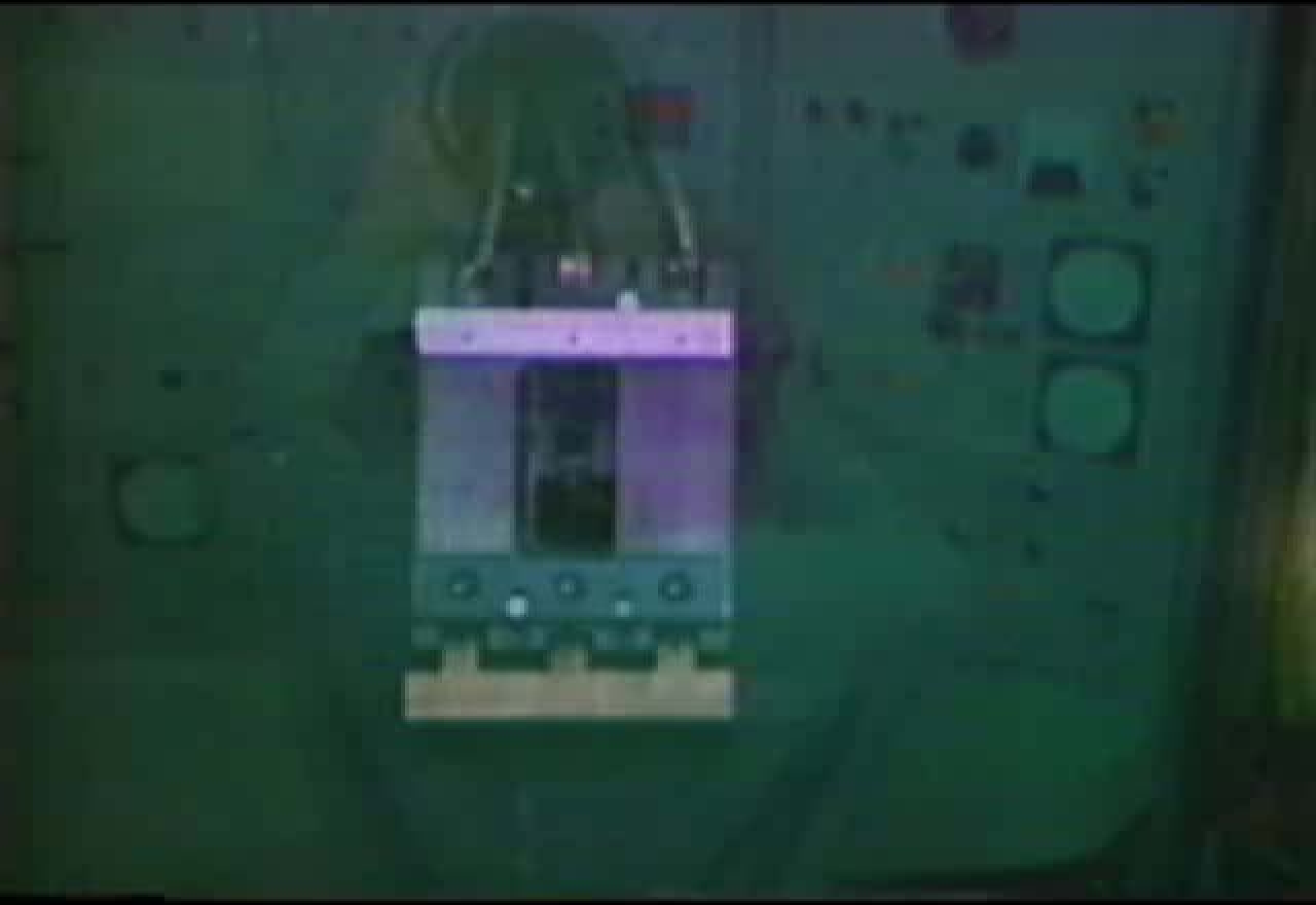
Overload (Up to 10 times rated current)



Short Circuit

Can be 1,000 times rated current!





NEC and SCCR

What is the NEC trying to prevent by regulating SCCR?

New Section for 2005 Edition

409 Industrial Control Panels

- 409.1 Scope- This article covers industrial control panels intended for general use and operating at 600 volts or less.

409.110 Marking

An industrial control panel shall be marked with the following information that is plainly visible after installation:

- (3) Short circuit current rating (SCCR) of the industrial control panel based on one of the following:

409.110(3) Markings-Continued

- a. Short-circuit current rating of a listed and labeled assembly
- b. Short-circuit current rating established using an approved method

- FPN: UL 508A-2001, Supplement SB, is an example of an approved method.

Additional Changes

Includes Panels with multiple Power Sources

Revised to correlate with the marking requirements of NFPA 79 and UL 508A and to include an exception on marking of control panels containing only control components.

USFM Gives Higher Ratings Plus the IEC Width

CARBONE LORRAINE

Ferraz Shawmut

2. Series Ratings

New Labeling requirements for engineered systems

New Engineering Criteria

What is a Series Rating?

New Labeling Requirements

CAUTION —

ENGINEERED SERIES COMBINATION SYSTEM
RATED _____ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED.

New Engineering Requirement

Engineer must check that downstream circuit breakers remain passive during the interruption period

What is a Series Rating?

Overview
Application Considerations
Advantages
Disadvantages

NEC 110.9 Interrupting Rating

Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment.

240.86 Series Ratings

Where a circuit breaker is used on a circuit having an available fault current higher than the marked interrupting rating by being connected on the load side of an acceptable overcurrent protective device having a higher rating, the circuit breaker shall meet the requirements specified in (A) or (B) and (C).

Series Ratings

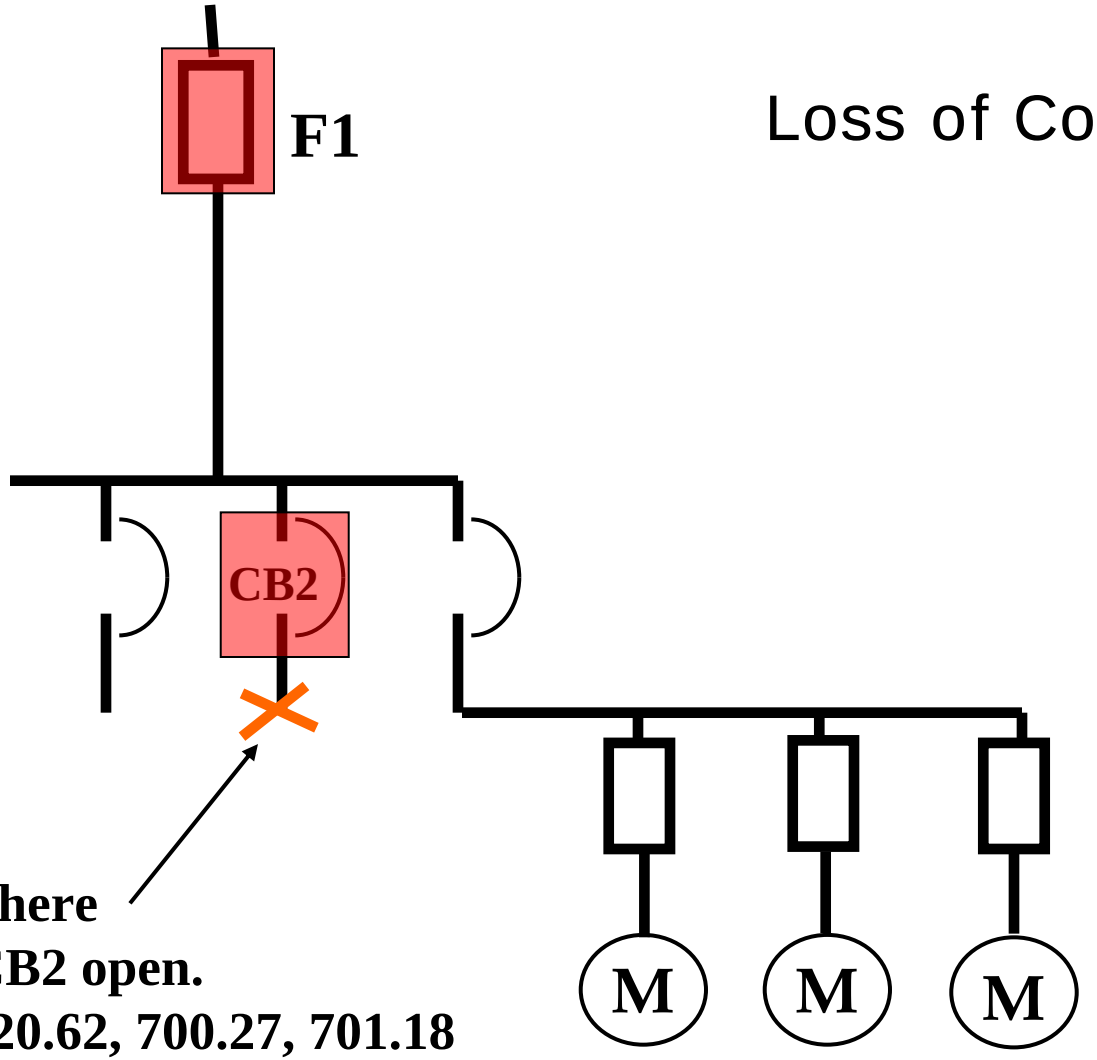
240.86 (A) Selected Under Engineering Supervision in Existing Installations.

OR

240.86 (B) Tested Combinations

AND

240.86 (C) Motor Contribution Less than 1%



Loss of Coordination

For fault here
F1 and CB2 open.
e.g. See 620.62, 700.27, 701.18

AmpTrap 2000 Fuses Can Protect Breakers

CARBONE LORRAINE

Ferraz Shawmut

3. Selective Coordination Requirements Modified

What is Selective Coordination?

517.26 Hospital Essential Life Safety Systems

620.20 Elevators, Dumbwaiters, Escalators, Moving Sidewalks, Wheelchair & Stairway Lifts

700.27 Emergency Systems, Essential Life Safety

701.18 Legally Required Standby Systems

708.54 Critical Operations Power Systems

What is Selective Coordination?

Article 100

Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the choice of overcurrent protective devices and their ratings or settings.

What is Selective Coordination?

Localizes Fault Condition to minimize affects to Electrical System

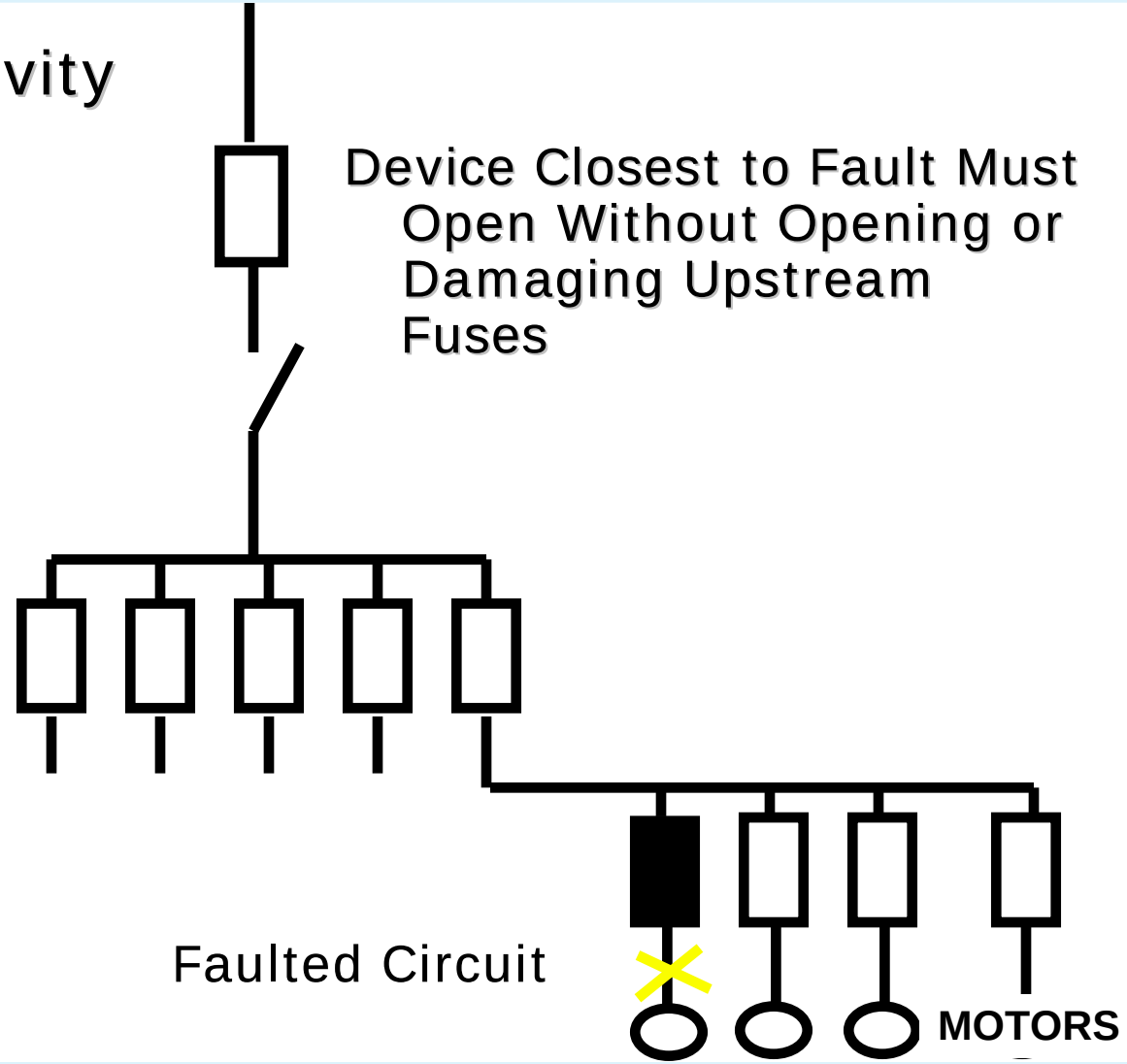
Reduces System Downtime

Coordination is Often Required by the NEC

Reduces Personnel Hazards

Reduces Component Damage

System Selectivity

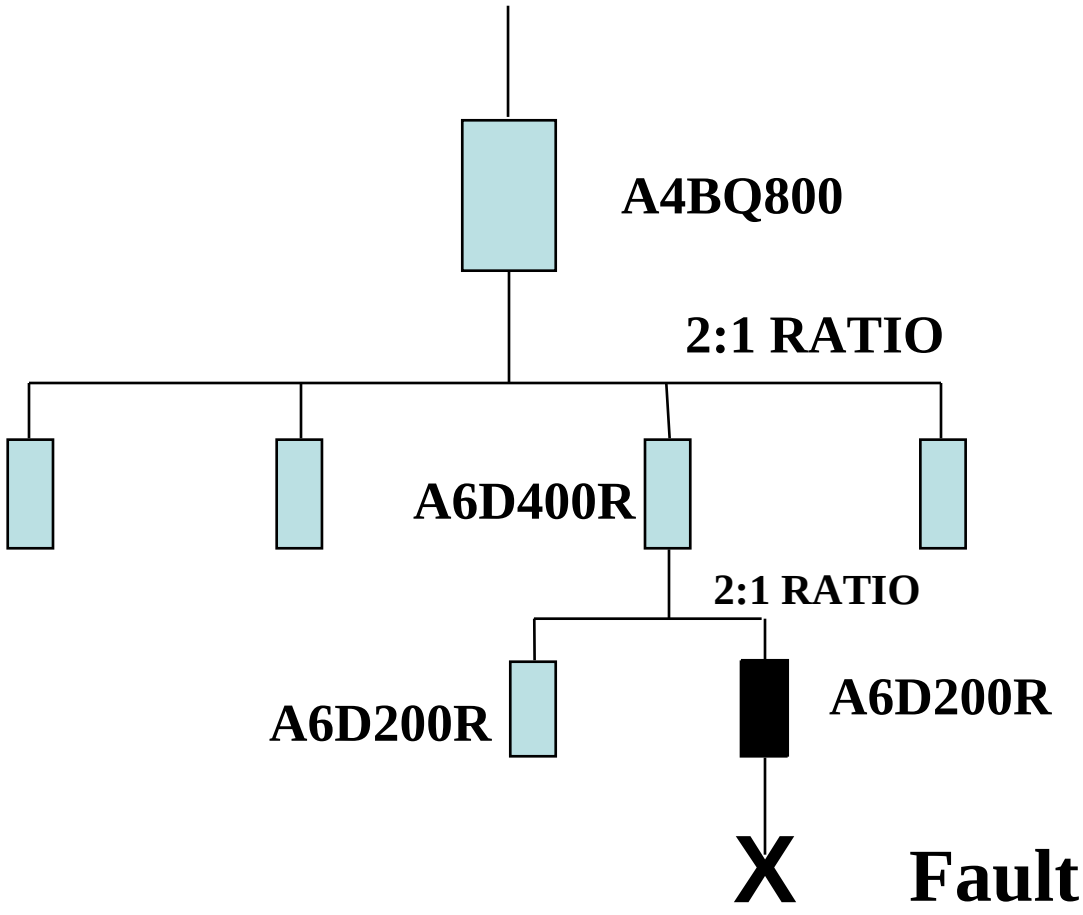


Selectivity Table-Minimum Ratios

Branch Fuse	Main Fuse		
	A4BQ	A6D	AJT
A4BQ	2:1	--	--
A6D	2:1	2:1	2:1
AJT	2:1	2:1	2:1

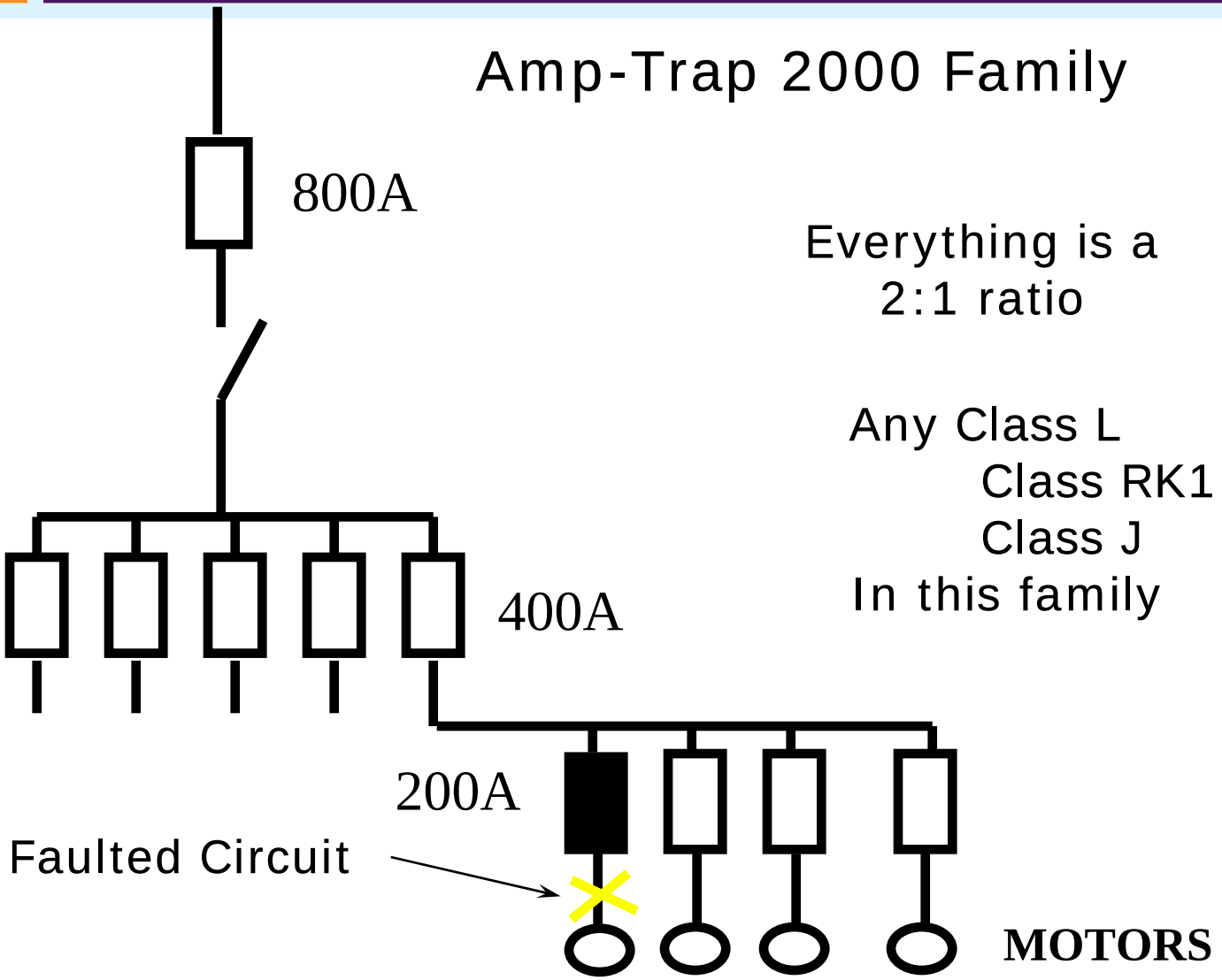
Independent of Available Fault Current

Example of a Coordinated System



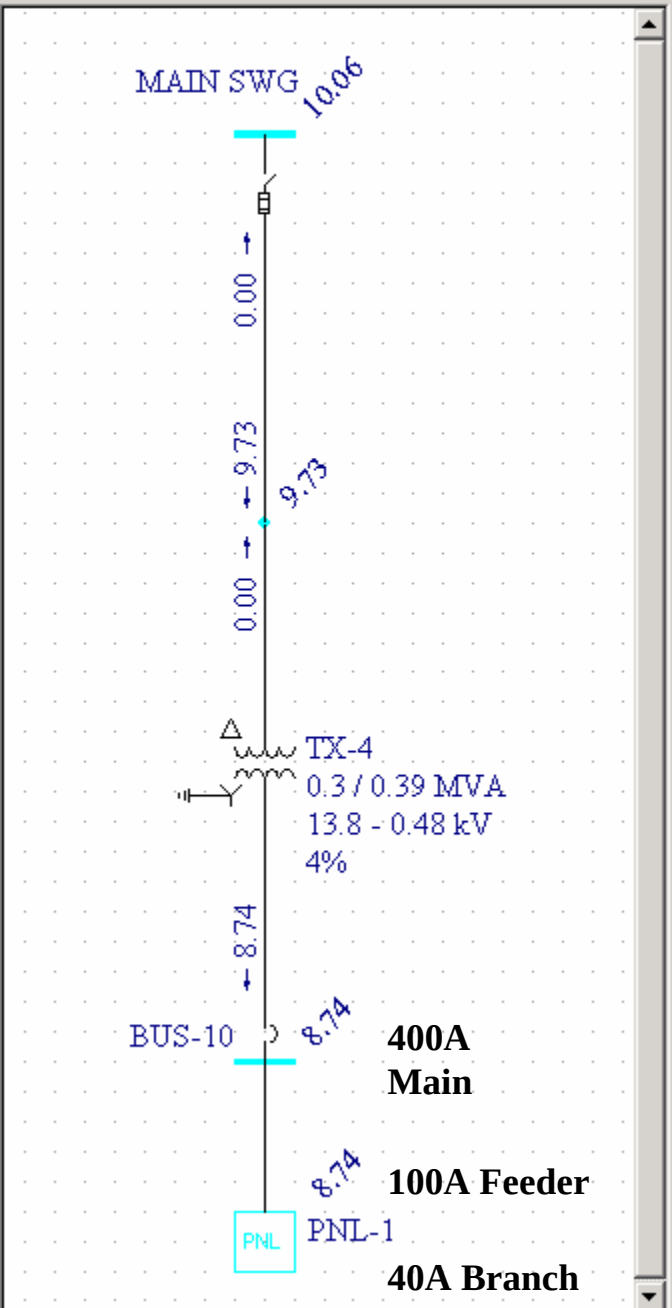
A fault anywhere on this system will have the downstream fuse open before any upstream fuse could begin to melt.

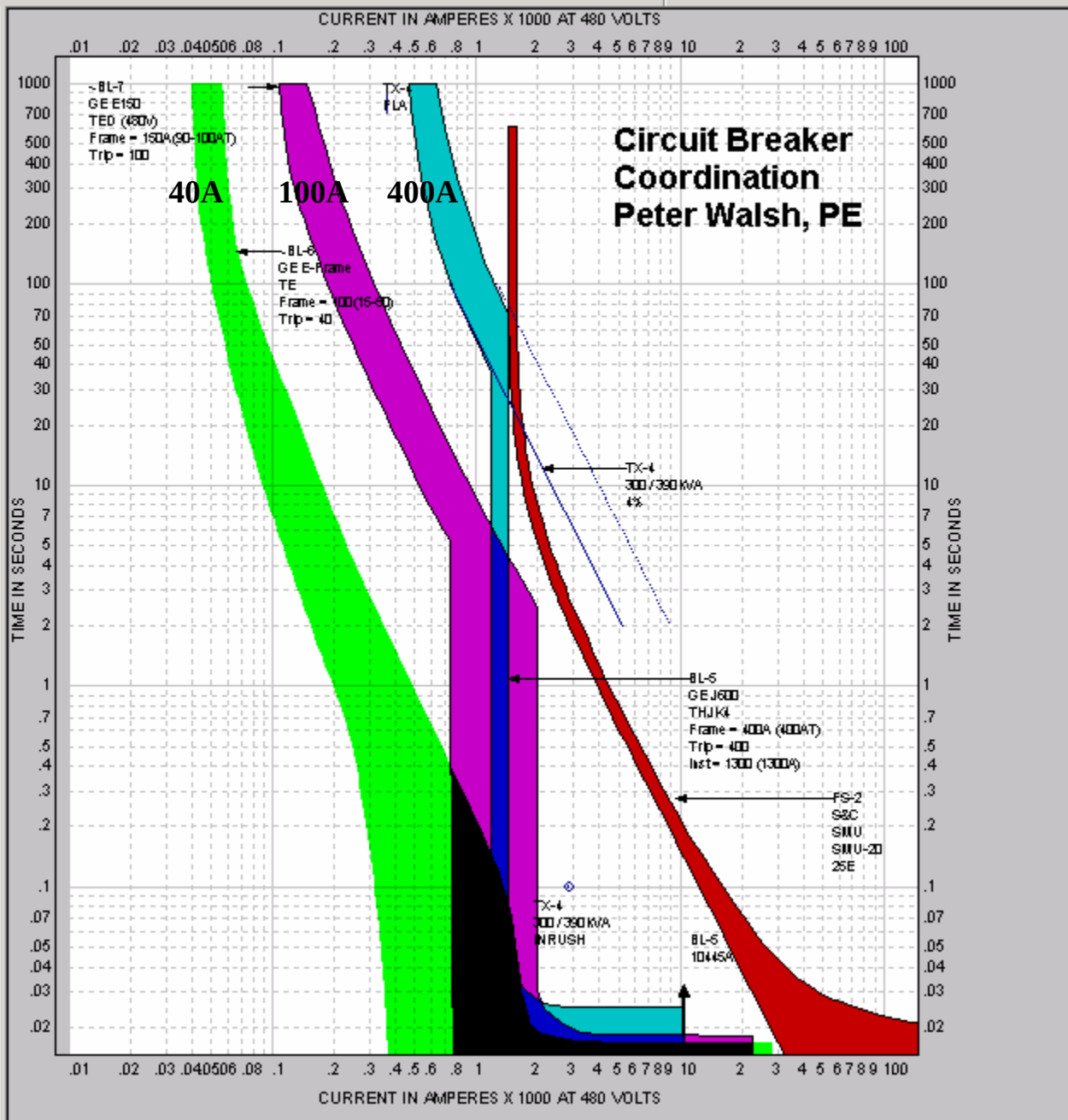
Changes with Selective Coordination



ESA EasyPower - ['TCC-6' plot for "Protection-1 (Base case)"]

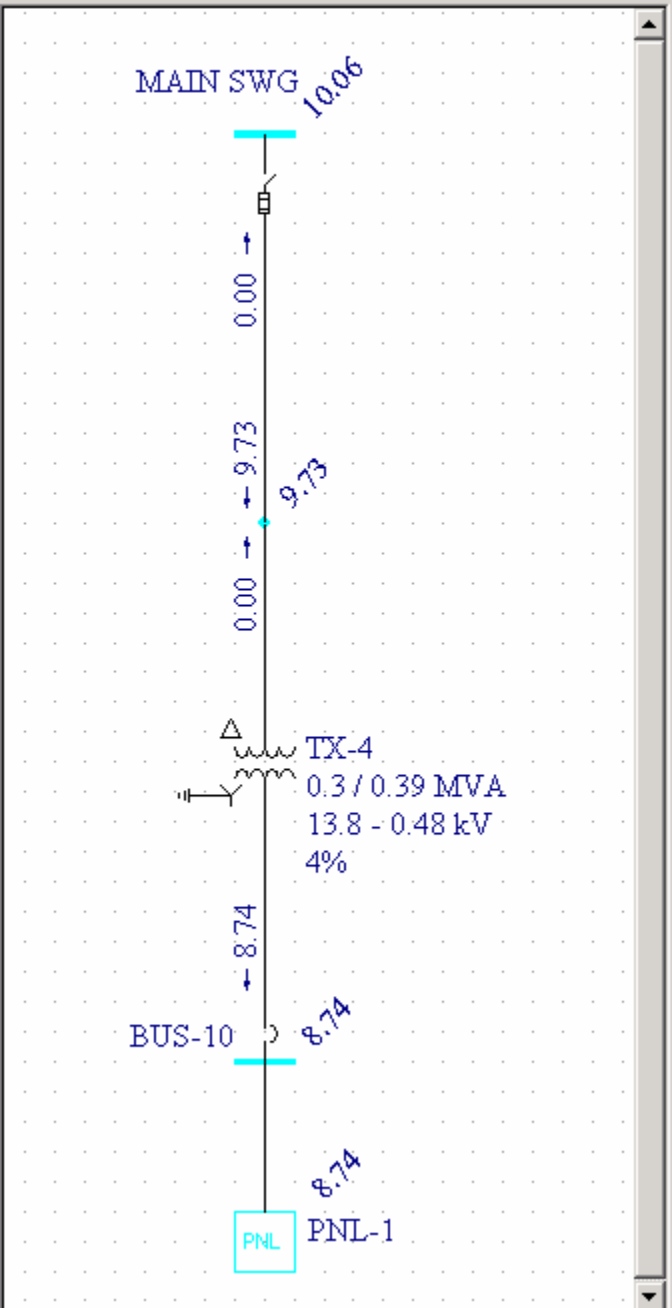
File Edit View Insert Format Analysis Solve TCC Tools Window Help

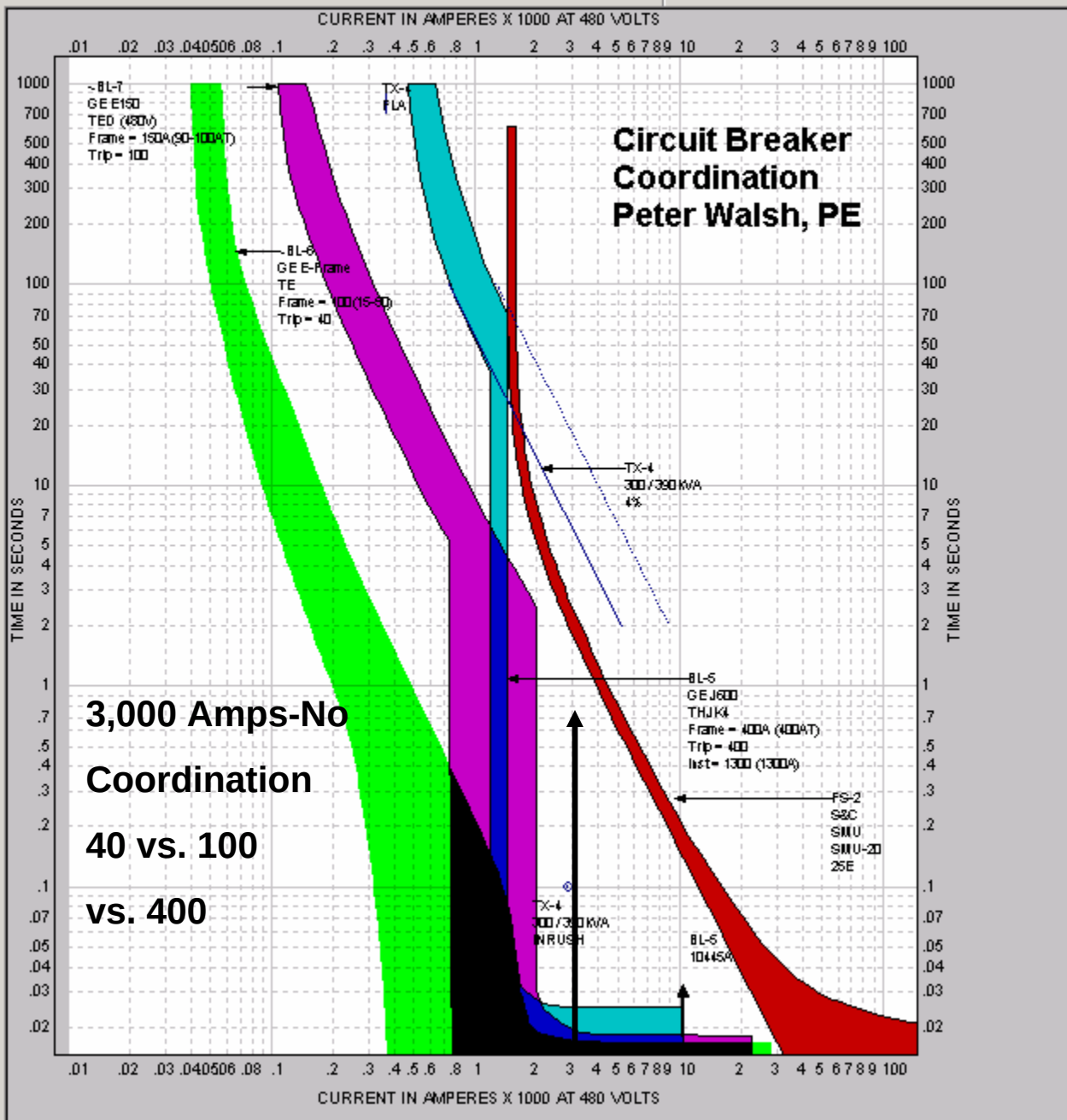




ESA EasyPower - ['TCC-6' plot for "Protection-1 (Base case)"]

File Edit View Insert Format Analysis Solve TCC Tools Window Help





517.26 Hospital Essential Electrical Systems

The essential electrical systems of hospitals are tied to complying with Article 700 unless specifically contradicted by Article 517.

This code cycle an amendment to cut the critical branch from this requirement was vigorously debated but not implemented. This affirms the 2005 selective coordination requirement located in Article 700.

620.20 Elevators, Dumbwaiters, Escalators, Moving Sidewalks, Wheelchair & Stairway Lifts

Selective Coordination has been required for elevators and similar equipment for several code cycles. This insures more continuity of operation if a electrical fault occurs. A code change to make exceptions failed to pass.

700.27 Emergency Systems, Essential Life Safety

The requirement for selective coordination has two new exceptions-

1. Between primary and secondary overcurrent protection

2. Between protective devices of the same size in series

701.18 Legally Required Standby Systems

The requirement for selective coordination has two new exceptions-

1. Between primary and secondary overcurrent protection

2. Between protective devices of the same size in series

708.54 Critical Operations Power Systems

This is new complete Article for Mission Critical Systems

708.54 Coordination

Critical operations power system(s) overcurrent devices shall be selectively coordinated with all the supply side overcurrent protective devices.

Branch Circuits Can Be Coordinated

4. Engineering Analysis Permitted for Feeder Tap Adequacy

- 240.92(B) Feeder Tap Conductor Sizing Option
- For supervised Industrial Locations Only

240.92(B) Feeder Tap Conductor Sizing Option

- Ampacity can be calculated for Feeder Tap conductors instead requiring immediate overcurrent protection. This calculation protects the wire and is coordinated with the upstream protection.

240.92(B) Feeder Tap Conductor Sizing Option

(1) Short-Circuit Formula for Copper Conductors

$$(I^2/A^2)t \leq 0.0297 \log_{10} [(T_2 + 234)/(T_1 + 234)]$$

(2) Short-Circuit Formula for Aluminum Conductors

$$(I^2/A^2)t \leq 0.0125 \log_{10} [(T_2 + 228)/(T_1 + 228)]$$

Engineering Analysis for Tap Adequacy

Where:

I=short circuit current maximum in amperes

A=conductor area in circular mils

t=time of short circuit in seconds (for times less than or equal to 10 seconds)

T_1= initial conductor temperature in degrees Celsius

T_2= final conductor temperature in degrees Celsius

Copper or aluminum conductor with paper, rubber, varnished cloth insulation,

T_2 = 200 maximum

Copper or aluminum conductor with thermoplastic insulation,

T_2 = 150 maximum

Copper or aluminum conductor with cross-linked polyethylene insulation,

T_2 = 250 maximum

Copper conductor or aluminum with ethylene propylene rubber insulation,

T_2 = 250 maximum

CARBONE LORRAINE

Ferraz Shawmut

Fusible Protection Permits Smaller Wire Sizes

CARBONE LORRAINE

Ferraz Shawmut

5. Field Marking Required for Delta Mid-Point Grounded systems

For Safety in Applying Correct

Overcurrent Protective Devices

408.3(F) High Leg Identification

Panelboards and switchboards with midpoint grounding shall be permanently field marked

“Caution _ Phase Has __ Volts to Ground”

408.3(F) High Leg Identification

Devices such as circuit breakers and combination motor controllers have limited safety ratings for maximum voltage to ground.

These shall not be applied where the voltage to ground exceeds the device rating-240.83(E), 430.52(C)(6), and 430.83(E)

Fuses Have a Full Voltage Rating

6. Disconnect Requirement for Non-Removable Lock-Out Hardware

424.19 Disconnecting Hardware for Space Heating Equipment

430.227 Requirement for Non-removable Locking Hardware

440.14 HVAC Disconnect Placement and Locking hardware

620.51 Elevator Disconnects with Non-Removable locking Hardware

Disconnect Switches with Proper Hardware

7. Stationary Batteries Now Require Disconnects

To comply with OSHA and NFPA 70E, people have been disconnecting cables or working live with PPE

480.5 Disconnects Required for Batteries

Stationary battery systems over 30 volts shall have a disconnect for all ungrounded conductors.

Disconnects Required for Batteries

8. Surge Suppressors Have Been Re-Defined

280.1 Changed Scope
285.1 Changed Scope
285.5 Listing Requirement
285.6 SCCR Required
285.23 Type 1 Surge SPDs
285.24 Type 2 Surge SPDs
285.25 Type 3 Surge SPDs

280.1 and 285.1 Changed Scope

The scope of 280 is limited to surge arresters over 1kV

The scope of 285 covers 1kV or less

Surge arresters less than 1 kV are also called Type 1 SPDs

TVSSs are also known as Type 2 and 3 SPDs

285.5 Listing Requirement

Surge arresters, surge protective devices, and transient voltage surge suppressors shall be listed devices

285.6 SCCR Required

Surge Protective Devices shall be marked with their short-circuit current rating.

The SCCR has to equal or exceed the available short circuit current at its terminals.

Surge Trap SPDs

9. Modified Arc Flash and Requirements

100 Definition: Qualified Person

110.16 Arc Flash Labeling Requirements Expanded

110 Definition- Qualified Person

100. Qualified Person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training **to recognize and avoid** the hazards involved.

110.16 Arc Flash Labeling Requirements Expanded

Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling occupancies, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

(Since the 2002 Code labeling is required. This change expands the list of equipment by inserting “such as” to the prior list.)

Specialty Arc Flash Fuses Are Available

CARBONE LORRAINE

Ferraz Shawmut

10. Branch Circuit Overcurrent Devices Defined

100 Definition: Branch Circuit Overcurrent Device

(The 2005 Code Defined Supplementary Protection)

100 Definition: Branch Circuit Overcurrent Device

A device capable of providing protection for service, feeder, and branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating. Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate for the intended use but no less than 5,000 amperes.

(Only branch circuit rated overcurrent devices can provide adequate protection of branch circuits. Supplementary devices cannot provide complete protection.)

Branch Circuit Overcurrent Protection

Helpful Products-

1. Short Circuit Current Ratings (SCCR) –**USFM, FSPDB, Switches, and Surge Trap**
2. Series Ratings –**AmpTrap 2000 Family**
3. Selective Coordination –**New Coordination Panel**
4. Engineering Analysis Permitted for Feeder Taps **Fuses Vs. Breakers**
5. Field Marking for Delta Mid-Point Grounding **–Fuses vs. Breakers**
6. Disconnect Requirement for Non-Removable Hardware -**Switches**
7. New Requirement for Stationary Battery Disconnect
   – **Enclosed Disconnect**
8. Surge Suppressors are Re-Defined –**Surge Trap**
9. Modified Arc Flash Requirements -**AmpTrap 2000 Family**
10. Branch Circuit Overcurrent Devices Defined -**USFM**

CARBONE LORRAINE

Ferraz Shawmut

Thank You

Peter Walsh, PE

CARBONE LORRAINE

Ferraz Shawmut