Overcurrent Device Studies – Code Requirements for Healthcare Facilities

Understanding the requirements and components of an OCPD and a few tips and tricks to assure a successful study and outcome.

Your Speakers Today

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Electricity is a form of energy that should be respected and handled with care to ensure safety for all.

- Michael Faraday

Agenda

- What is an Overcurrent Device Study
- Applicable Codes and Standards
- Why and Why to do a Study
- Process to Perform a Study
- Tips and Tricks
- Early Equipment Procurement
- A few fun examples

WHAT IS AN OVERCURRENT PROTECTIVE DEVICE (OCPD) STUDY

What is a Study: The Specification Requirements

260572 – Short-Circuit Studies

260573 – Coordination Studies

260574 – Arc-Flash Hazard Analysis

❖Fun fact – most OCPD study programs can analyze ALL 3 of the requirements for evaluating a system! Woot!

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Extent of Study: Only new added equipment and existing modified equipment needs to be included in study and report.

B. Executive summary of study findings.

C. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

D. One-line diagram of modeled power system, showing the following:

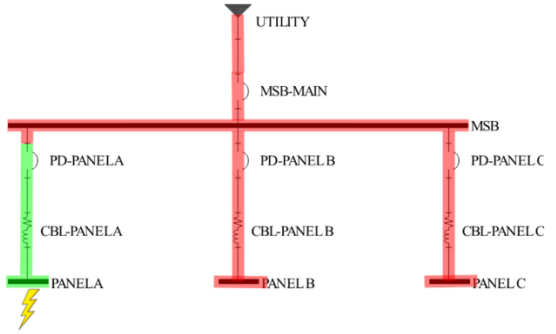
1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Conduit material.
4. Transformer kilovolt ampere (kVA) and voltage ratings.
5. Motor and generator designations and kVA ratings.
6. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
7. Derating factors and environmental conditions.
8. Any revisions to electrical equipment required by the study.

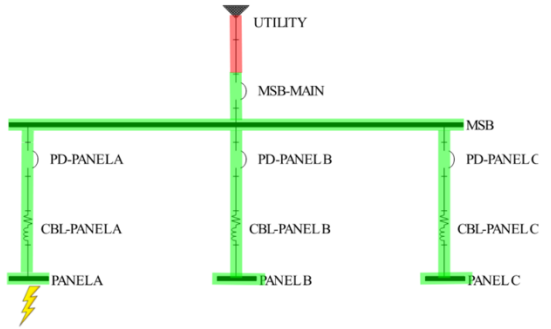
E. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.

F. Protective Device Evaluation:

What is a Study: The Basics

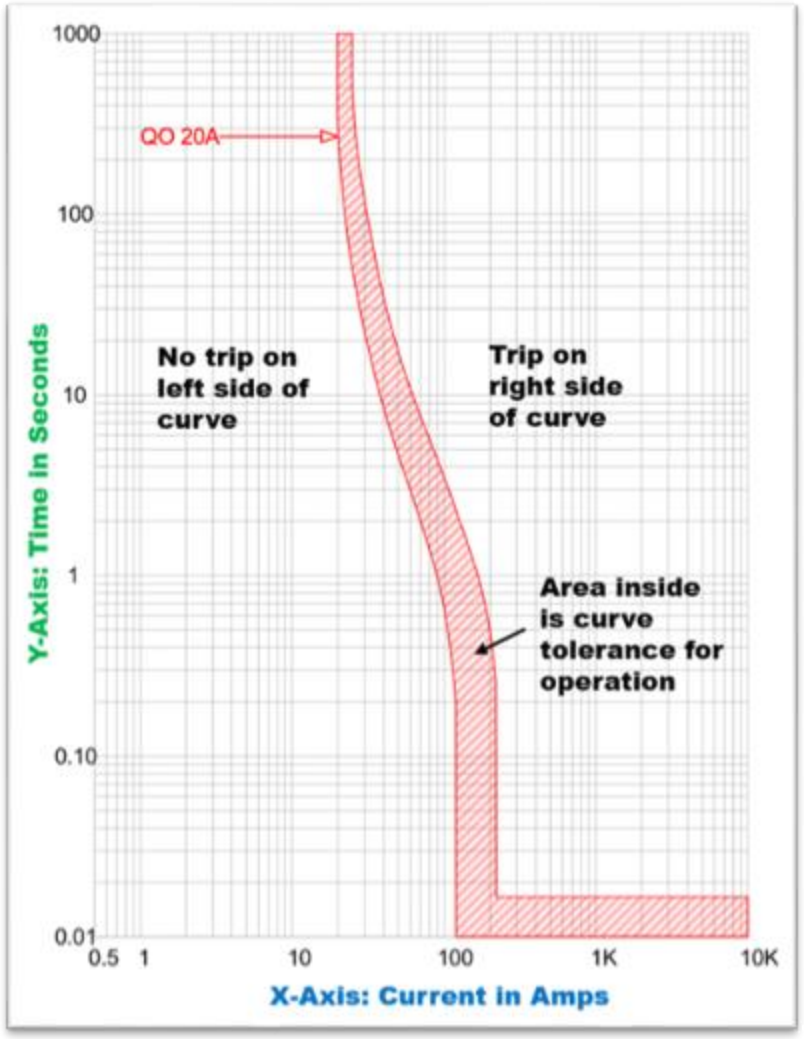
An engineering analysis of an electrical power system to ensure that equipment is adequately rated and protective devices (circuit breakers, fuses, relays) operate in a coordinated manner, isolating fault conditions to minimize disruption to the rest of the electrical system, enhancing safety and reliability.



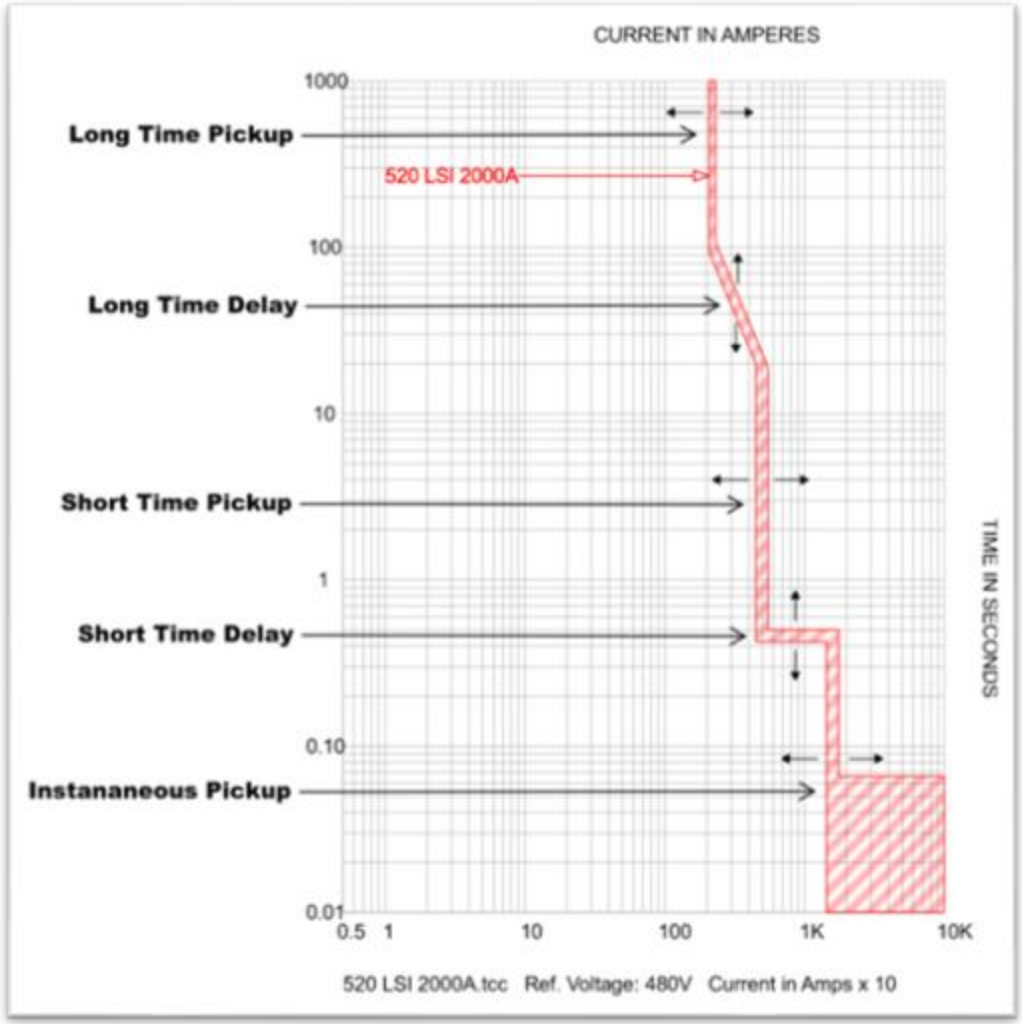


What is a Study: Time Current Curve (TCC)

Note that TCCs use logarithmic scales!

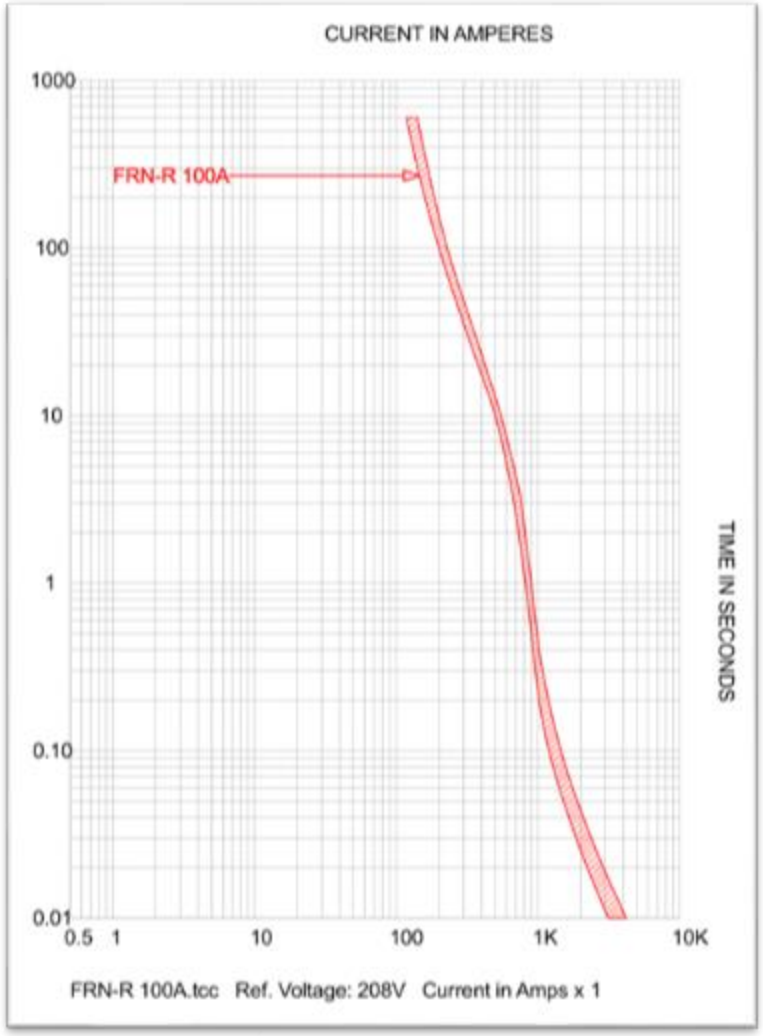


What is a Study: Electronic Trip Breaker TCC

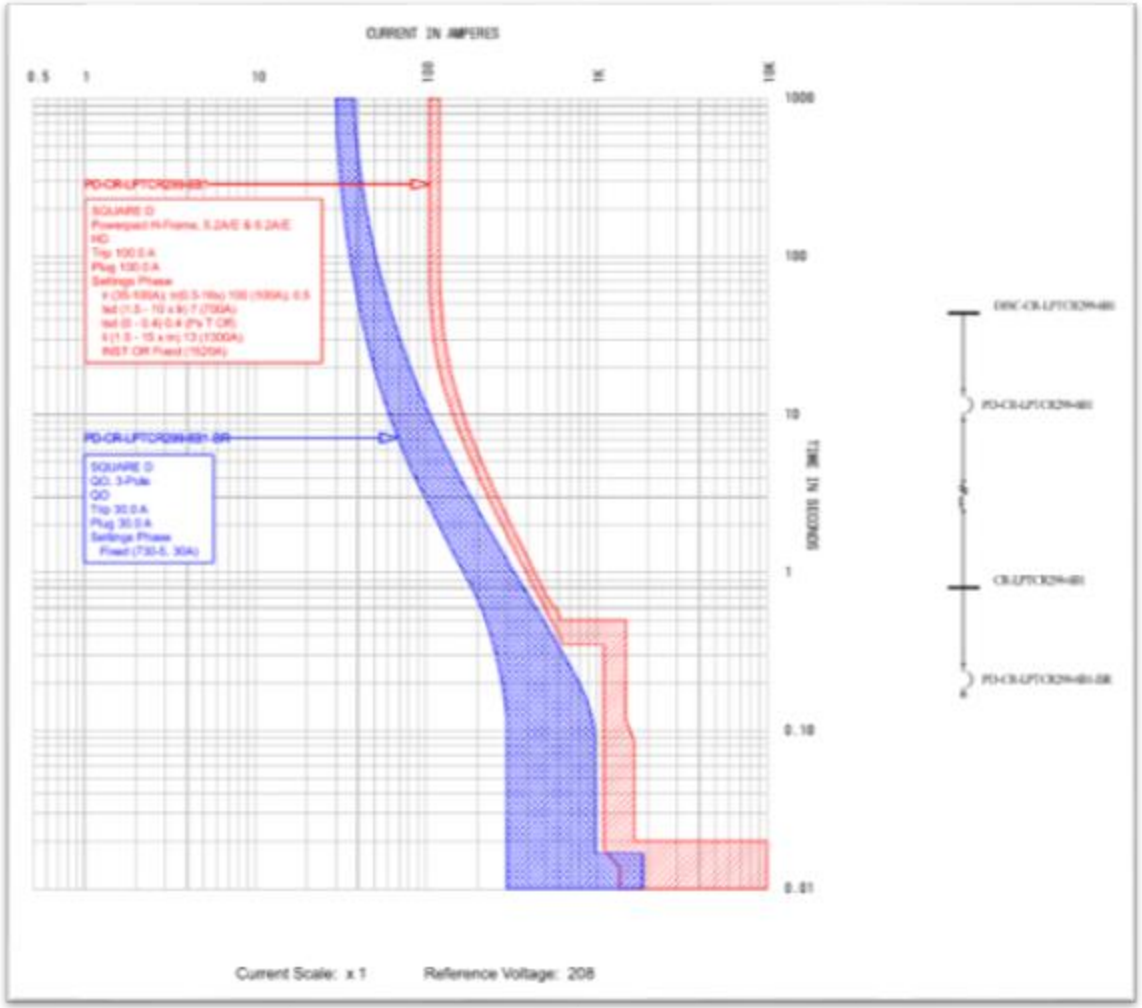


What is a Study: Fuse TCC

Note the narrow curve tolerance through the entire range- particularly the instantaneous region.

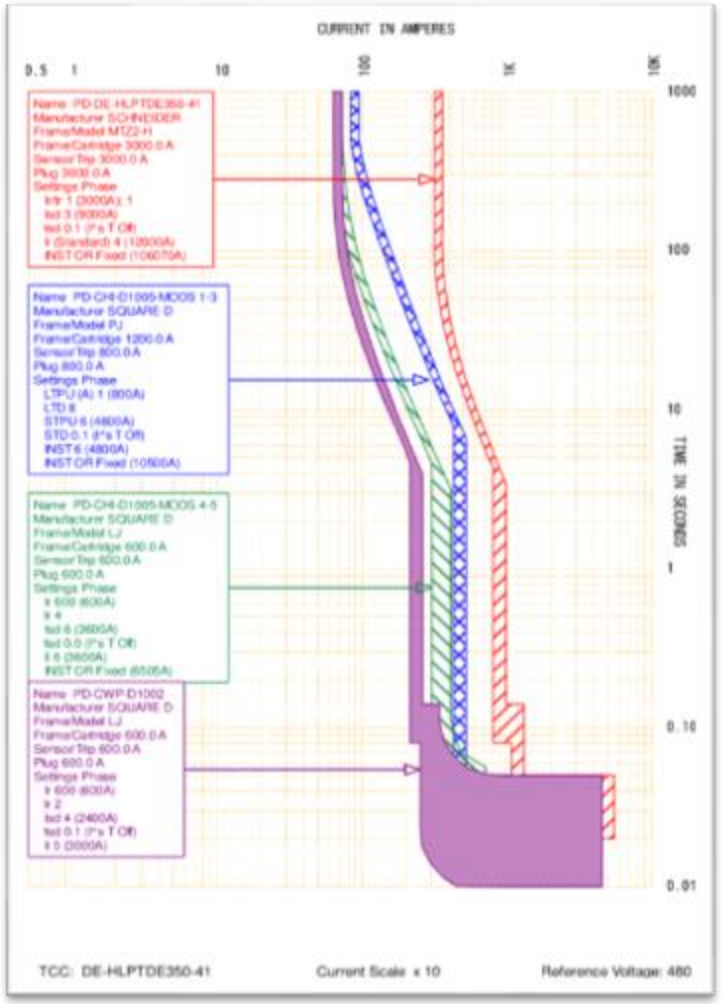


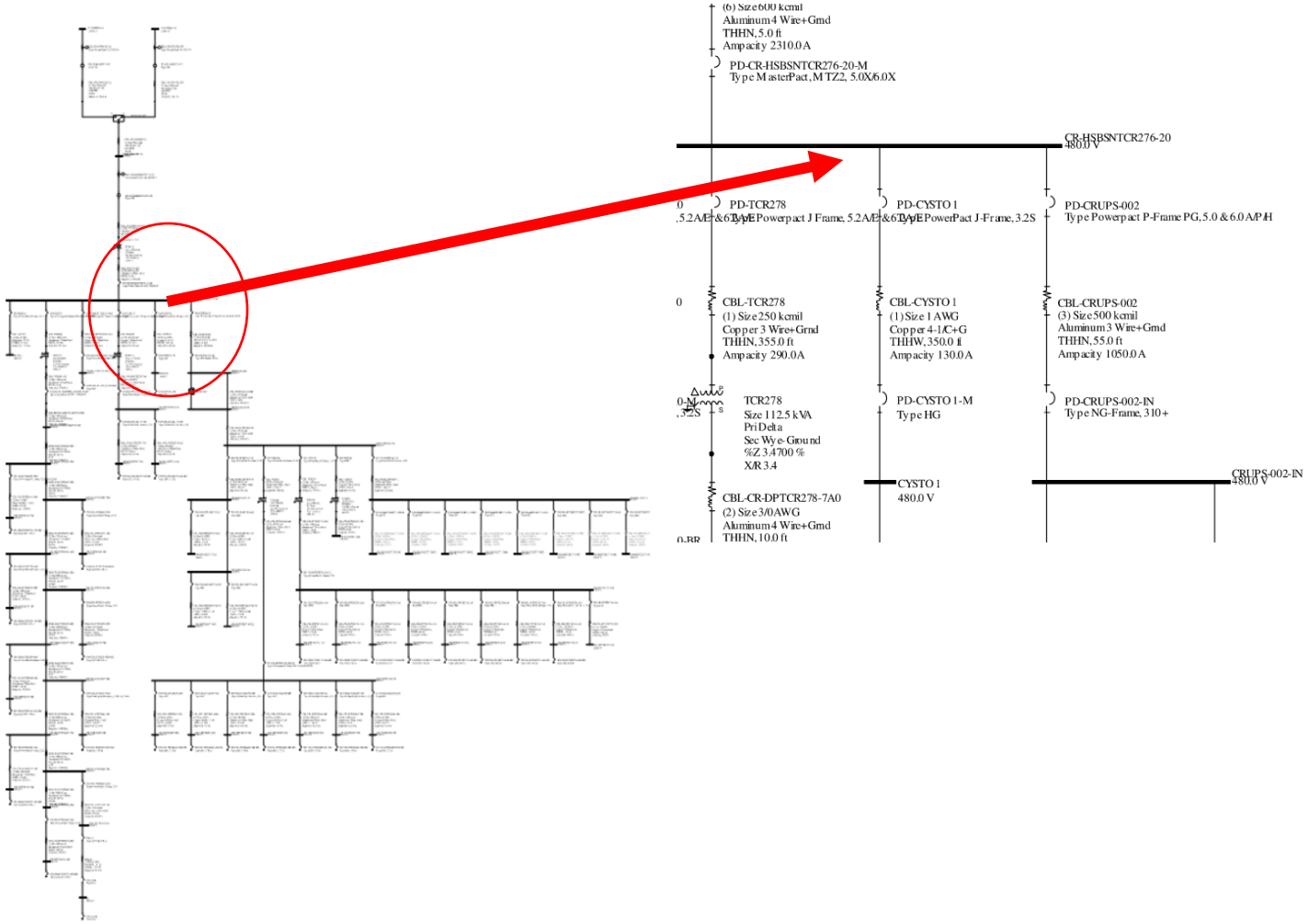
What is a Study: Device Coordination Example



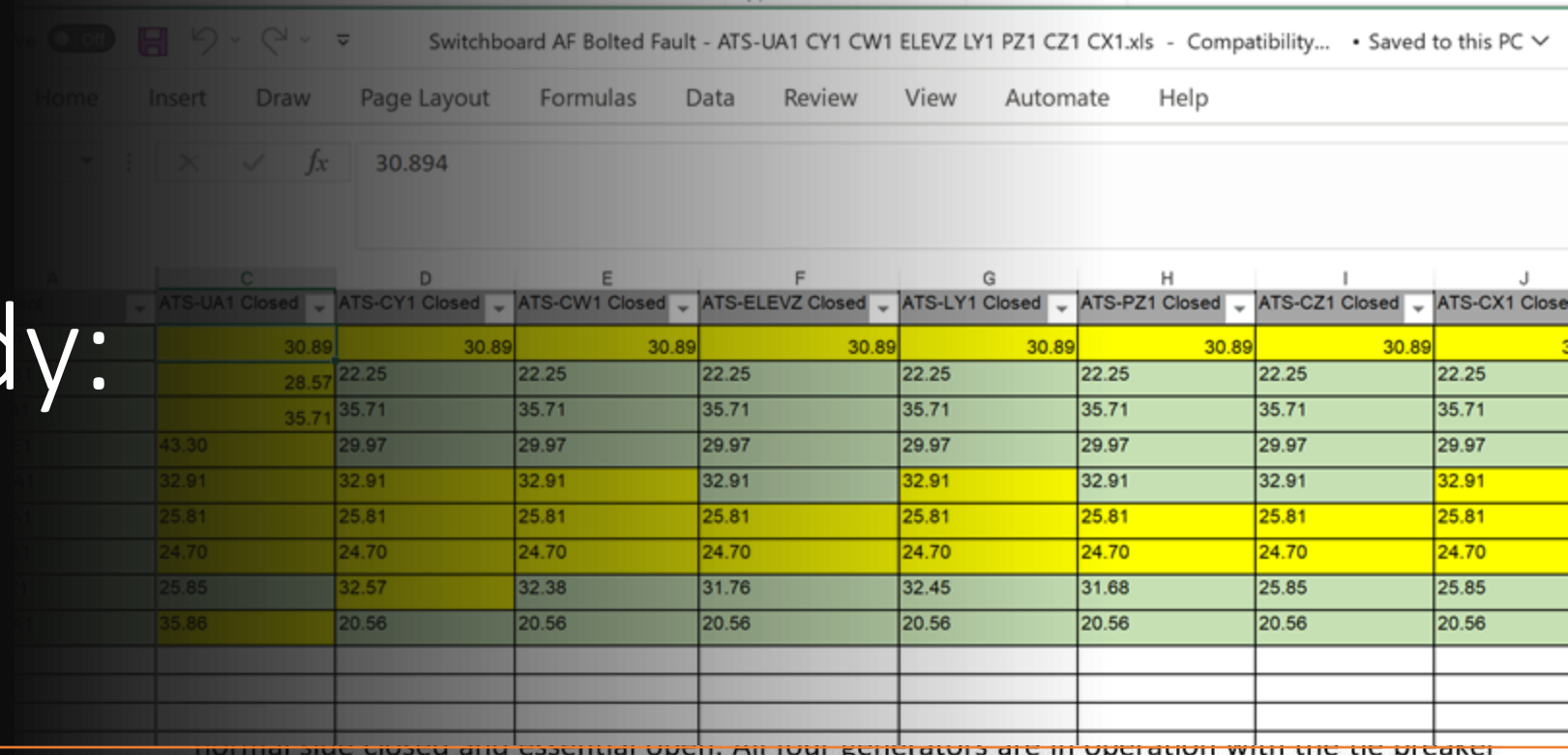

DANGER
HIGH
VOLTAGE
KEEP OUT
DANGER
HIGH
VOLTAGE
KEEP OUT
LIFT
JACK
LIFT
JACK
Arc Flash Information
VOLTAGE
TRANSFORMERS
(LINE SIDE)
MAIN
BREAKER
DANGER
AC-N15SGOA1

What is a Study: Coordination Example





What is a Study: Short Circuit Information



ATS-UA1 Closed	ATS-CY1 Closed	ATS-CW1 Closed	ATS-ELEVZ Closed	ATS-LY1 Closed	ATS-PZ1 Closed	ATS-CZ1 Closed	ATS-CX1 Close
30.89	30.89	30.89	30.89	30.89	30.89	30.89	
28.57	22.25	22.25	22.25	22.25	22.25	22.25	22.25
35.71	35.71	35.71	35.71	35.71	35.71	35.71	35.71
43.30	29.97	29.97	29.97	29.97	29.97	29.97	29.97
32.91	32.91	32.91	32.91	32.91	32.91	32.91	32.91
25.81	25.81	25.81	25.81	25.81	25.81	25.81	25.81
24.70	24.70	24.70	24.70	24.70	24.70	24.70	24.70
25.85	32.57	32.38	31.76	32.45	31.68	25.85	25.85
35.86	20.56	20.56	20.56	20.56	20.56	20.56	20.56

closed in the generator paralleling switchgear.

- **ATS-PA1 Closed** – ATS-PA1 is in a closed transition state while all other ATS's are set to normal and all switchgear transfer pairs (QMVSGP3A1, PMVSGP3A1, QSB15A1, and QSB15B1) have the normal side closed and essential open. All four generators are in operation with the tie breaker closed in the generator paralleling switchgear.

- **ATS-PZ1 Closed** – ATS-PZ1 is in a closed transition state while all other ATS's are set to normal and all switchgear transfer pairs (QMVSGP3A1, PMVSGP3A1, QSB15A1, and QSB15B1) have the normal side closed and essential open. All four generators are in operation with the tie breaker closed in the generator paralleling switchgear.

- **ATS-QA1 Closed** – ATS-QA1 is in a closed transition state while all other ATS's are set to normal

What is a Study: Arc Flash and Shock Hazard

APPLICABLE CODES AND STANDARDS

Codes and Standards: Selective Coordination

NFPA 70 2023 ed
Article 100

Coordination, Selective. (Selective Coordination)

Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the selection and installation of overcurrent protective devices and their ratings or settings **for the full range of available overcurrents**, from overload to the available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents. (CMP-10)

Codes and Standards: Coordination - Healthcare

NFPA 99 2024 ed

6.7.2.1.1. Coordination

6.7.2.1.1.1

Overcurrent protective devices serving the essential electrical system shall be coordinated for the **period of time that a fault's duration extends beyond 0.1 second**.

6.7.2.1.1.2

Coordination shall not be required as follows:

(1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary

(2) Between overcurrent protective devices of the same size (ampere rating) in series

Codes and Standards: Coordination - Healthcare

NFPA 99 2012 ed (For compliance with CMS)

6.4.2.1.2. Selective Coordination

6.4.2.1.2.1

Overcurrent protective devices serving the essential electrical system selectively coordinate for the **period of time that a fault's duration extends beyond 0.1 second**.

6.4.2.1.2.2

Selective coordination shall not be required as follows:

(1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary

(2) Between overcurrent protective devices of the same size (ampere rating) in series

Codes and Standards: Coordination - Healthcare

NFPA 70 2023 ed
517.31 (G) Coordination.

Overcurrent protective devices serving the essential electrical system shall be coordinated for the **period of time that a fault's duration extends beyond 0.1 second**.

Exception No. 1: Coordination shall not be required between transformer primary and secondary overcurrent protective devices where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary.

Exception No. 2: Coordination shall not be required between overcurrent protective devices of the same size (ampere rating) in series.

Informational Note No. 1: The terms coordination and coordinated as used in this section do not cover the full range of overcurrent conditions.

Informational Note No. 2: See 517.17(C) for information on requirements for the coordination of ground-fault protection.

Codes and Standards: ACHA

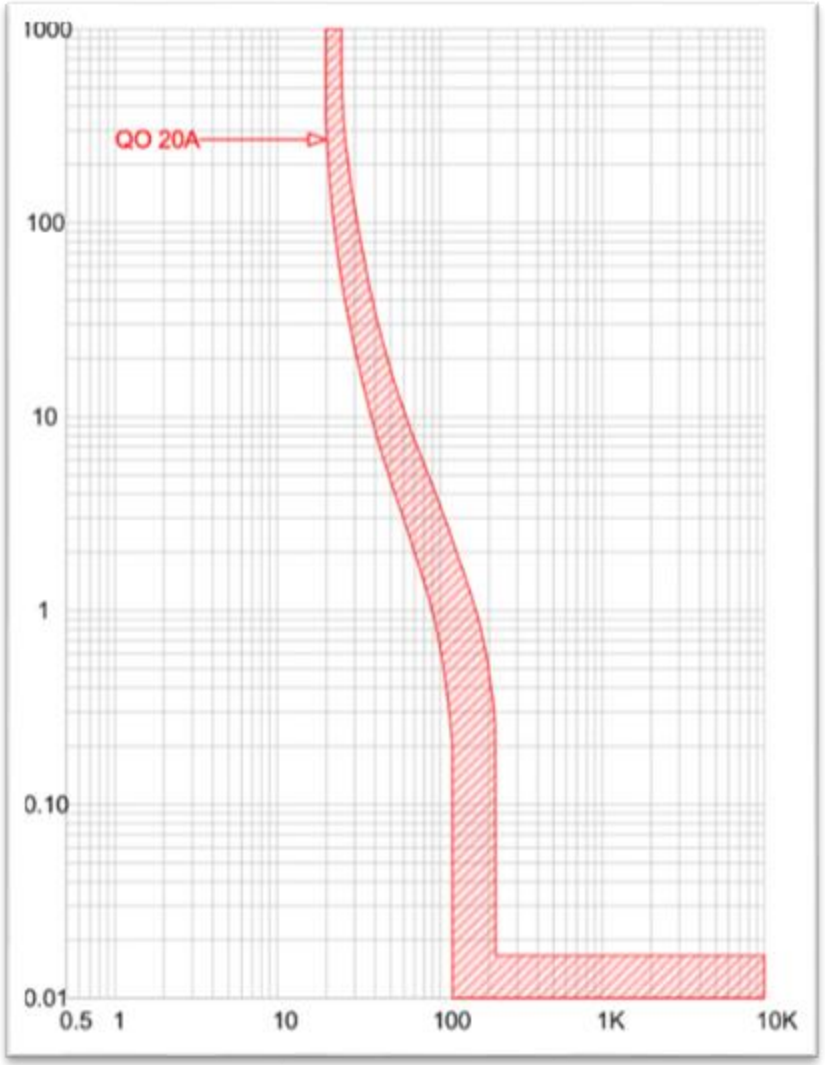
Stage III, Construction Documents / Revised Construction Documents

A **power study** that must include a fault study complete with calculations to **demonstrate** that over-current devices, transfer switches, switchboards, panel boards, motor controls, transformers and feeders **are adequately sized** to safely withstand available phase-to-phase and phase-to-ground faults. The study must also include an analysis of generator performance under fault conditions and a coordination study resulting in the **tabulation of settings for all over-current** device adjustable trips, time delays, relays and ground fault coordination. This **must be provided for all new equipment and existing equipment** serving any new equipment. **Power studies for renovations** of existing distribution systems must include only new equipment and existing equipment upstream to the normal and emergency sources of the new equipment. Renovations involving only branch circuit panel boards without modifications to the feeder must not require a full power study; instead, the power study must be limited to the calculation of new and existing loads of the branch circuit panel;

WHEN AND WHY DO A STUDY
(BEYOND THE OBVIOUS COMPLIANCE REQUIREMENTS)

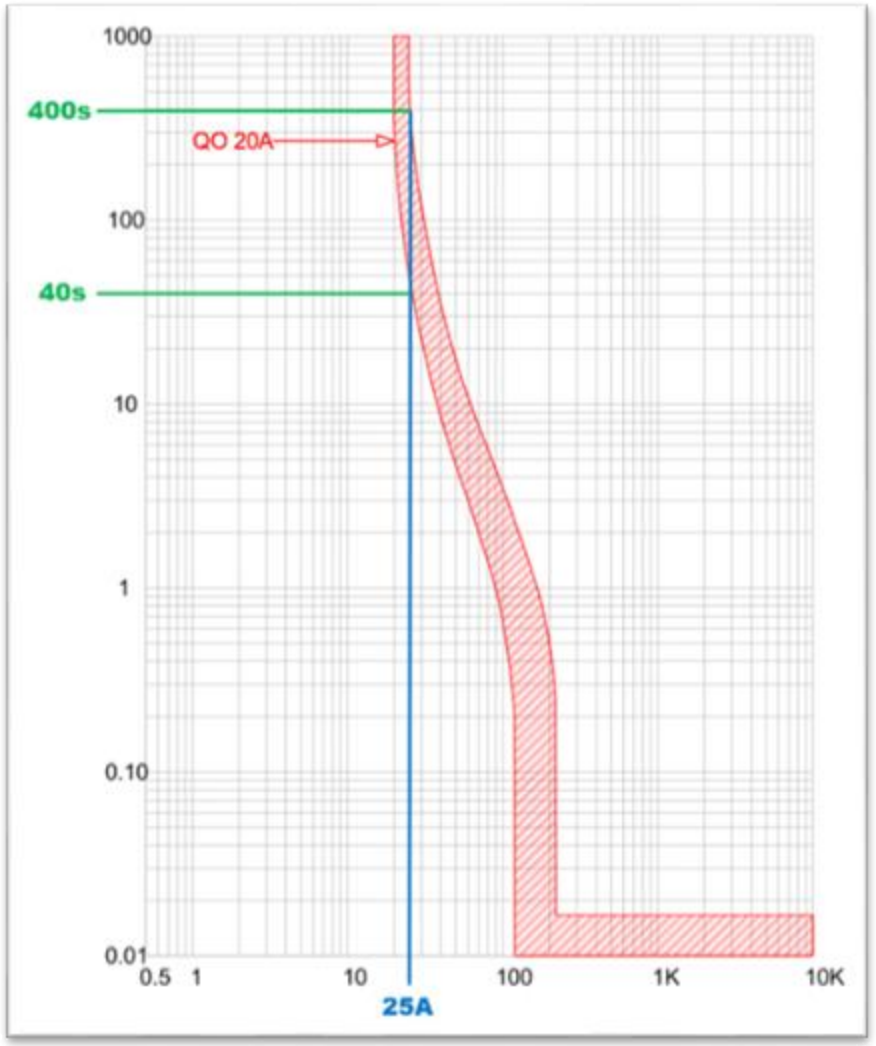

always
100%
usually
90%
often
70%
sometimes
50%
never
0%

Why: How long for a 20A breaker with 25A of load to trip?



Why: How long for a 20A breaker with 25A of load to trip?

Answer:
Between 40 and
400 seconds



Why: What happens when a System isn’t coordinated

WHAT IS THE PROCESS TO PERFORM A STUDY?

Study Components

- Distribution Design
- Electrical Equipment Characteristics
- Large Equipment (Motor) contribution
- Feeder information and length
- Incoming available fault current
- Generator fault rating
- Transfer switch types
- Operating scenerios

The more I learn, the more I realize how much I don't know.

- Albert einstein

The Basics: New Construction

- Create Electrical Distribution Design
- Input information based upon BOD equipment and feeder lengths
- Define operating scenerios
- Evaluate Results

- Validate study after equipment procurement and installation

The Basics: Remodel

- Create Electrical Distribution Modification Design
- Gather pertinent information of Equipment and feeders upstream
- Input information
- Define operating scenerios
- Evaluate Results

- Validate study after equipment procurement and installation

The Basics: Existing Facility

- Find existing Drawings – if they exist
- Walk the entire site to find electrical equpiment
- Have a qualified electrician open equipment to gather pertinent electrical details (if not rated as dangerous)
- Try to figure out routing of feeders
- Shake your head at a piece of equipment you have never seen in your career and wonder what to do about it
- Input whatever information you have agregated
- Figure out how the heck to evaluate the existing scenerios based on the best information you have been able to compile
- Evaluate Results and make best judgements

The strength of the team is each individual member. The strength of each member is the team.

- Phil Jackson

The Basics: The Team

- Owner
- Engineer
- Electrical Contractor
- Manufacturers

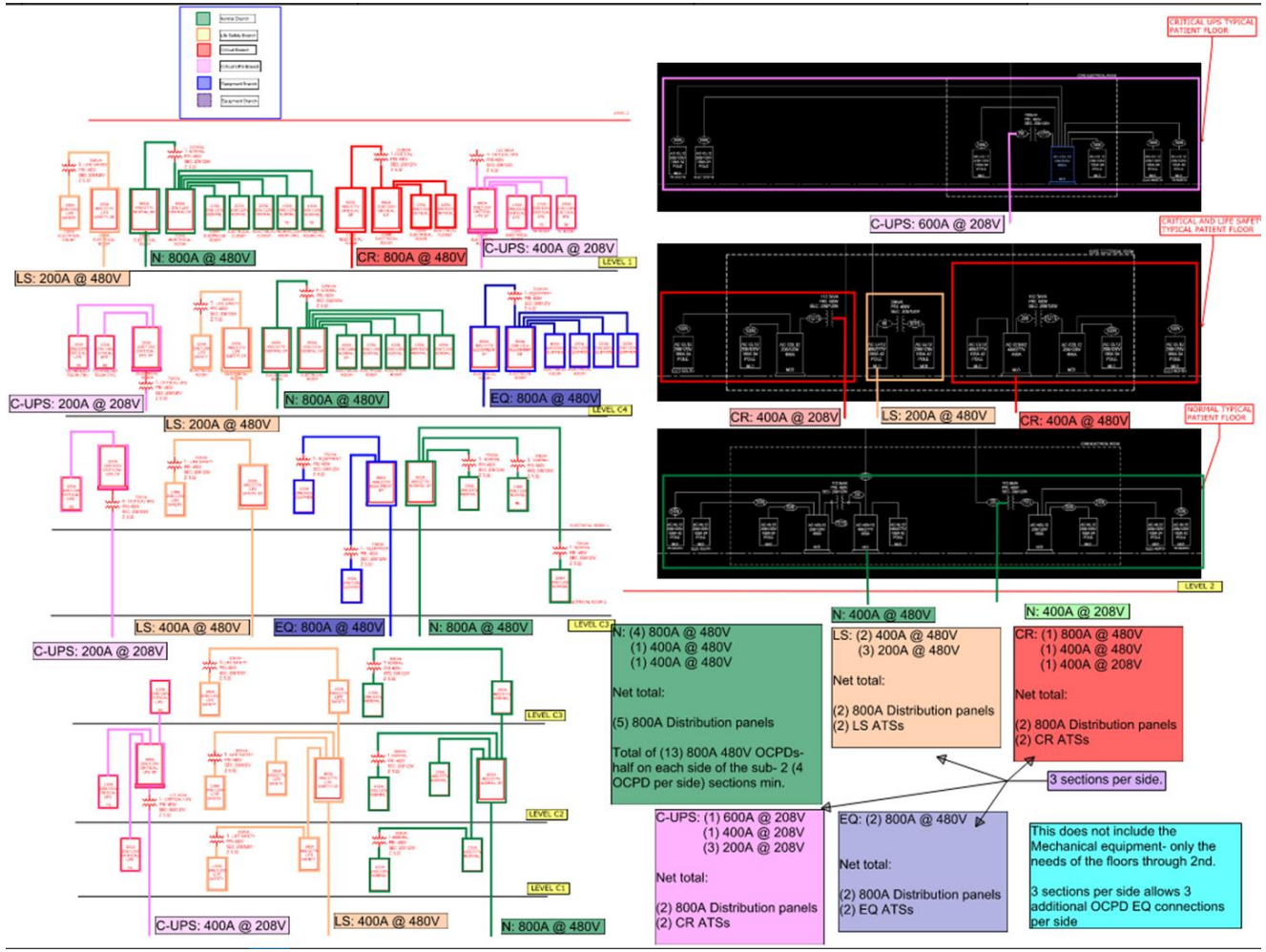
TIP AND TRICKS


WARNING
REMEMBER KIDS,
ELECTRICITY WILL KILL YOU!!

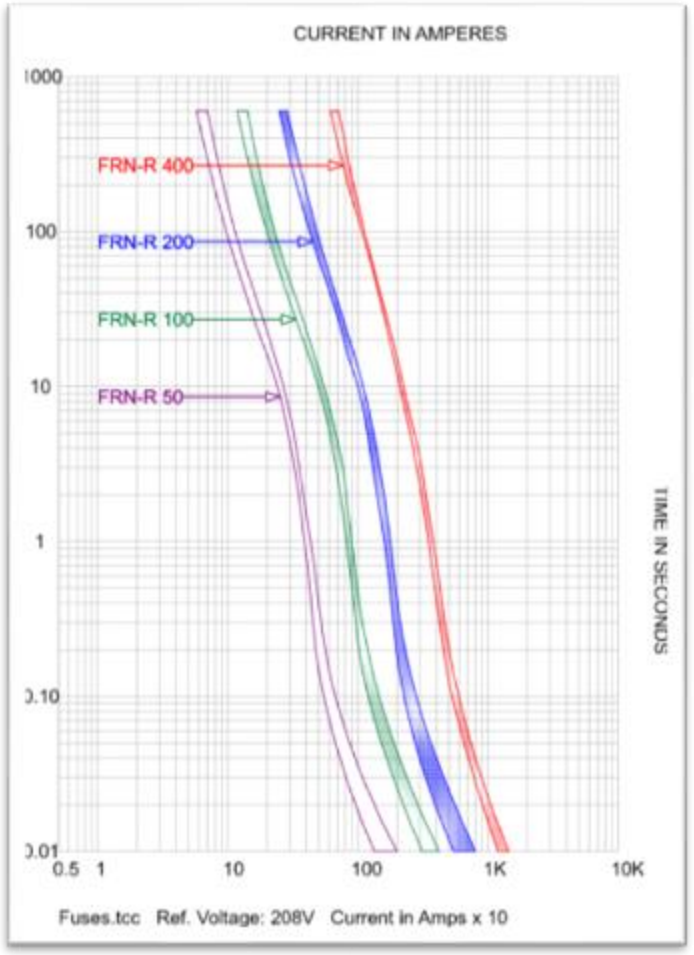
Tips and Tricks: Helpful Strategies

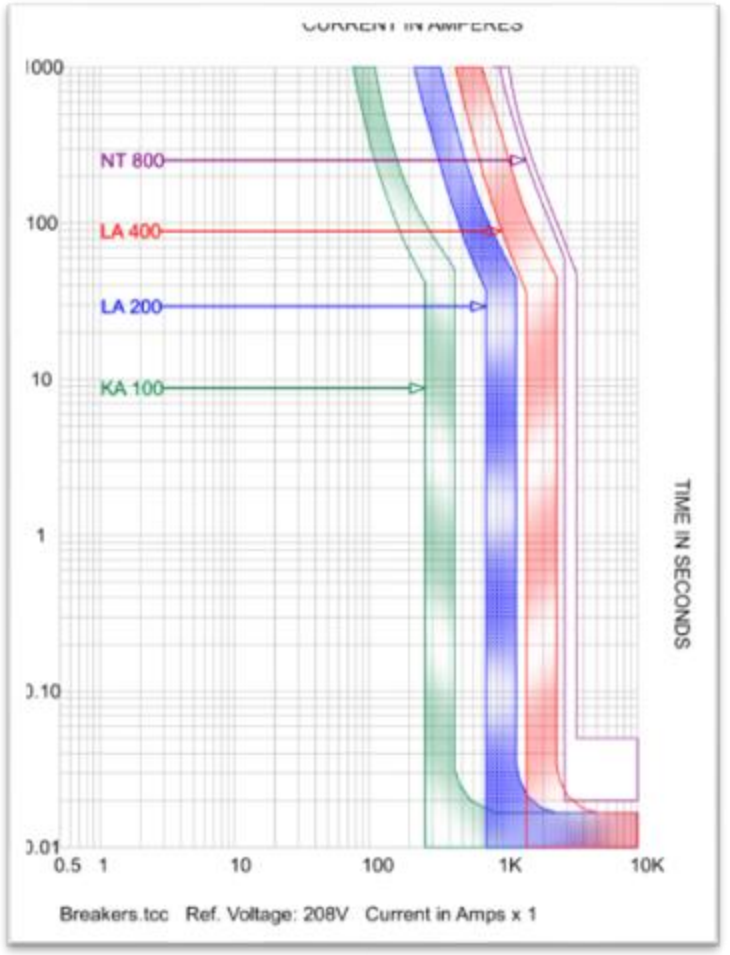
- Distribution Strategies
- Ratios of OCPDs
- Transformer damage curves
- Motor and generator damage curves
- Devices rated to work in series (but not series rated devices)
- Manufacturer's coordination tables
- Frame Sizes
- 10 second overload point and damage curve interception
- Operating Scenerios

Tips and Tricks: Distribution Choices

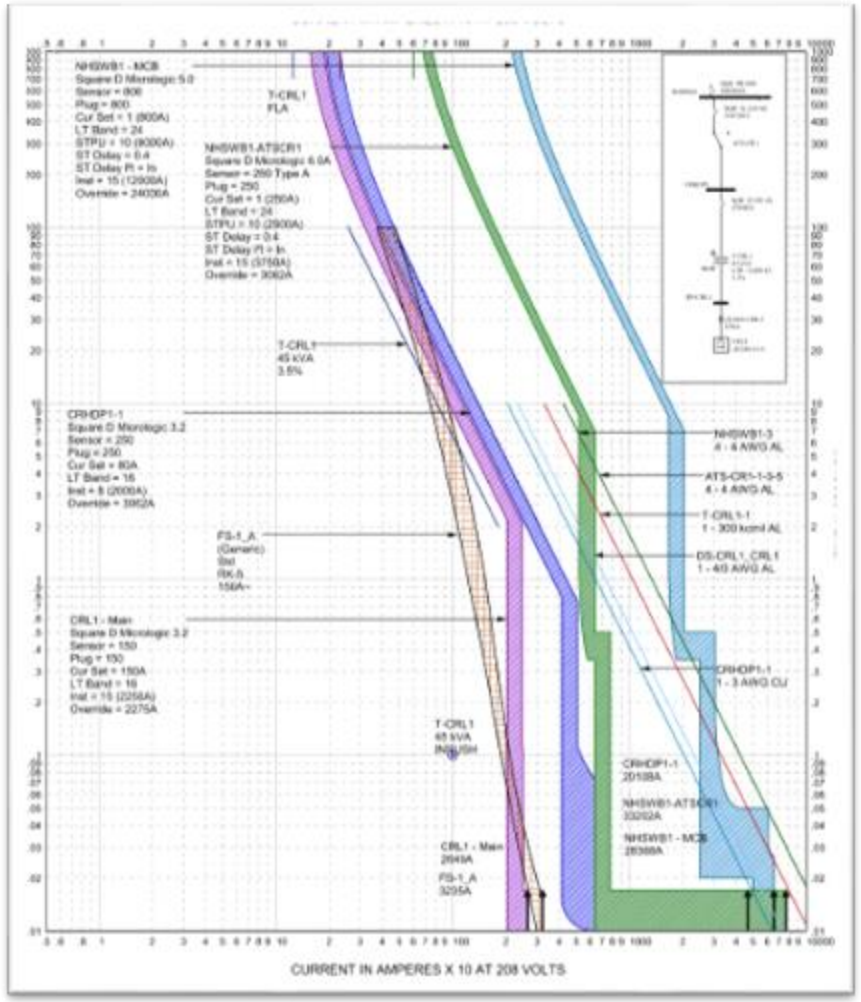


Tips and Tricks: 2-to-1 Ratios





Tips and Tricks: Damage Curves



Tips and Tricks: Manufacturer's Tables

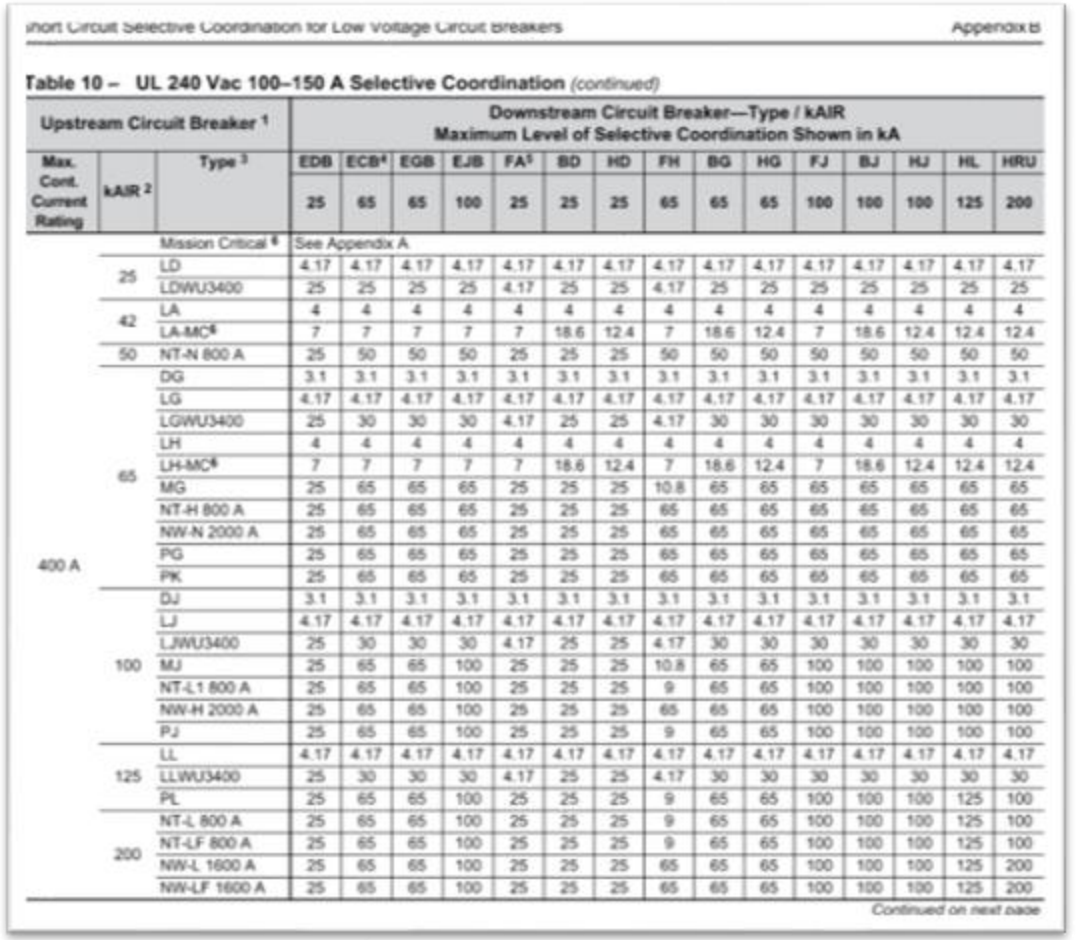


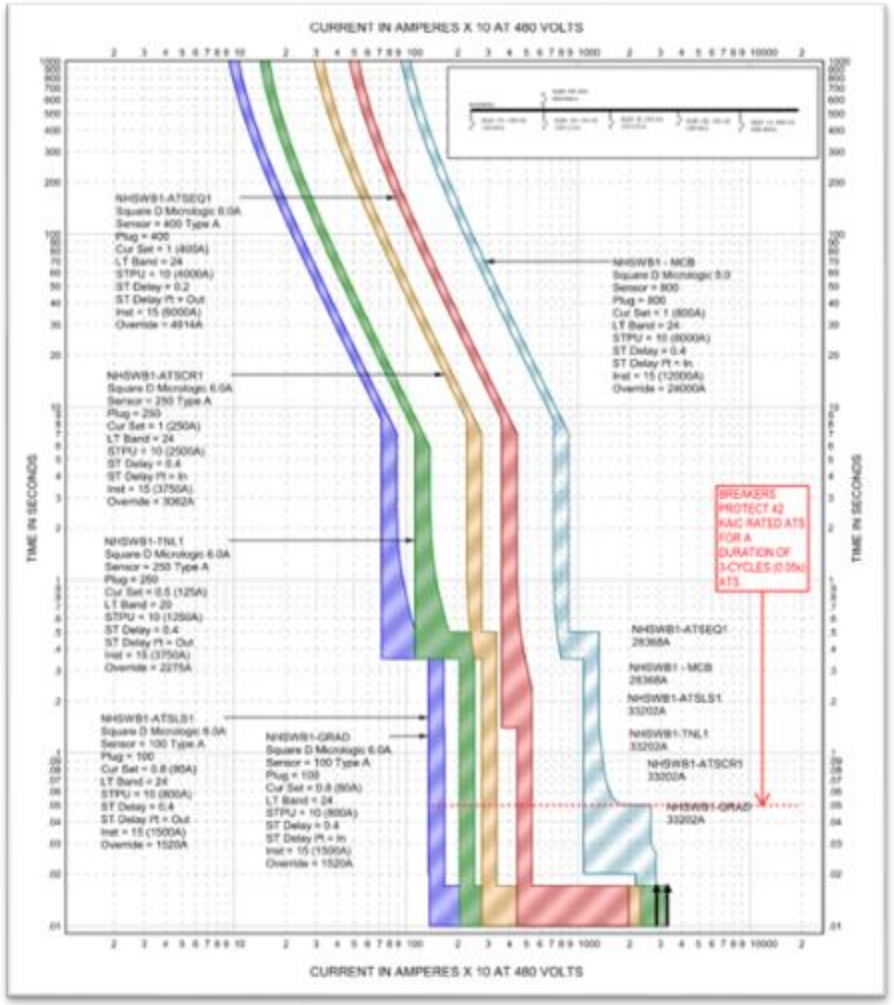
Table 10 – UL 240 Vac 100–150 A Selective Coordination *(continued)*

Upstream Circuit Breaker [1]			Downstream Circuit Breaker—Type / kAIR Maximum Level of Selective Coordination Shown in kA														
Max. Cont. Current Rating	kAIR [2]	Type [3]	EDB	ECB [4]	EGB	EJB	FA [5]	BD	HD	FH	BG	HG	FJ	BJ	HJ	HL	HRU
			25	65	65	100	25	25	25	65	65	65	100	100	100	125	200
400 A		Mission Critical [6]	See Appendix A														
	25	LD	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
		LDWU3400	25	25	25	25	4.17	25	25	4.17	25	25	25	25	25	25	25
	42	LA	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		LA-MC [6]	7	7	7	7	7	18.6	12.4	7	18.6	12.4	7	18.6	12.4	12.4	12.4
	50	NT-N 800 A	25	50	50	50	25	25	25	50	50	50	50	50	50	50	50
	65	DG	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
		LG	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
		LGWU3400	25	30	30	30	4.17	25	25	4.17	30	30	30	30	30	30	30
		LH	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
		LH-MC [6]	7	7	7	7	7	18.6	12.4	7	18.6	12.4	7	18.6	12.4	12.4	12.4
		MG	25	65	65	65	25	25	25	10.8	65	65	65	65	65	65	65
		NT-H 800 A	25	65	65	65	25	25	25	65	65	65	65	65	65	65	65
		NW-N 2000 A	25	65	65	65	25	25	25	65	65	65	65	65	65	65	65
		PG	25	65	65	65	25	25	25	65	65	65	65	65	65	65	65
		PK	25	65	65	65	25	25	25	65	65	65	65	65	65	65	65
	100	DJ	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
		LJ	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
		LJWU3400	25	30	30	30	4.17	25	25	4.17	30	30	30	30	30	30	30
		MJ	25	65	65	100	25	25	25	10.8	65	65	100	100	100	100	100
		NT-L1 800 A	25	65	65	100	25	25	25	9	65	65	100	100	100	100	100
		NW-H 2000 A	25	65	65	100	25	25	25	65	65	65	100	100	100	100	100
		PJ	25	65	65	100	25	25	25	9	65	65	100	100	100	100	100
	125	LL	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17	4.17
		LLWU3400	25	30	30	30	4.17	25	25	4.17	30	30	30	30	30	30	30
		PL	25	65	65	100	25	25	25	9	65	65	100	100	100	125	100
	200	NT-L 800 A	25	65	65	100	25	25	25	9	65	65	100	100	100	125	100
		NT-LF 800 A	25	65	65	100	25	25	25	9	65	65	100	100	100	125	100
		NW-L 1600 A	25	65	65	100	25	25	25	65	65	65	100	100	100	125	200
		NW-LF 1600 A	25	65	65	100	25	25	25	65	65	65	100	100	100	125	200

Continued on next page

Tips and Tricks: ATS Withstand Ratings

Frame	Switch rating (Amps)		300, 4000 & 7000 Series							4000 & 7000 Series				7000 Series							
			Current Limiting Fuses				Specific Breaker			Time Based				Short Time Ratings[1] (sec)							
														480V Max.				600V Max.			
	Transfer Switches	Bypass Switches	480V Max.	600V Max.	Max. Size, A	Class	240V Max.	480V Max.	600V Max.	Time (sec)	240V Max.	480V Max.	600V Max.	.15	.2	.3	.5	1	.15	.3	.5
D	30	-	100kA	-	300	J															
			200kA	35kA	200	J	22kA	22kA	10kA	0.025	10kA	10kA	10kA	-				-			
			25kA	25kA	200	RK1															
D	70, 100	-	35kA	35kA	200	RK1															
			200kA	35kA	200	J	150kA	65kA	25kA	0.025	10kA	10kA	10kA	-				-			
D	100	-	35kA	35kA	200	RK1															
			200kA	35kA	200	J	150kA	65kA	25kA	0.025	10kA	10kA	10kA	-				-			
D	200	-	200kA	35kA	200	J															
			35kA	35kA	200	RK1	200kA	85kA	14kA	0.025	10kA	10kA	10kA	-				-			
D	230	-	100kA	-	300	J	200kA	85kA	14kA	0.025	10kA	10kA	-	-				-			
E	260, 400	-	200kA	-	600	J	65kA	42kA	22kA	0.05	35kA	35kA	22kA	-				-			
J	150, 200, 260	150, 200, 230, 260	200kA	200kA	600	J	200kA	200kA	42kA	0.05	65kA	42kA[1]	35kA	7.5kA		-		-			
					800	L															
J	400	400	200kA	200kA	600	J	65kA	50kA	42kA	0.05	65kA	42kA[1]	35kA	7.5kA		-		-			
					800	L															
J	600	600	200kA	200kA	800	L	65kA	65kA	42kA	0.05	65kA	42kA[1]	35kA	7.5kA[1]		-		-			
			200kA	200kA	600	J															
HF	600	600	200kA	200kA	1600	L	65kA	150kA	65kA	0.05	50kA	50kA	50kA	35kA		-		35kA		-	
F*	600	600	200kA	200kA	1600	L	65kA	150kA	65kA	0.05	50kA	50kA	50kA	35kA		35kA		35kA		-	
F*	800	800 - 1200	200kA	200kA	1600	L	65kA	150kA	65kA	0.05	50kA	50kA	50kA	35kA		35kA		35kA		-	
H	800 - 1200	800 - 1200	200kA	200kA	1600*	L	65kA	150kA	65kA	0.05	50kA	50kA	50kA	35kA		-		35kA		-	
Q*	600 - 1600	600 - 1600	200kA	200kA	2000	L	65kA	65kA	65kA	0.05	65kA	65kA	65kA	50kA				50kA			
S*	800 - 1200	800 - 1200	200kA	200kA	2500	L	100kA	100kA	65kA	0.05	100kA	100kA	65kA	65kA				65kA			
Q*	1000 - 1200	1000 - 1200	200kA	200kA	2000	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	-				-			
G	1600 - 2500 (Front Connected TS Only)		200kA	200kA	2500	L	85kA	85kA	85kA	0.05	85kA	85kA	85kA	42kA		35kA		-			
Q*	1600 - 2000	1600 - 2000	200kA	200kA	3000	L	200kA	200kA	100kA	0.05	100kA	100kA	100kA	42kA		35kA		42kA		-	
S*	1600 - 2000	1600 - 2000	200kA	200kA	2500	L	100kA	100kA	65kA	0.05	100kA	100kA	65kA	65kA		65kA		65kA		65kA	
G	2500 - 3000	2500 - 3000	200kA	200kA	4000	L	125kA*	125kA*	100kA	0.05	100kA	100kA	100kA	42kA		35kA		42kA		-	
Q*	3200	-	200kA	-	4000	L	100kA	100kA	-	0.05	100kA	100kA	-	-				-			
G	4000	4000	200kA	200kA	5000	L	100kA	100kA	100kA	0.05	100kA	100kA	100kA	85kA		65kA		65kA			
U*	2500 - 4000	2500 - 4000	200kA	200kA	5000	L	125kA	125kA	125kA	0.05	125kA	125kA	125kA	100kA				100kA			



Tips and Tricks: Generator Fault Conditions

Selected Model

Engine: C32	**Generator Frame:** 1402	**Genset Rating (kW):** 1000.0	**Line Voltage:** 480
Fuel: Diesel	**Generator Arrangement:** 4630140	**Genset Rating (kVA):** 1250.0	**Phase Voltage:** 277
Frequency: 60	**Excitation Type:** Permanent Magnet	**Pwr. Factor:** 0.8	**Rated Current:** 1503.5
Duty: STANDBY	**Connection:** SERIES STAR	**Application:** EPG	**Status:** Current

Version: 41205 /41596 /41926 /10615

Spec Information

Generator Specification

Frame: 1402 **Type:** SR5	**No. of Bearings:** 1
Winding Type: RANDOM WOUND	**Flywheel:** 18.0
Connection: SERIES STAR	**Housing:** 0
Phases: 3	**No. of Leads:** 6
Poles: 4	**Wires per Lead:** 4
Sync Speed: 1800	**Generator Pitch:** 0.6667

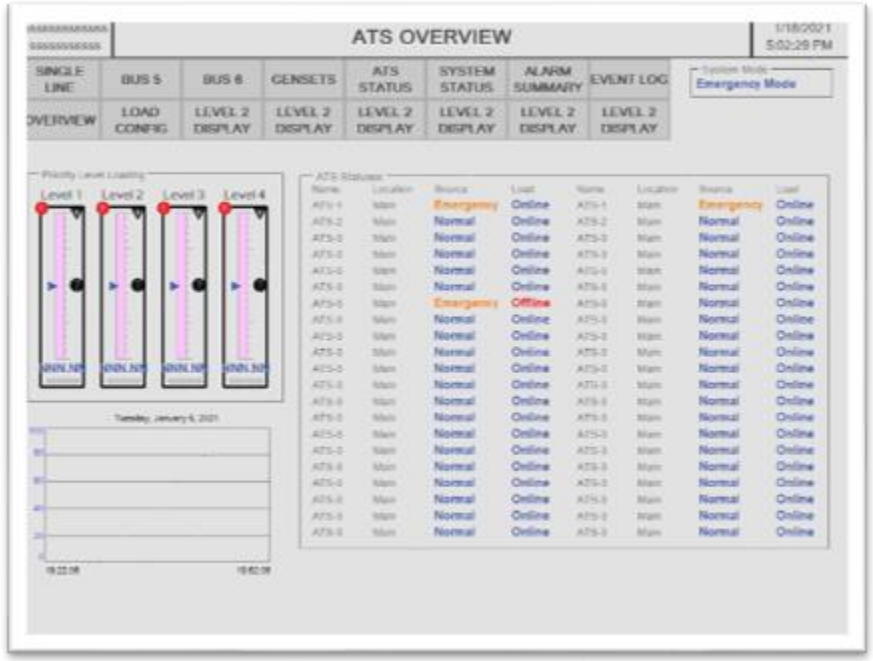
Generator Efficiency

Per Unit Load	kW	Efficiency %
0.25	250.0	92.2
0.5	500.0	94.6
0.75	750.0	94.9
1.0	1000.0	94.8

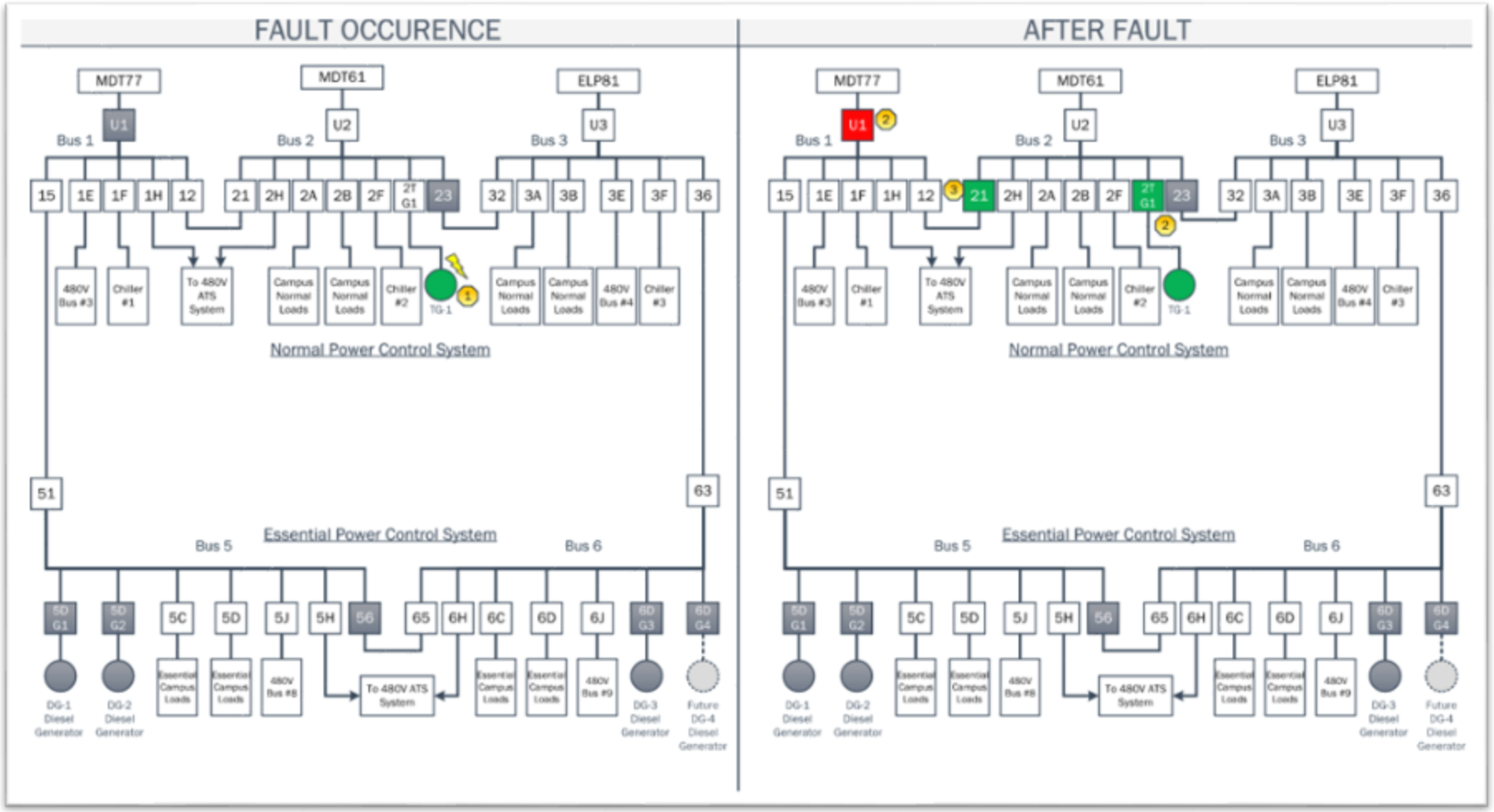
Reactances	Per Unit	Ohms
SUBTRANSIENT - DIRECT AXIS X''_d	0.1573	0.0290
SUBTRANSIENT - QUADRATURE AXIS X''_q	0.1861	0.0343
TRANSIENT - SATURATED X'_d	0.2799	0.0516
SYNCHRONOUS - DIRECT AXIS X_d	3.9453	0.7272
SYNCHRONOUS - QUADRATURE AXIS X_q	2.3698	0.4368
NEGATIVE SEQUENCE X_2	0.1725	0.0318
ZERO SEQUENCE X_0	0.0374	0.0069

Time Constants	Seconds
OPEN CIRCUIT TRANSIENT - DIRECT AXIS T'_{d0}	2.5090
SHORT CIRCUIT TRANSIENT - DIRECT AXIS T'_d	0.1800
OPEN CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_{d0}	0.0320
SHORT CIRCUIT SUBSTRANSIENT - DIRECT AXIS T''_d	0.0180
OPEN CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_{q0}	0.2290
SHORT CIRCUIT SUBSTRANSIENT - QUADRATURE AXIS T''_q	0.0180
EXCITER TIME CONSTANT T_e	0.0600
ARMATURE SHORT CIRCUIT T_a	0.0270

Short Circuit Ratio: 0.31	Stator Resistance = 0.0042 Ohms	Field Resistance = 0.39 Ohms



Tips and Tricks: Operating Scenarios



EARLY PROCUREMENT
AND
OCPD STUDIES

Early Procurement: Strategies

LEVEL	EQUIPMENT NAME	IPC NAME	BRANCH	VOLTAGE	TYPE							MAIN OCPD		AIC
					MV SWITCH	SWITCHGEAR	SWITCHBOARD	IPC	DIST PANEL	POWER PANEL	LIGHTING PANEL	MAIN BREAKER	MLO	
6	CP-6-DP-NH-Y1	CP-6-IPC-N-Y1	NORMAL	480/277V				X	X			400A		65KAIC
6	CP-6-DP-NL-Y1	CP-6-IPC-N-Y1	NORMAL	208/120V				X	X			400A		10KAIC
6	CP-6-NL-Y1		NORMAL	208/120V							X		100A	10KAIC
6	CP-6-NL-Y2		NORMAL	208/120V							X		100A	10KAIC
6	CP-6-NL-Y3		NORMAL	208/120V							X		100A	10KAIC
6	CP-6-NH-Y1		NORMAL	480/277V							X		100A	35KAIC
6	CP-6-DP-NH-Z1	CP-6-IPC-N-Z1	NORMAL	480/277V				X	X			400A		65KAIC
6	CP-6-DP-NL-Z1	CP-6-IPC-N-Z1	NORMAL	208/120V				X	X			400A		10KAIC
6	CP-6-NL-Z1		NORMAL	208/120V							X		100A	10KAIC
6	CP-6-NL-Z2		NORMAL	208/120V							X		100A	10KAIC
6	CP-6-NL-Z3		NORMAL	208/120V							X		100A	10KAIC
6	CP-6-NL-Z4		NORMAL	208/120V							X		100A	10KAIC

E900, E901, E902, E903 KEYNOTES

1. REFER TO RISER DIAGRAMS AND SPECIFICATIONS FOR ADDITIONAL DETAILS ON EQUIPMENT. SCHEDULE IS NOT ALL INCLUSIVE OF PRIMARY CONFIGURATION, XFMR, OCPDS, RATINGS, RELAYS, SHUNT TRIP, EQUIPMENT CONFIRGURATIONS, CONNECTIONS, OR CONTROLS.
2. SECONDARY OF MV TRANSFORMER TO BE SWITCHGEAR CONSTRUCTION AND EACH SECTION SHALL BE BARRIERED. ALL 480V OCPD FRAMES SHALL BE 1600A WITH ADJUSTABLE TRIP UNITS AS NOTED ON DRAWINGS. MAIN BREAKER SHALL BE AS INDICATED.
3. FURNISH SEPARATE BARRIERED SECTION FOR FIRE PUMP OCPD AND FURNISH SECTION FOR TIE SWITCH.
4. 1600A MCB WITH ADJUSTABLE TRIP. RATING INDICATED IN MAIN OCPD AND ON DRAWINGS.
5. OCPD TO BE COORDINATED WITH MECHANICAL EQUIPMENT LOADS.
6. PANEL DESIGNATED FOR TR ROOM LOADS. PROVIDE 200% RATED NEUTRAL.

DISTRIBUTION BREAKERS																													NOTES
1600A/3P	800A/3P	600A/3P	500A/3P	400A/3P	300A/3P	250A/3P	225A/3P	200A/3P	175A/3P	150A/3P	125A/3P	100A/3P	90A/3P	80A/3P	70A/3P	60A/3P	60A/2P	50A/3P	50A/2P	40A/3P	40A/2P	35A/3P	35A/2P	30A/3P	30A/2P	25A/3P	20A/3P	20A/2P	20A/1P	3P SPACES	
								1				2																		2	NOTE 9
												6																		2	NOTES 10, 12
																													84		
																													84		
																									12				18		NOTE 6
																													42		NOTE 12
								1				2																		2	NOTE 9
												6																		2	NOTES 10, 12
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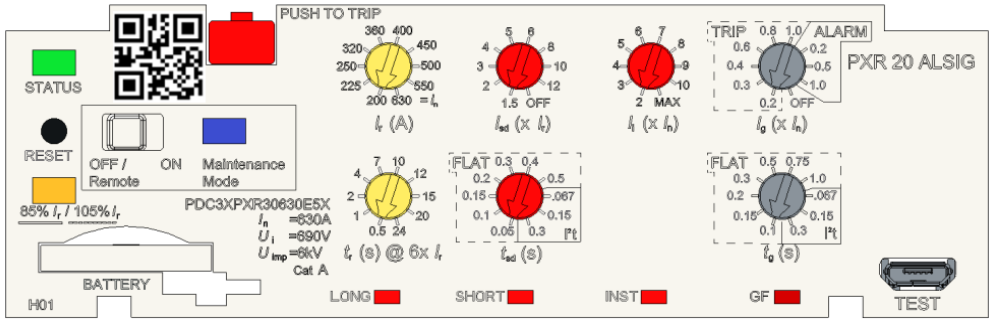
																													84		
																									12				18		NOTE 6
																													84		

Early Procurement: OCPD Selection Impact

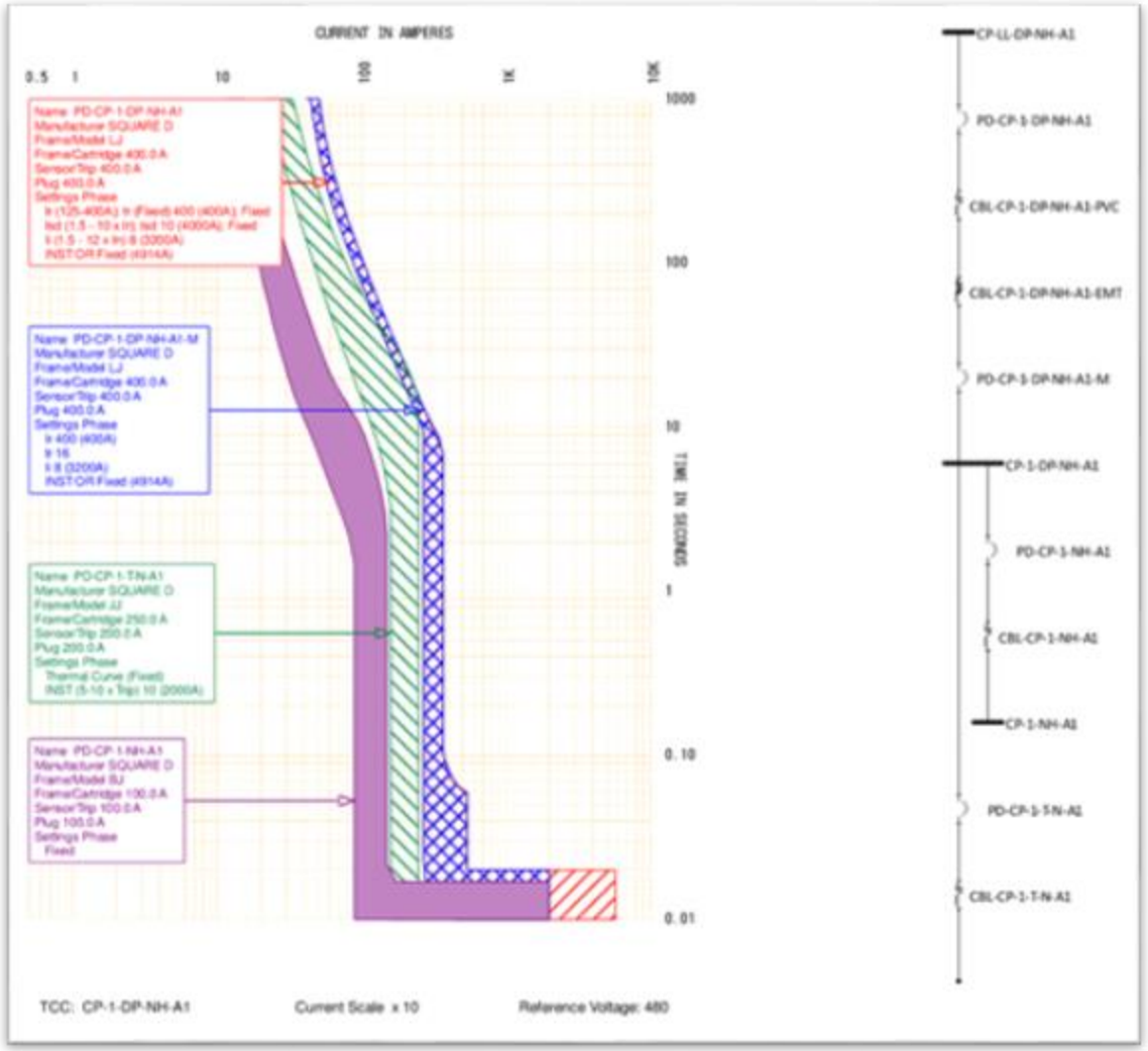


10.2.27 PDG4 PXR20 settings

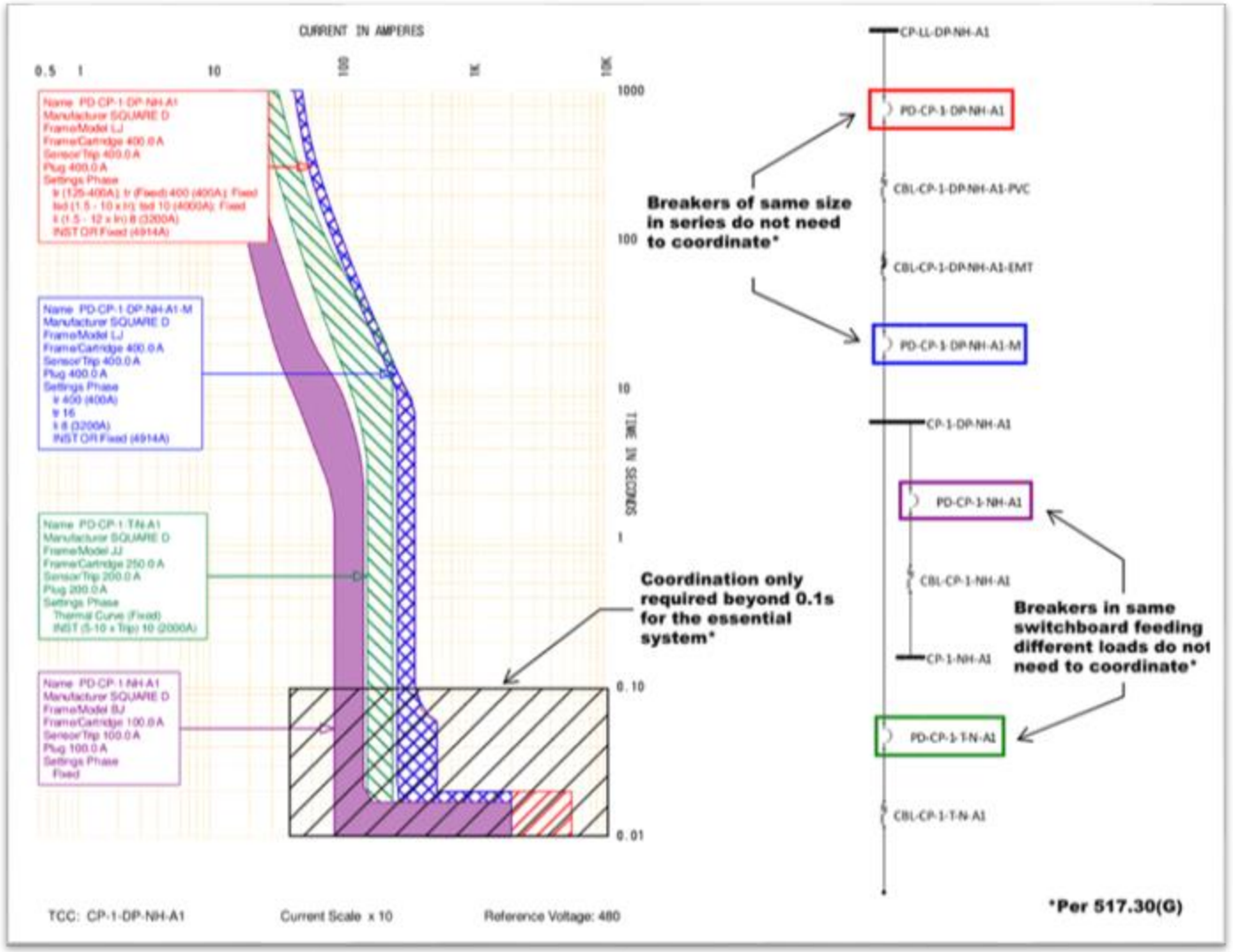
Frame	800 A	All	All		800 A	G styles	
Profile	Long delay		Short delay		Instantaneous	Ground	
Dial	Ir (A)	Tr(S)@6x Ir	Isd (x Ir)	tsd (s)	Ii (x In)	Ig (x In)	tg (s)
Setting	Pickup Ir (amps)	Time (s) at 6x (Ir)	Pickup (Isd) Isd =nx (Ir)	Time (tsd) tsd (s)	Pickup Ii = nx (In)	Pickup (Ig) Ig = nx (In)	Time (tg) tg (s)
A	320	0.5	1.5	0.050	2	0.2	0.100
B	350	1	2.0	0.100	3	0.3	0.150
C	400	2	2.5	0.150	4	0.4	0.200
D	450	4	3.0	0.200	5	0.6	0.300
E	500	7	4.0	0.300	6	0.8	0.500
F	550	10	5.0	0.400	6.5	1.0	0.750
G	600	12	6.0	0.500	7	0.2	1.000
H	630	15	7.0	0.067	7.5	0.5	0.067
J	700	20	8.0	0.150	8	1.0	0.150
K	800	24	OFF	0.300	8.5	OFF	0.300
				Flat	Instantaneous override	Trip	Flat
				I^2t	6800 A	Alarm	I^2t
				Pickup (Isd) and (Ii) limited by Max Instantaneous			

EXAMPLES WITH AUDIENCE PARTICIPATION

Can You Spot The Coordination Issue?



Can You Spot The Coordination Issue?



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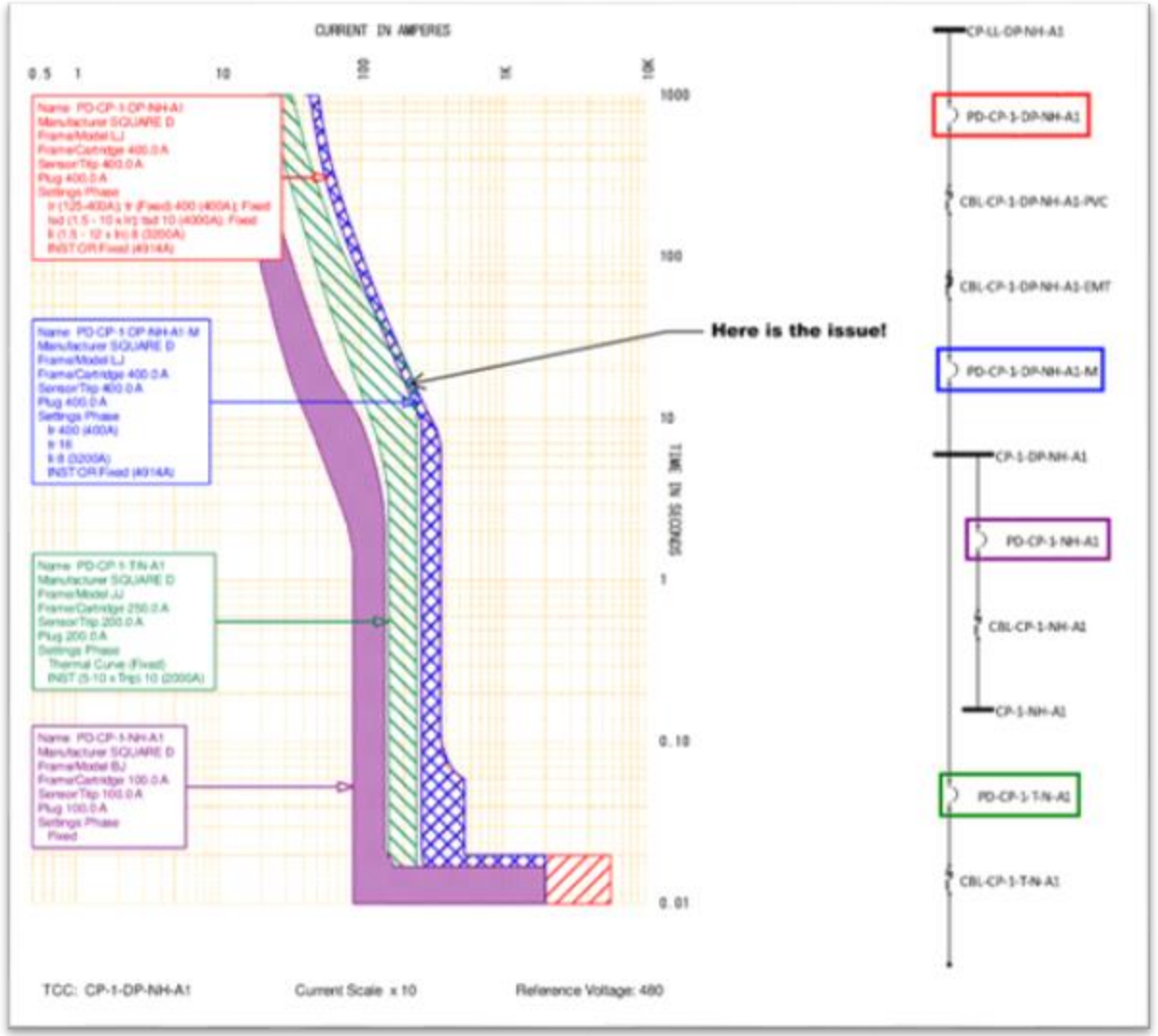

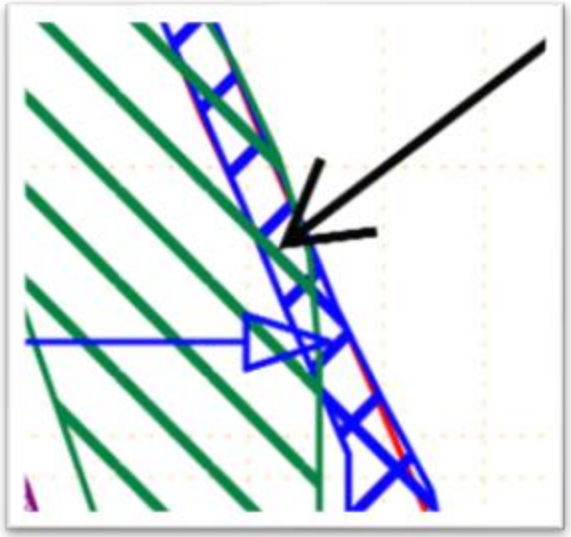

The Big Take Aways

- Preliminary Study is required
- Final Study should be completed to confirm BOD equipment with the installed conditions
- Early Procurement strategies help create minimal changes when design is complete
- Understanding tips and tricks make life a LOT easier
- OCPD studies are not only code required but a significant safety issue

Ensuring electrical safety is not just about following rules; it's about understanding the power and respecting its potential risks.

- Henry Ford

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