

Ways to Reduce Arc Flash Energy

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Arc Flash

- Produces
 - Excessive Noise
 - Pressure Wave
 - Extreme Heat
 - Toxic Gases, Vapors
 - Flying Molted Metal Particles

Arc Flash

- Produces Energy in the form of
 - Thermal
 - Radiation
 - Chemical
 - Mechanical
 - Electrical

Arc Flash Hazard Analysis – Key Steps

- Use NFPA 70E* Tables, IEEE 1584, or Lee Equations to Determine
 - Arc Flash hazard boundary
 - Incident energy levels @ a working distance
 - *Arc Flash PPE Category

*Use with Extreme Caution!!!!

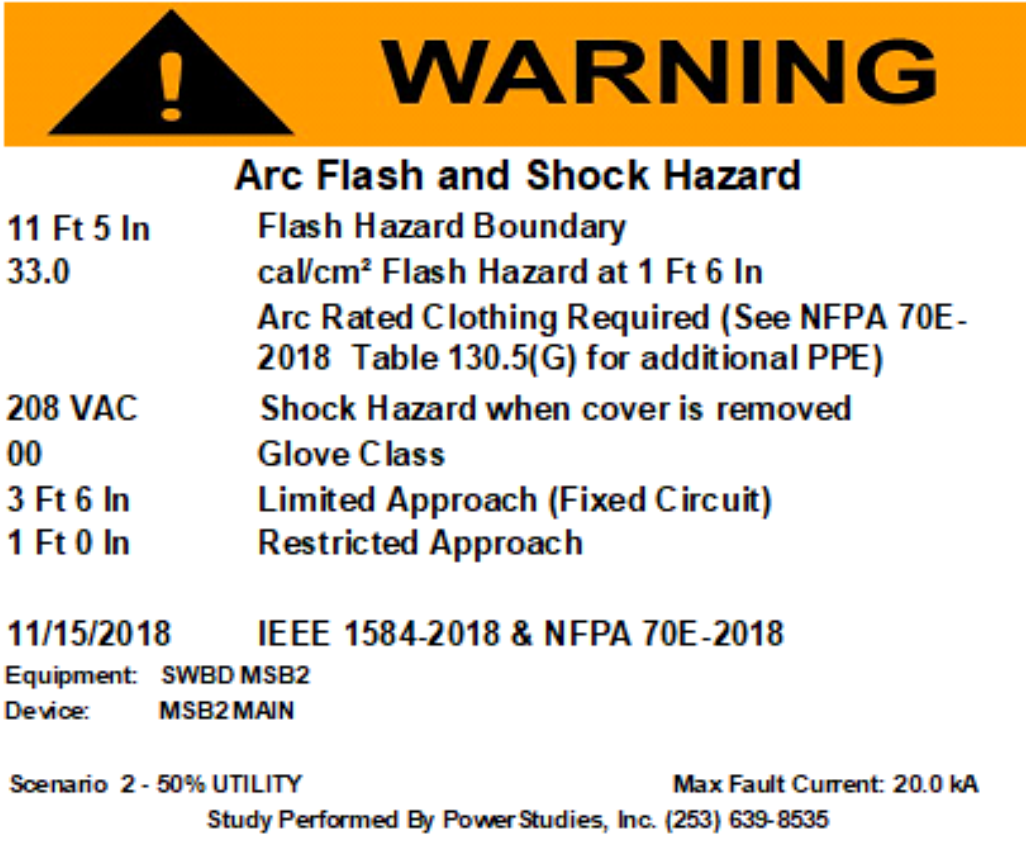
Arc Flash Hazard Analysis Key Steps

- NFPA 70E Tables 130.7(C)(15)(a)* or 130.5(G) to determine
 - *Arc Flash Hazard Category
 - Required PPE



Arc Flash Hazard Analysis Key Steps

- Create Arc Flash Warning Labels showing the details.



WARNING

Arc Flash and Shock Hazard

11 Ft 5 In	Flash Hazard Boundary
33.0	cal/cm ² Flash Hazard at 1 Ft 6 In
	Arc Rated Clothing Required (See NFPA 70E-2018 Table 130.5(G) for additional PPE)
208 VAC	Shock Hazard when cover is removed
00	Glove Class
3 Ft 6 In	Limited Approach (Fixed Circuit)
1 Ft 0 In	Restricted Approach

11/15/2018 IEEE 1584-2018 & NFPA 70E-2018

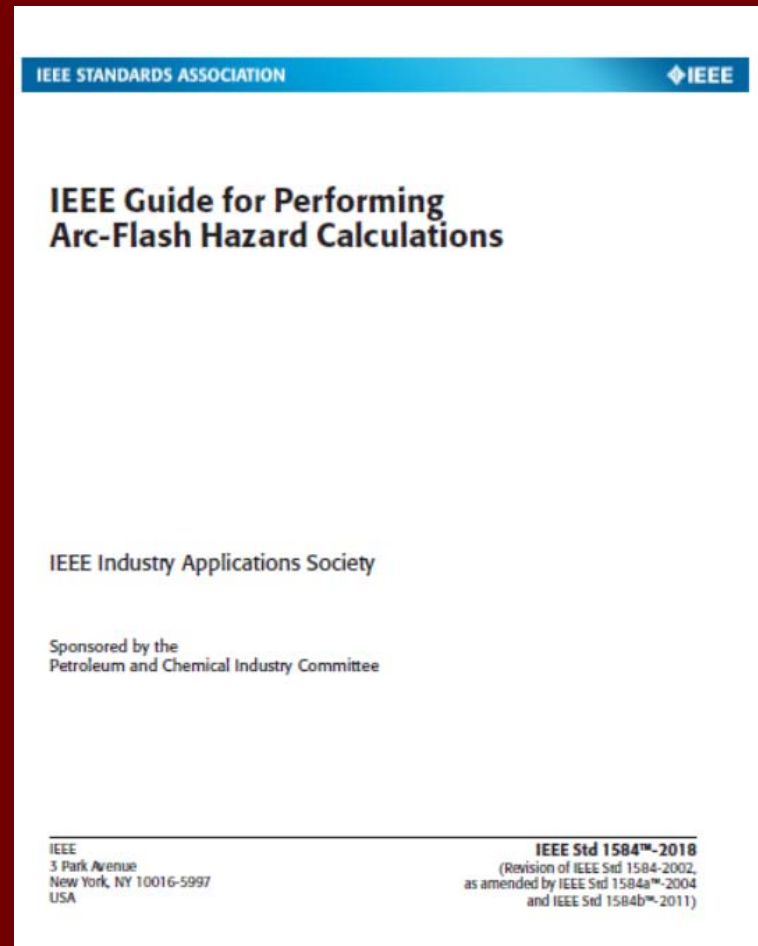
Equipment: SWBD MSB2
Device: MSB2MAIN

Scenario 2 - 50% UTILITY Max Fault Current: 20.0 kA
Study Performed By PowerStudies, Inc. (253) 639-8535

IEEE 1584-2018

Guide for Performing Arc-Flash Hazard Calculations

- Provides the steps and equations
- Arc Flash Energy Equations Require:
 - Equipment Bolted Fault Currents
 - Arcing Fault (AF) Current
 - Upstream Protective Device Clearing Times



Arc Flash Energy Level

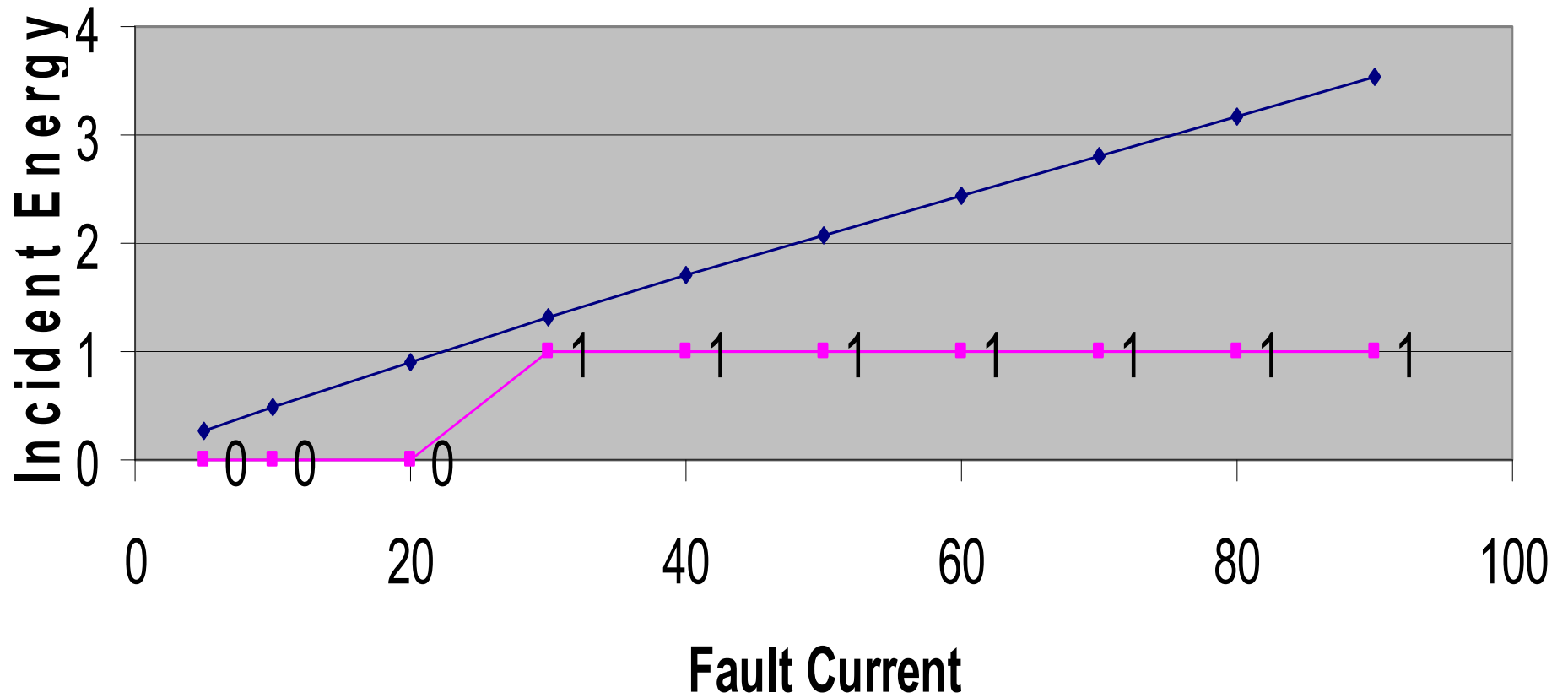
- Also Dependent Upon
 - Operating Voltage
 - Gap Length
 - Type of Grounding
 - Enclosure Type (Box or Open Air)
 - Enclosure Size
 - Electrode Configuration

Arc Flash Energy Level

- Greatest Effect on Calculations
 1. Time Upstream Device Operates
 2. Working Distance
 3. Available fault current

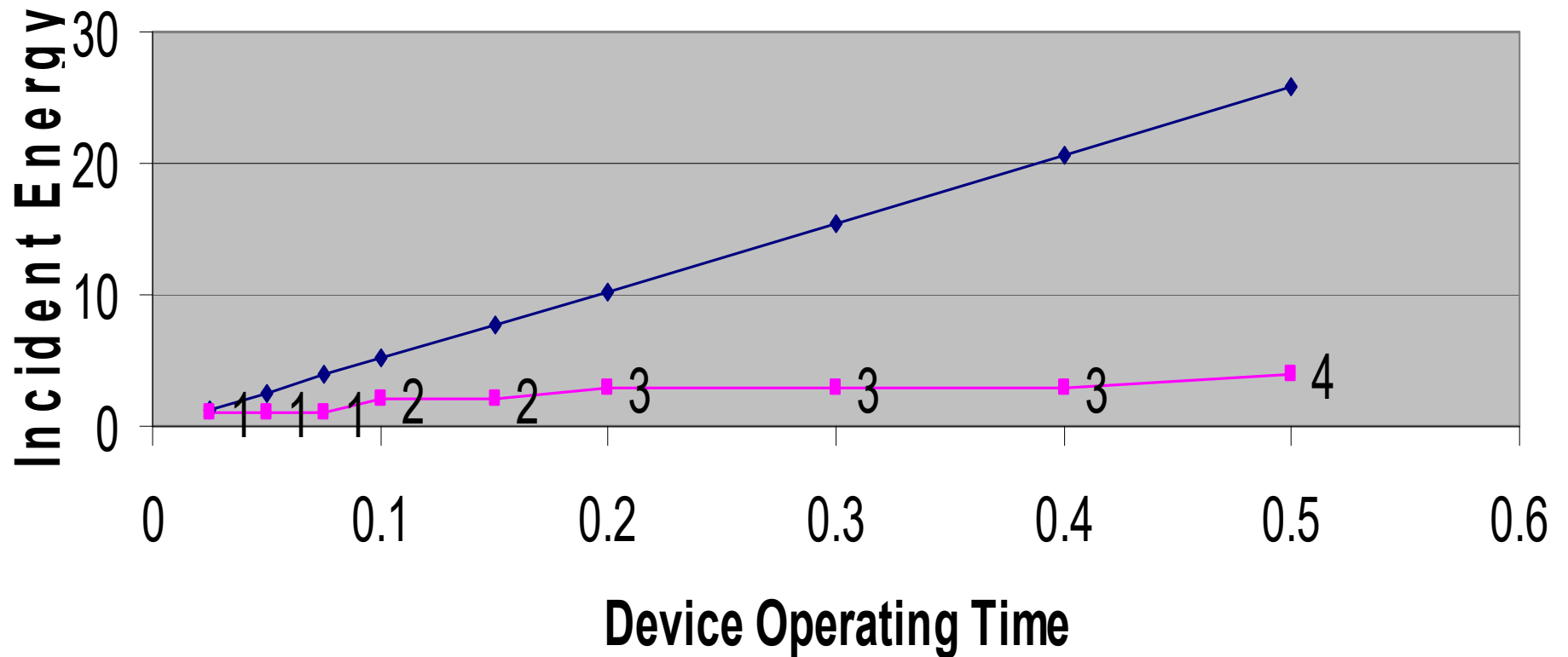
Fault Current vs. Incident Energy

(Time Constant @ 0.025 Sec)



◆ Energy ■ PPE Class

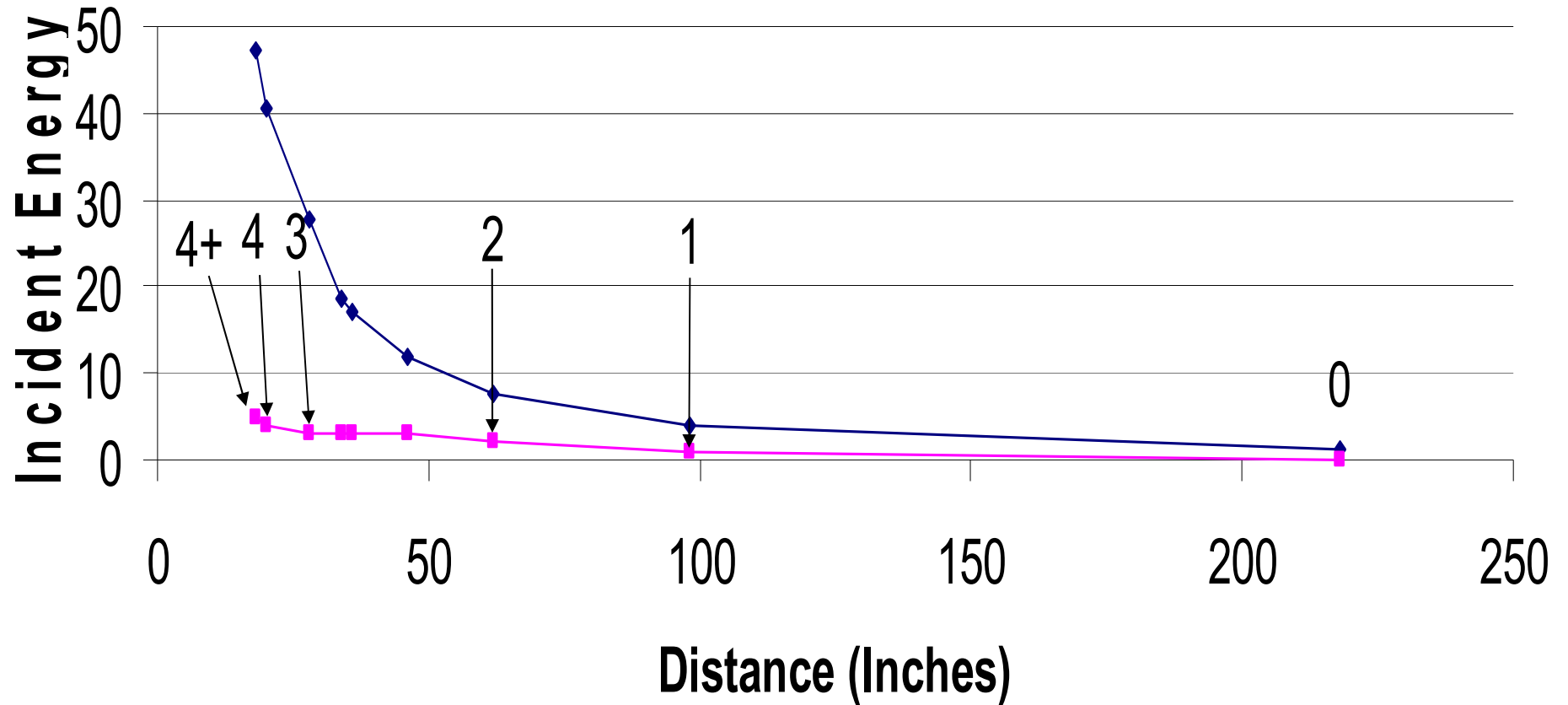
Time vs. Incident Energy (Fault Current Constant @ 30 kA)



—◆— Incident Energy —■— PPE Class

Distance vs. Incident Energy

(Time Constant @ 0.5 Sec & Fault = 60 kA)



◆ Energy ■ Class

Reduce Energy Level to Zero

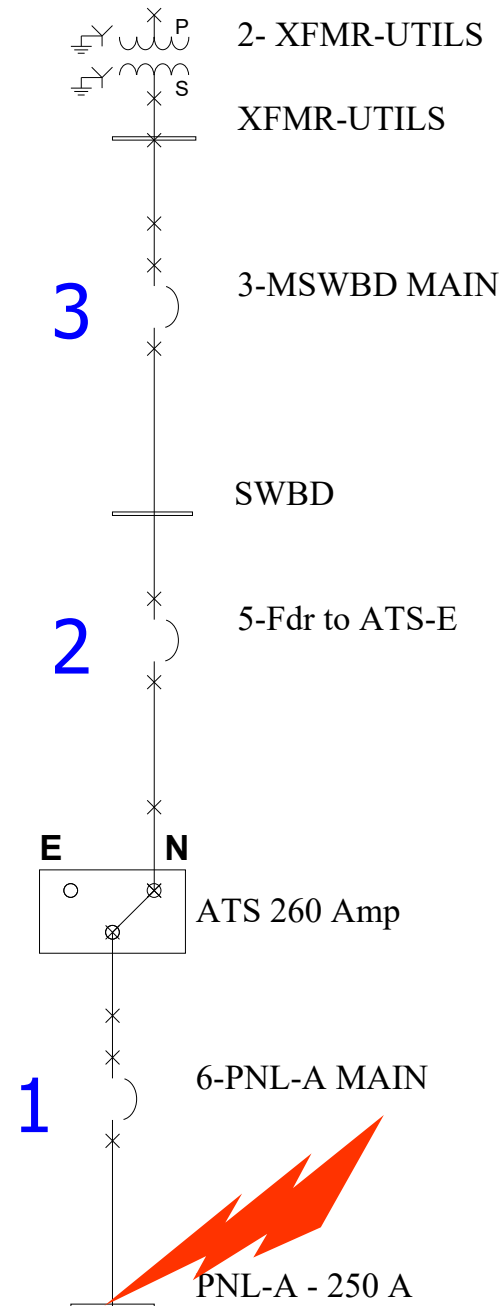
- De-energize the equipment!
- Put the equipment in an electrically safe work condition.

Next Best Solution

- Increase the Work Distances
- Lower the Fault Current
- Reduce Device Clearing (Trip) Times

Design, Modifications, Retrofits, & Work Procedures

- Reduce the fault current.
- Clear the arcing fault as quickly as possible without sacrificing coordination.



Reduce Fault Current

- Use Several Smaller Transformers / Substations vs. One Large One
- Current Limiting Reactors

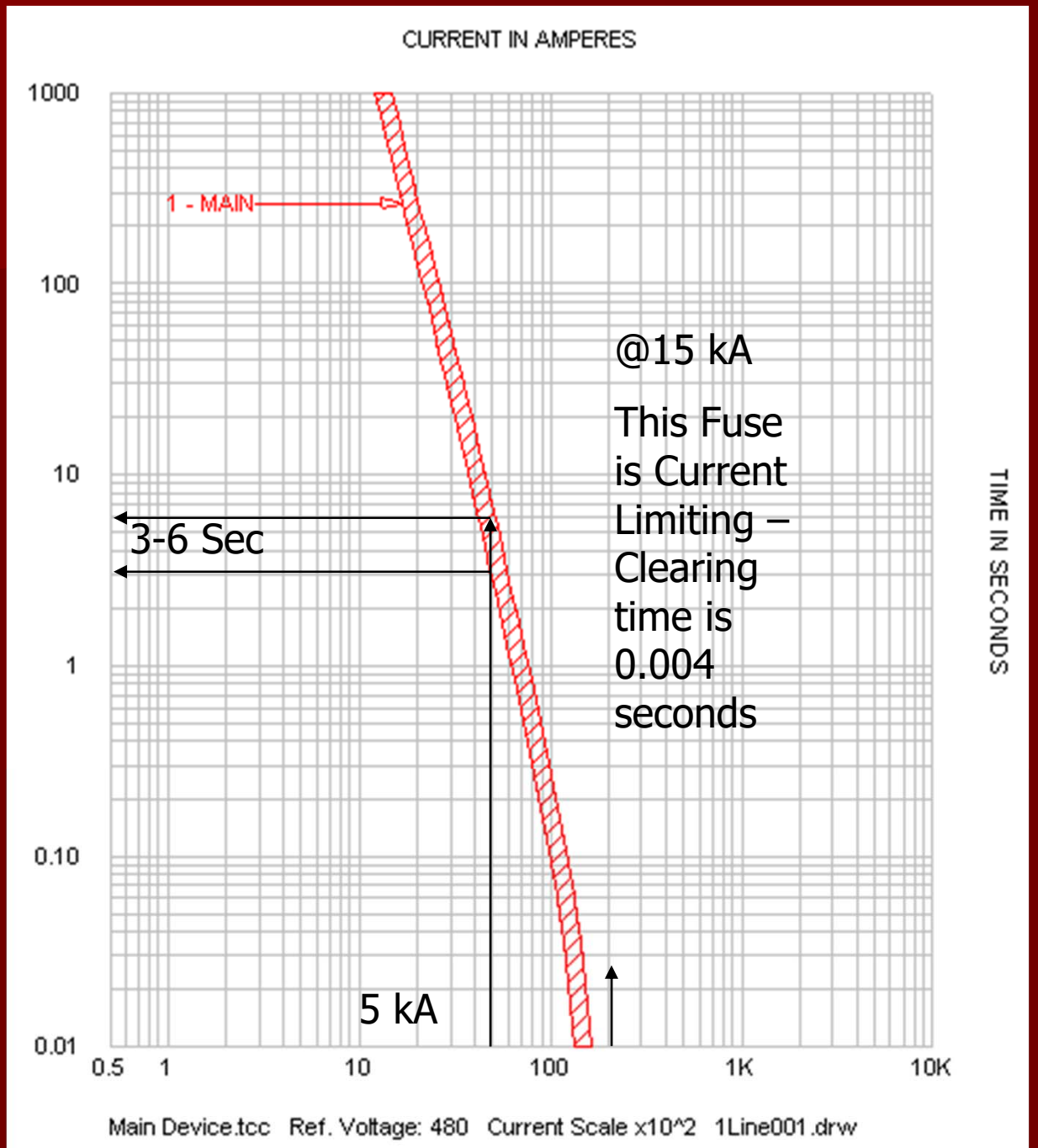
Fuses

- Operates Extremely Fast (If in current limiting range.)
- Reduces Current and Energy levels
- Change Fuse Types
 - Faster Clearing Curves
 - CL vs. Expulsion
 - Different types
- Reduce Fuse Ampere Size

Fuses

- Fused vs. Un-Fused Disconnect Switches

Fuse TCC



Circuit Breakers

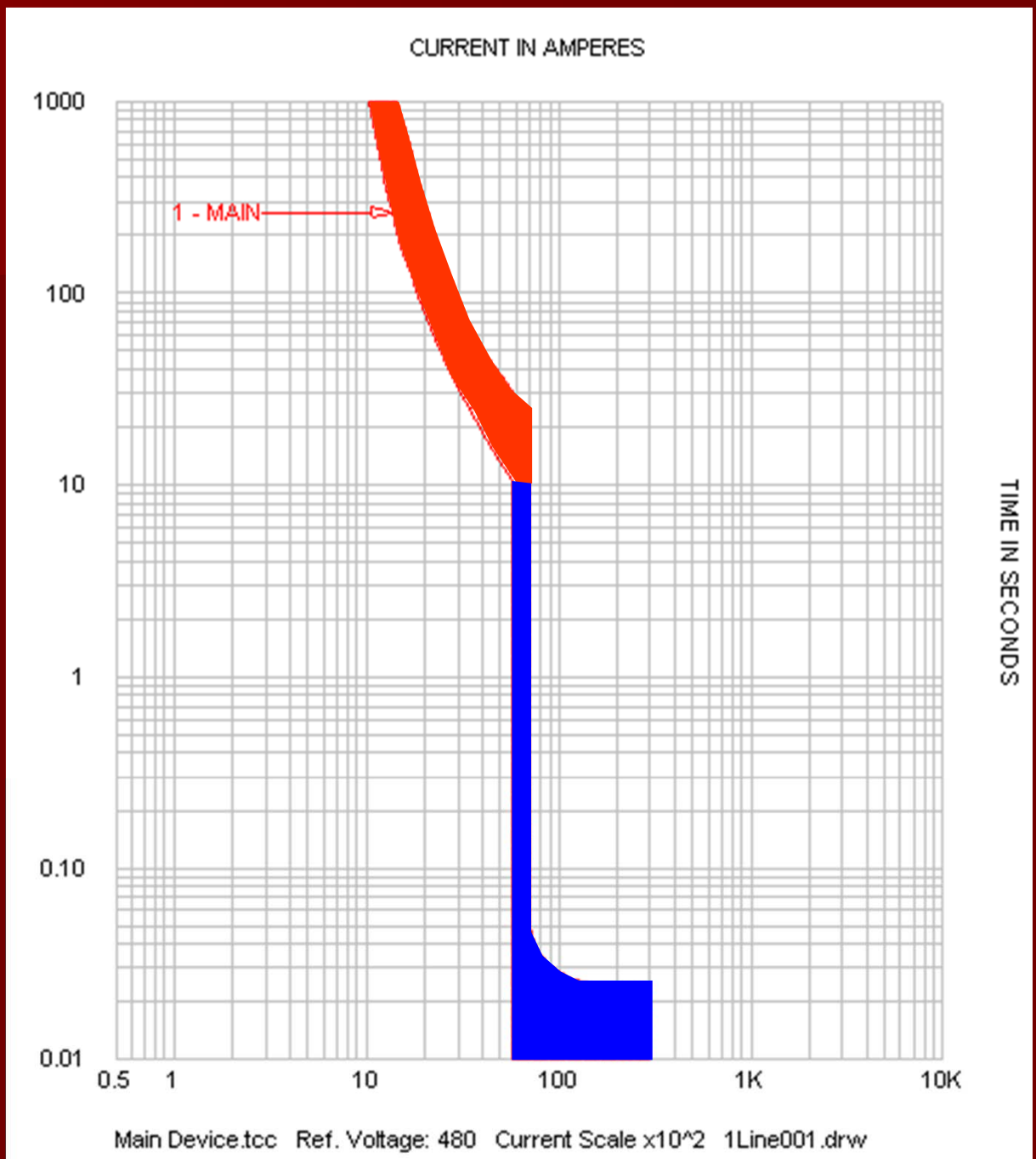
- Current Limiting Breakers
 - Reduces currents and energy levels

Circuit Breakers

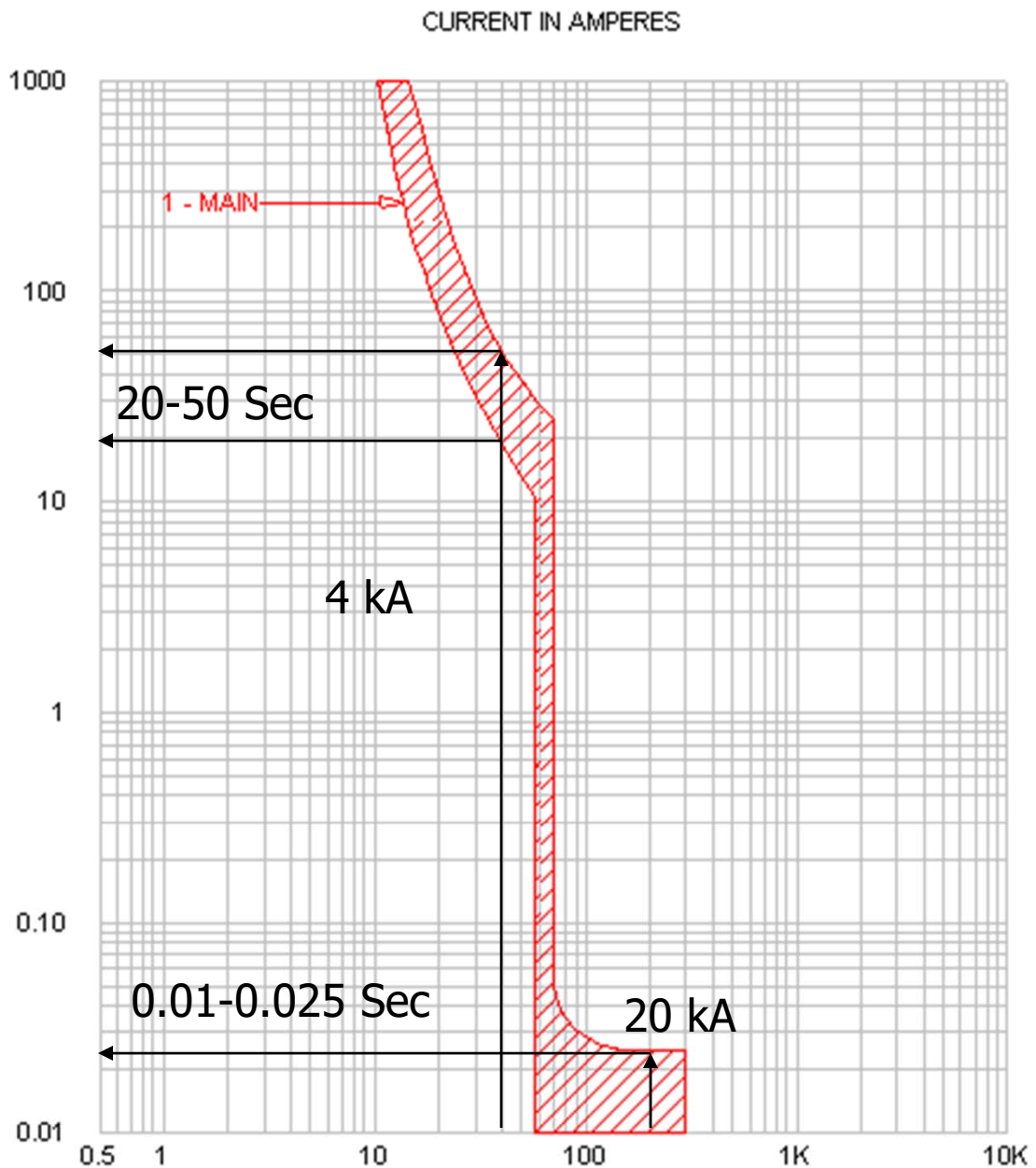
- Specify breakers with Solid State Trip Units
 - Long, Short & Instantaneous, Arc Flash Reduction Mode (If Possible)
 - Set Short Time PU & Delay as low as possible.

Thermal Magnetic Trip Unit

- Thermal Unit is Fixed
- Instantaneous
 - Fixed
 - Adjustable



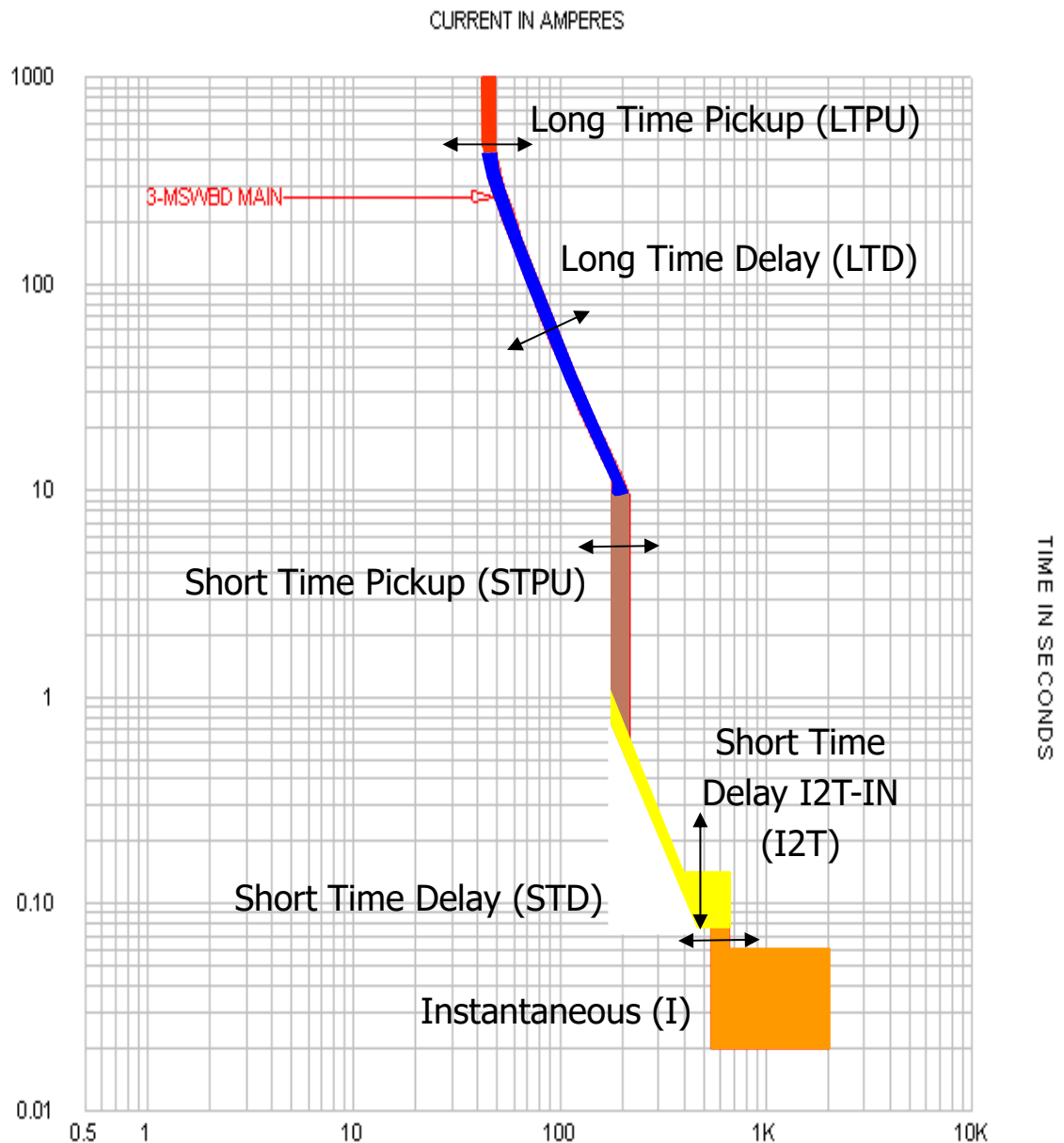
Thermal Magnetic Breaker



Main Device.tcc Ref. Voltage: 480 Current Scale x10² 1Line001.drw

Solid State Trip Unit

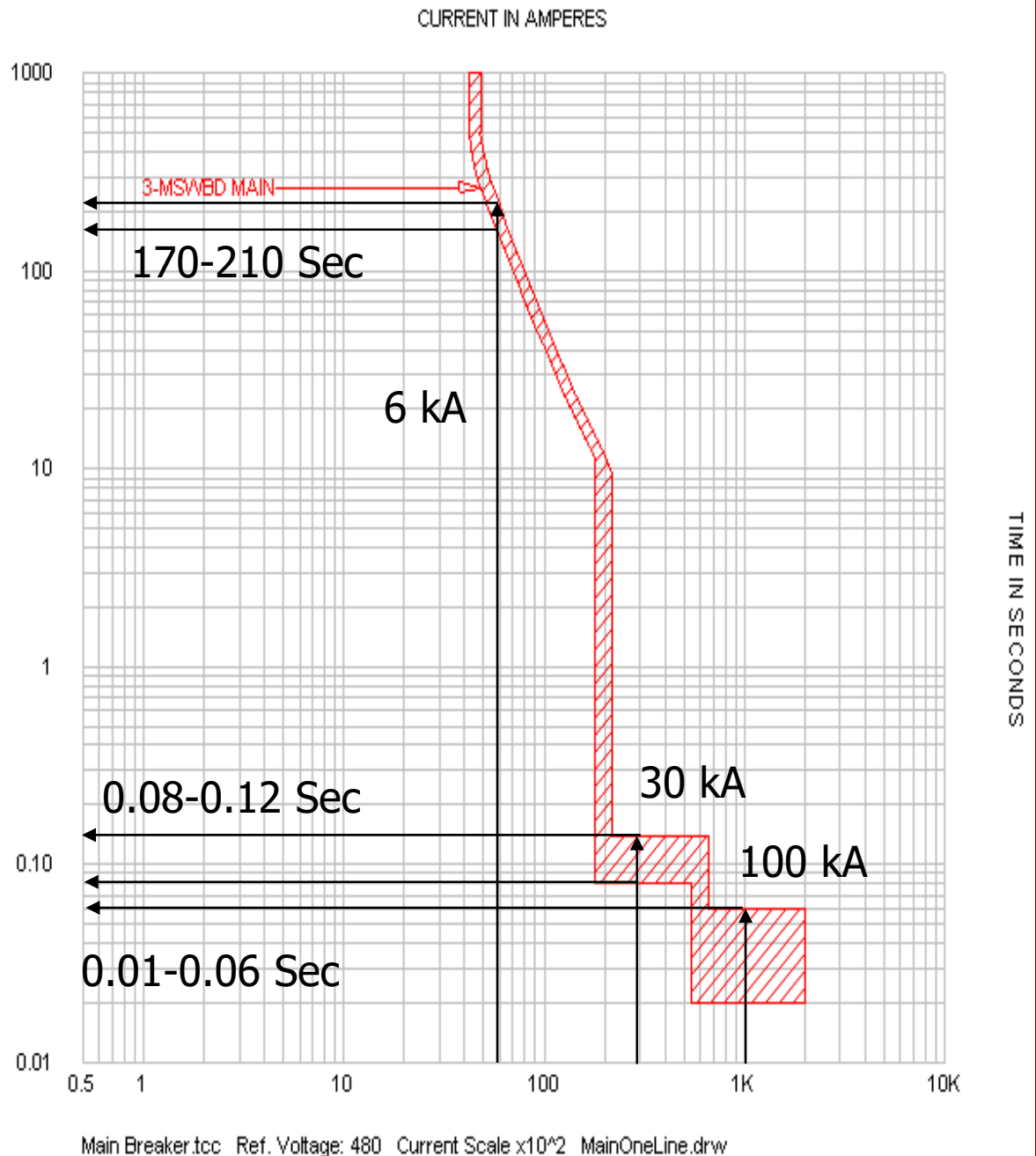
- Varies for each Trip Unit!
- Some Functions are Not Adjustable!



Main Breaker.tcc Ref. Voltage: 480 Current Scale x10² MainOneLine.drw

Solid State Trip

- SQ D NW 40H
- 4000 Amp
- Micrologic



Circuit Breakers

- Use Same Settings for:
 - Main and Bus Tie
 - Primary & Secondary Devices
- Use Zone Interlocking between Mains and Feeders.

Circuit Breakers & Switchgear

- Flash Sensing Relays
- Differential Protection
- Arc Flash Venting (Arc Resistant) Switchgear

Relays

- Change Relay Types and Curves
 - Solid State Programmable
 - Curve Shapes (Definite or Mod Inverse)
- Reduce MV Feeder Relay Pickup

Modification of Work Procedures

- Eliminate Paralleling of Transformers
- Eliminate work between Transformer Secondary and Main Breaker.
- Implement Faster Trip Times for Maintenance Work
 - Circuit Breakers
 - Arc Flash Reduction Mode Switches
 - Relays

Modification of Work Procedures

- Use Infrared Windows



Modification of Work Procedures

- Work at a Greater Distance
 - Remote Breaker Racking



Summary

- Reduce Arc Flash Energy by:
 - Increasing the Worker Distance
 - Reducing Fault Currents
 - Decreasing the Trip Times

Need more Information

- www.powerstudies.com
 - Articles
 - Links
 - Specifications for Power System Studies
 - Short Circuit
 - Protective Device Coordination
 - Arc Flash Hazard

Who are we?

- Electrical Engineering Consulting Firm
- We Specialize in performing Power System Studies
- 90% of our business is in performing Power System Studies

Where are we located?

- Our office is located in Maple Valley, WA.
- Near Seattle