

**Arc Flash Risk Assessment
With
Short-Circuit Analysis and Overcurrent
Protective Device Coordination Analysis
For
Jurupa Community Services District
Facility
Well #23, Bldg A, Bldg B & Modular
Jurupa, CA**

Update April 2, 2019

Accomplished By

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The feeder breaker to PNL HB was increased to 400A. This breaker was installed in an open spot in BLDG A MSB. This caused all of the breaker identification locations to change in BLDG A MSB. A new label for the equipment immediately downstream from BLDG A MSB. PNL LC was also added downstream from PNL HB. New or modified equipment with an incident energy above 4 cal/cm² has recommendations at the end of section 3.A.

Executive Summary

This report presents the results of short circuit calculations, protective device coordination, and arc flash incident energy calculations at the major electrical buses in the Jurupa Community Services District – Facility – Jurupa, CA facility. The scope of this report is to determine incident energy exposures at the equipment within the system, to verify that the interrupting ratings of the equipment in the distribution system are adequate for the available short circuit current, and to determine the settings for the protective devices to achieve optimum coordination. All calculations were done using the PTW software package supplied by SKM Systems Analysis, Inc. Version 8.0.3.4.

The study was conducted considering three operating scenarios:

- S0 – designates an incident energy that is higher when the system (Well #23) is operated at infinite bus
- S1 – designates an incident energy that is higher when the system (Well #23) is operated at 80% infinite bus
- S2 – designates an incident energy that is higher when the system is operating its' emergency equipment

For more information about the infinite bus calculation and how this may affect the results of this study, please refer to Section 2.A of this report.

One of the hazards found in this facility with an incident energy greater than 40 cal/cm² was found at the first panel or disconnect downstream from the utility transformer. The other was found directly downstream from a generator. Recommendations to reduce the arc flash incident energy exposure at these panels were not researched, due to the fact that this part of the system is either being protected by utility owned equipment or there is no upstream protective device to reduce the incident energy exposure.

Of the five hazards that can be reduce, two require replacing the existing protective device where the rest can be reduce by adjusting the settings of the existing protective device.

The following incident energy table provides a breakdown of the different incident energy exposure levels that are to be used when an incident energy analysis has been completed for the selection of appropriate PPE as outlined in the 2018 Edition of NFPA 70E Table 130.5(G). SEAM Group will review all hazards with an incident energy exposure greater than 4 cal/cm² and attempt to provide a recommendation to reduce these incident energies as shown in Section 3. The complete list of all the equipment calculated incident energies can be found in Section 7.

Summary of Incident Energy Exposure Levels

Incident Energy	Number of Busses	% of System
< 1.2 cal/cm ²	57	86%
1.2 to 12 cal/cm ²	1	<1%
12 to 40 cal/cm ²	7	12%
> 40 cal/cm ²	2	3%
Total:	67	100%

All protective devices in the facility appear to have adequate interrupting capacity as required in the National Electrical Code (NEC) Article 110.9 based on the base operating scenario, Scenario (S0).

Table of Contents

Section	Page
1. Introduction.....	6
2. Utility & Assumptions	8
3. Findings & Recommendations	10
4. Input Data.....	18
5. Summary of Calculated Fault Currents.....	25
6. Coordination Curves and Device Settings	31
7. Incident Energy Summary and Calculations Methods.....	57
8. Single-Line Drawings	66
9. Appendix.....	67
10. Professional Services Contract.....	76

1. Introduction

This report presents the results of short circuit calculations, protective device coordination, and arc flash incident energy exposure calculations at the major electrical buses in the Jurupa Community Services District – Facility – Jurupa, CA facility. The scope of this report is to determine incident energy exposures at the equipment within the system, to verify that the interrupting ratings of the equipment in the distribution system are adequate for the available short circuit current, and to determine the settings for the protective devices to achieve optimum coordination. All calculations were done using the PTW software package supplied by SKM Systems Analysis, Inc. Version 8.0.3.4.

Section 2 of this report outlines the information used to generate the results of this report. This section will outline any assumptions that had to be made about the utility data provided or of any of the devices used within the incident energy analysis. Sometimes the specific settings for the devices cannot be determined in the field due to location, worn labels, or because of a digital interface. In these instances, SEAM Group will assume settings for the purposes of the report and then direct the customer to verify the settings for these particular devices. This section will also outline any equipment which we were unable to collect data along with a brief description explaining the reason the data was not collected.

Section 3 of this report presents findings describing dangerous or disruptive conditions within the facility. Arc flash incident energy levels are calculated using the algorithms specified by IEEE Standard 1584. The calculated arc flash incident energies above 4 cal/cm² are reported. Recommendations for correcting the findings reported are then presented for each hazard found within the system. The largest overcurrent protective devices are analyzed for system coordination, and any undesirable conditions are reported along with recommendations for correcting the situation. Each overcurrent protective device included in the facility model is evaluated for adequate short circuit interrupting capability. Devices having insufficient interrupting capability are a safety hazard and are reported. All recommendations presume the protective devices have been well and properly maintained to operate in accordance with the manufacturer's specifications.

Section 4 contains tabulated input data for the utility, generators, transformers, motors, and conductors. This information represents the data collected and utilized for the calculated results found within this report.

Section 5 presents a summary of the calculated fault currents at every major bus modeled in the computer program. The three-phase to ground and single-phase to ground currents are reported. These two currents typically bracket the other possible fault currents and represent the worst-case scenario, and thus are sufficient for the analyses done for this report.

Section 6 presents the time-current coordination curves for the largest overcurrent protective devices, and the tabulated settings for those devices. The curves present a graphical representation of the device characteristics. The relative positions between and/or

among the protective devices indicate the coordination. Coordination implies the protective device closest to the fault reacts first to isolate the faulted part of the system from the remainder of the system. Following the time-current coordination curves will be the protective device types and settings as found during the on-site data collection process.

Section 7 presents the calculated incident energy exposure levels and appropriate PPE protection to wear. Calculated NFPA 70E 2018 protection levels are also described in this section. Labels indicating the incident energy exposure and arc flash approach boundary are provided with this report in Section 7.

Section 8 presents the single-line drawings of the plant electrical distribution system. These drawings provide the graphical user interface to the computer program as well as a record of the system topology. The calculated available fault currents for major buses, cable data, transformer data, and overcurrent protective device data are shown on the drawings included in this report. The same data is also shown on larger drawings that are included on the accompanying USB drive.

The Appendix presents the supplementary information provided by the owner. This information will include the utility data as provided by the utility for the facility and any supplementary information provided by the Customer for information requested by SEAM Group at the time of data collection or during the preparation of the report.

The report is also provided with a USB drive that will include PDF versions of the report and single line drawings of the system. In addition, the USB drive will include .dxf version of the drawings shown in the PDF and an Excel file containing an arc flash PPE table for the Customer's use.

2. Utility, Assumptions & Comments

- A. The utility data for this report was provided by the utility Southern California Edison. A copy of this information can be seen in the Appendix.

The utility company did not provide neither the primary fault nor secondary fault information for Well #23. However, SEAM Group had an adequate amount of information for this site to be analyzed based on the infinite bus model. This information is the maximum amount of fault current that would be available at the facility. While this will provide worst case results for the equipment interrupting ratings, it is not the ideal value needed for the incident energy analysis. The infinite bus model produces higher fault currents within the system in comparison to fault currents that may be experienced during an actual faulting event. This higher fault current can result in a lower incident energy rating than what may have been calculated with the actual values. To provide a more accurate representation of the actual arc fault levels within the system SEAM Group will analyze the system at the infinite bus 100% fault current level, fault current level of 80% of the infinite bus, fault current produced by the on-site generator, and take the worst-case situation for the purposes of this report. In the PPE table and in Section 3, (S0) designates an incident energy that is higher during 100% infinite bus calculation, (S1) designates an incident energy that is higher during 80% infinite bus calculation, and (S2) designates an incident energy that is higher during the on-site generator(s) calculation. The worst- case scenario is used in the tables and for recommendations.

This utility data is current as of the writing of this report. Any future changes within the utility system could affect the incident energy exposure results presented herein. These changes can be done by the utility at any time and often are done without any knowledge to the owner unless the change directly affects the customer's facility. Since these types of changes cannot be foreseen or predicted SEAM Group is not responsible for any incident energy exposure ratings affected by utility system changes. This utility information along with the data collected onsite has been used to construct a model of the facility for the incident energy analysis. In addition, the 2018 Edition of NFPA70E, 130.5(G) states that:

“The incident energy analysis shall be updated when changes occur in the electrical distribution system that could affect the results of the analysis. The incident energy analysis shall also be reviewed for accuracy at intervals not to exceed 5 years.”

- B. The information (make, model, or settings) for the following protective devices could not be determined during the field investigation. This is most likely due to the equipment being inaccessible, worn labels, no labels, or simply because there is no longer information available due to the age of the equipment:
- i. MCC RELAY (Drawing #2) – Unable to determine the settings during the on-site collection. As a result, SEAM Group excluded this overload relay from the study to provide conservative results.
- C. In some cases, a portion of the information may not have been available for the following equipment. In these instances, estimates were made based on engineering judgment and a knowledge of “typical” values:
- i. PNL HA to PNL HA CONTACTOR CP (Drawing #3) – Assumed a cable size of #12 to match the ampacity of the upstream 20 ampere protective device in order to provide conservative results for PNL HA CONTACTOR CP.
- D. The following equipment contained multiple fuse models for one equipment load. SEAM Group assumed one model of fuse for each load as the software does not allow modeling of separate fuse models per phase. It is important to note that with multiple fuse models the arc flash findings found herein may not be accurate as each arc flash level was determined by analyzing with one fuse model for the given load. Customer should replace the odd fuse with the one assumed below to ensure the accuracy of the labels provided for the equipment.

<u>Fused Disconnect</u>	<u>Fuses in Disconnect</u>	<u>Fuses Used</u>
CU EAST #1 DSC	FLSR30ID, FLSR20ID, FRSR15	FLSR30ID
CU EAST #9 DSC	1-TRS20, 1-FLSR15ID	TRS20
CU WEST #12 DSC	1-TRS20, 1-FLSR20ID	FLSR20ID

- E. The ATS in the electrical systems listed below were analyzed during Emergency Operation only. The normal feed serviced from Panel HA ID 15 has been disconnected. If the normal feed is reconnected, the incident energy in this report may not be accurate since the available fault current from Panel EHA would be different from that of Panel HA. Since there will be a difference in calculated fault current, this will affect the Trip Time of the upstream protective device resulting in different calculated incident energies.
- i. 2ND FLR ATS (Drawing #3)

3. Findings & Recommendations

WARNING

The PPE requirements when working on the line side of main disconnects, bus work and cabling between main transformers and main disconnects, and the connections within main transformers are not affected by the recommendations made in this report unless specifically indicated otherwise. That part of the system is protected by devices on the primary side of the transformers that are normally owned and set by the utility. The primary or line side of these devices will often be considered “Dangerous”, unless otherwise noted. In the arc flash table, the primary side of main circuit breakers, if present, will have “(LineSide)” designated in the bus name. Note that this exact name with the “(LineSide)” designation will not appear in the single line drawings; only the bus name will be displayed.

This section outlines the equipment within the system that has an incident energy exposure of greater than 4 cal/cm². Immediately following is a recommendation to lower the incident energy exposure of the equipment if one exists. These recommendations will not negatively affect the coordination unless otherwise noted. SEAM Group will attempt to lower the incident energy values by adjusting breaker settings whenever possible; however, adjusting the breaker settings is not always an option. In some cases, SEAM Group will recommend a faster acting fuse to replace the current model of fuse being used. The customer should verify with the equipment manufacturer that the particular fuse recommendation is compatible with the equipment within which it is to be installed. It is also important to use the exact manufacturer and model of fuse as a similar fuse from another manufacturer may not have the same curve characteristics as the one indicated in the recommendation and could result in different incident energy values than those outlined in this report.

In other cases, only a different characteristic curve type (different circuit breaker model) will change the incident energy value. This may require a breaker with a faster acting instantaneous trip or replacing the breaker with discrete LI or LSI functions. In these instances, SEAM Group will try to select a breaker from the same manufacturer as the other breakers in the equipment to illustrate that the incident energy value can be reduced with a breaker that has similar characteristics and settings to the one shown. Due to the vast number of equipment types, manufacturers, and model numbers SEAM Group cannot guarantee that the particular breaker chosen will be compatible with the equipment. The customer should note that the actual level that can be achieved in the customer’s equipment will be dependent on what manufacturer and model of breaker(s) are compatible with that equipment and may not necessarily achieve a level as low as what was shown in the report example. ***It is the customer’s responsibility to consult their local equipment representative to determine what breakers are compatible with each piece of equipment.***

LSI, LS, and LI refers to electronic trip circuit breakers with the following functions:
L-Functions {Long Time Pickup – LTPU (Ir), Long Time Delay - LTD (tr)}
S-Functions {Short Time Pick Up – STPU (Isd), Short Time Delay – STD (tsd)}
I-Functions {Instantaneous – INST (Ii)}

A. Arc Flash Recommendations

1. **Bus WELL #23 MSB, fed from UTILITY 1 XFMR on Drawing #1, has an incident energy exposure of 54.55 cal/cm2. (S0)**

SEAM Group is unable to provide a recommendation to reduce the incident energy exposure at bus WELL #23 MSB. It is the first bus downstream from the utility transformer, and it is assumed there is no upstream protective device to reduce the hazard. SEAM Group does not recommend energized work to be performed on equipment with an incident energy exposure greater than or equal to 40 cal/cm2.

2. **Bus GEN DSC, fed from GEN on Drawing #1, has an incident energy exposure of 42.63 cal/cm2. (S2)**

SEAM Group is unable to provide a recommendation to reduce the incident energy exposure at bus GEN DSC. It is the first bus downstream from a generator. SEAM Group does not recommend energized work to be performed on equipment with an incident energy exposure greater than or equal to 40 cal/cm2.

3. **Bus BLDG-A MSB MN DSC, fed from UTILITY 2 XFMR on Drawing #1, has an incident energy exposure of 36.78 cal/cm2. (S0)**

SEAM Group is unable to provide a recommendation to reduce the incident energy exposure at bus BLDG-A MSB MN DSC. It is the first bus downstream from the utility transformer, and it is assumed there is no upstream protective device to reduce the hazard. It has an incident energy exposure of 36.78 cal/cm2, and appropriate PPE must be worn when working on energized equipment.

4. **Bus BLDG-A ATS, fed from BLDG-A MSB MN DSC on Drawing #1, has an incident energy exposure of 36.55 cal/cm². (S0)**

Replace fuses BLDG-A MSB MN DSC FS with faster acting fuses. SEAM Group tried 800A, BUSSMANN, KTU fuses. This change will reduce the incident energy exposure at bus BLDG-A ATS from 36.55 cal/cm² to 32 cal/cm². Appropriate PPE must be worn when working on energized equipment.

To further reduce the incident energy exposure at bus BLDG-A ATS, reset the instantaneous setting of circuit breaker BLDG-A EM DSC CB to "4" (3,200 amperes). This change will reduce the incident energy exposure at bus BLDG-A ATS from 32 cal/cm² to 9 cal/cm². These changes will also improve coordination with upstream protective device GEN DSC CB. Please note, implementing the alternative recommendation in A.5 for protective device BLDG-A MSB MN DSC FS, will further reduce the incident energy exposure at bus BLDG-A ATS to 2 cal/cm². *It is the customer's responsibility to consult their local equipment representative to determine what protective devices are compatible with each piece of equipment; see paragraph 3.A above.*

5. **Bus BLDG-A MSB, fed from BLDG-A ATS on Drawing #1, has an incident energy exposure of 28.6 cal/cm². (S0)**

Implement recommendation A.4 for both protective devices BLDG-A MSB MN DSC FS and BLDG-A EM DSC CB. These changes will reduce the incident energy exposure at bus BLDG-A MSB from 28.6 cal/cm² to 24 cal/cm². Appropriate PPE must be worn when working on energized equipment.

Alternatively, replace fuses BLDG-A MSB MN DSC FS with an electronic trip breaker having an LSI tripping unit. SEAM Group tried an 800A, CUTLER-HAMMER, CHMDL electronic trip breaker with the following settings: LTPU "FIXED", LTD "FIXED", STPU "4", STD "FIXED", i2t "Out", and an instantaneous trip of "FIXED" (6,800 amperes). This change will reduce the incident energy exposure at bus BLDG-A MSB from 28.6 cal/cm² to 2 cal/cm². *It is the customer's responsibility to consult their local equipment representative to determine what protective devices are compatible with each piece of equipment; see paragraph 3.A above.*

6. **Bus BLDG-A EM DSC, fed from GEN DSC on Drawing #1, has an incident energy exposure of 26.66 cal/cm2. (S2)**

Reset the tripping unit of circuit breaker GEN DSC CB to the following settings: LTPU "1", LTD "20", STPU "2.5", STD "0.1", i^2t "Out", and an instantaneous trip of "10" (16,000 amperes). This change will also improve coordination with downstream protective devices MCC CB 3 and BLDG-A EM DSC CB. This change will reduce the incident energy exposure at bus BLDG-A EM DSC from 26.66 cal/cm2 to 4 cal/cm2. Appropriate PPE must be worn when working on energized equipment.

7. **Bus MCC, fed from ATS on Drawing #1, has an incident energy exposure of 26.57 cal/cm2. (S2)**

Implement recommendation A.6 for protective device GEN DSC CB. This change will reduce the incident energy exposure at bus MCC from 26.57 cal/cm2 to 4 cal/cm2. Appropriate PPE must be worn when working on energized equipment.

8. **Bus ATS, fed from WELL #23 MSB on Drawing #1, has an incident energy exposure of 26.46 cal/cm2. (S2)**

Implement recommendation A.6 for protective device GEN DSC CB. This change will reduce the incident energy exposure at bus ATS from 26.46 cal/cm2 to 4 cal/cm2. Appropriate PPE must be worn when working on energized equipment.

Recommendations from April 2, 2019 update

1. **Bus PNL HB (PNL HB MN CB LineSide), fed from BLDG-A MSB on DRAWING #3, has an incident energy exposure of 24.42 cal/cm².**

Reset the instantaneous setting of circuit breaker BLDG-A MSB CB 1 to "7" (2,800 amperes). To maintain coordination after this change, reset the INST setting of PNL HB MN CB to "5" (2,000A). This change will reduce the incident energy exposure at bus PNL HB (PNL HB MN CB LineSide) from 24.42 cal/cm² to < 1.2 cal/cm². Appropriate PPE must be worn when working on energized equipment.

2. **Bus PNL LC (PNL LC MN CB LineSide), fed from PNL HB on DRAWING #4, has an incident energy exposure of 11.08 cal/cm².**

Replace circuit breaker PNL HB CB 58 with an electronic trip breaker having an LS tripping unit. SEAM Group tried a 125A Cutler-Hammer CHKD RMS 310 electronic trip breaker with the following settings: LTPU "90", STPU "6", STD "200ms", and i²t "Out". This change will reduce the incident energy exposure at bus PNL LC (PNL LC MN CB LineSide) from 11.08 cal/cm² to 2 cal/cm². Appropriate PPE must be worn when working on energized equipment. *It is the customer's responsibility to consult their local equipment representative to determine what protective devices are compatible with each piece of equipment; see paragraph 3.A above.*

B. Coordination Recommendations

There are overcurrent protective devices (fuses, relays, and circuit breakers) that do not coordinate adequately with other protective devices in the same circuit. Inadequate coordination can be defined as one protective device's time current curve (TCC) overlapping a TCC of another protective device. The curves represent graphically when a protective device will trip based on a given fault current versus time. Refer to Section 6 for further details. The TCC name with the undesirable coordination is indicated followed by a recommendation for correcting each situation.

Recommendations in this section are based on existing protective devices only and do not reflect any replacement recommendations made in section 3.A. This might apply for situations where an arc flash replacement recommendation in section 3.A is not feasible but coordination of the existing equipment is still desirable. Please note that for some of the TCC's listed below SEAM Group may not make a recommendation. This may occur at points in the system where devices do not have adjustable settings to correct the undesirable coordination, and often times these devices are near the end point of the system where it is not economical to replace a circuit breaker for what may be small or marginal improvements in coordination. SEAM Group will only indicate increases in incident energy exposures, from the implementation of the coordination recommendations presented below, if the resulting value is above 1.2 cal/cm².

1. TCC BLDG-A MSB To ELEVATOR DSC

SEAM Group recommends accepting the miscoordination between protective devices BLDG-A MSB CB 6 and ELEVATOR DSC FS due to upstream protective device BLDG-A MSB CB 6 having a fixed instantaneous setting while downstream protective device ELEVATOR DSC FS does not have any settings to adjust and due to these protective devices being in series. Therefore if either protective device operates the same downstream equipment will be affected.

2. TCC BLDG-A MSB To PNL EHA

SEAM Group recommends accepting the miscoordination between protective devices BLDG-A MSB CB 7 and PNL EHA CB 12 due to both protective devices having fixed instantaneous settings.

3. TCC GEN DSC To BLDG-A EM DSC

Implement recommendation A.6 for protective device GEN DSC CB (LTPU "1", LTD "20", STPU "2.5", STD "0.1" i2t "OUT" and INST "10" (16,000 amperes)) to improve coordination with downstream protective device BLDG-A EM DSC CB.

To further improve coordination, implement recommendation 3.A.4 for protective device BLDG-A EM DSC CB (INST "4" (3,200 amperes)).

4. TCC GEN DSC To MCC

Implement recommendation 3.B.3 for upstream protective device GEN DSC CB to improve coordination with downstream protective device MCC CB 3.

To further improve coordination, reset the instantaneous setting of downstream protective device MCC CB 3 to “LO” (5,000 amperes).

5. TCC PNL LPA To CL2 PNL

SEAM Group recommends accepting the miscoordination between protective devices PNL LPA CB 12 and CL2 PNL CB due to these protective devices having similar amperage ratings and due to both protective devices having fixed instantaneous settings.

6. TCC PNL LPA To PRESSURE RLF VALVE

SEAM Group recommends accepting the miscoordination between protective devices PNL LPA MN CB and PNL LPA CB 18 due to both protective devices having fixed instantaneous settings.

SEAM Group recommends accepting any miscoordination between protective devices PNL LPA CB 18 and PFV MN CB due to these protective devices being in series. Therefore if either protective device operates the same downstream equipment will be affected.

SEAM Group recommends accepting the miscoordination between protective devices PNL LPA CB 18 and PFV CB due to downstream protective device PFV CB also having a fixed instantaneous setting.

SEAM Group recommends accepting the miscoordination between protective device PFV MN CB and PFV CB due to upstream protective device PFV MN CB having a fixed instantaneous setting.

7. TCC WELL #23 MSB To MCC

Reset the following settings for upstream protective device WELL #23 MSB CB: LTPU “1”, LTD “24”, STPU “4”, STD “0.4” i2t “ON” and the instantaneous setting “4” (4,800 amperes) to improve coordination with downstream protective device MCC CB 3.

To further improve coordination, implement recommendation 3.B.4 for downstream protective device MCC CB 3.

C. Short Circuit Device Evaluation

All protective devices in the facility appear to have adequate interrupting capacity as required in the National Electrical Code (NEC) Article 110.9 based on the base operating scenario, Scenario (S0).

4. Input Data

The conductor and transformer schedules on the following pages indicate the data that was entered and used by the computer program when calculating the fault currents. Data for the main feeders and transformers was documented by SEAM Group during the data collection visit. In some cases, information may not have been available. In these instances, estimates were made based on engineering judgment and a knowledge of “typical” values. In most cases, these estimates were selected to yield conservative results. Some of these instances may have a more detailed description in the assumptions in Section 2.

The customer was asked to secure data about fault current availability, utility protective devices, and utility transformers from the utility. If the proper data was secured from the servicing utility it has been incorporated into the computer model. If the proper data could not be secured, SEAM Group conservatively applied engineering judgment to arrive at reasonable source data as outlined in the assumptions in Section 2. The utility fault current information provided can be found in Appendix A.

Jurupa Community Services District - Facility

Fault Analysis Input Report (English)

Utilities

Contribution From Name	Bus Name	In/Out Service	Nominal Voltage	----- Contribution Data -----			PU (100 MVA Base)		
				Duty	Units	X/R	R PU	X PU	
UTILITY 1	BUS-0001	In	12,000	3P:	500,000	Amps	8.00	Pos: 0.001	0.010
				SLG:	250,000	Amps	8.00	Zero: 0.005	0.038
UTILITY 2	BUS-0003	In	12,000	3P:	8,481	Amps	2.04	Pos: 0.250	0.509
				SLG:	8,942	Amps	2.12	Zero: 0.189	0.441

Generators

Contribution From Name	Bus Name	In/Out Service	Nominal Voltage	----- Contribution Data -----			PU (100 MVA Base)	
				Base kVA	X"	X/R	R PU	X PU
GEN	GEN DSC	In	480	1,250.00	0.15	23.88	0.50	12.00
					0.15	23.88	0.50	12.00
					0.15	23.88	0.50	12.00

Motors

Contribution From Name	# of Motors	Bus Name	In/Out Service	Nominal Voltage	----- Contribution Data -----			PU (100 MVA Base)	
					Base kVA	Xd"	X/R	R PU	X PU
WELL PMP	1	BUS-0024	In	480	452.68	0.1692	10.00	3.737	37.367

Cables

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	----- Cable Description -----			Per Unit (100 MVA Base)			
					Size	Cond. Type	Duct Type	Insul	R pu	jX pu	
CBL-0001	BUS-0002 WELL #23 MSB	In	2	105	700	Aluminum	Magnetic	PVC	Pos:	0.7702	0.7975
									Zero:	2.4272	1.9642
CBL-0002	WELL #23 MSB BUS-0004	In	1	5	1200	Copper	Busway	Epoxy	Pos:	0.0241	0.0113
									Zero:	0.1432	0.0603
CBL-0003	BUS-0004 BUS-0005	In	4	10	350	Copper	Magnetic	PVC	Pos:	0.0410	0.0533
									Zero:	0.1292	0.1312
CBL-0004	ATS MCC	In	4	10	350	Copper	Magnetic	PVC	Pos:	0.0410	0.0533
									Zero:	0.1292	0.1312
CBL-0005	BUS-0009 BUS-0008	In	2	5	500	Copper	Magnetic	PVC	Pos:	0.0319	0.0506
									Zero:	0.1005	0.1245

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	----- Cable Description -----				Per Unit (100 MVA Base)			
					Size	Cond. Type	Duct Type	Insul	R pu	jX pu	Pos:	Zero:
CBL-0006	GEN DSC BUS-0009	In	4	45	350	Copper	Magnetic	PVC	Pos: 0.1846 Zero: 0.5815	0.2397 0.5903		
CBL-0007	BUS-0009 BLDG-A EM DSC	In	2	10	500	Copper	Magnetic	PVC	Pos: 0.0638 Zero: 0.2010	0.1011 0.2489		
CBL-0008	BLDG-A EM DSC BUS-0033	In	2	400	750	Copper	Magnetic	PVC	Pos: 1.8750 Zero: 5.9028	3.8628 9.5052		
CBL-0009	MCC BUS-0014	In	1	5	8	Copper	Magnetic	PVC	Pos: 1.7600 Zero: 5.5467	0.1636 0.4028		
CBL-0010	MCC BUS-0017	In	2	5	262	Copper	Non-Magnetic		Pos: 0.0574 Zero: 0.1149	0.0296 0.0591		
CBL-0011	BUS-0015 PNL LPA	In	1	5	4	Copper	Magnetic	PVC	Pos: 2.7865 Zero: 8.7813	0.5486 1.3507		
CBL-0012	BUS-0017 BUS-0018	In	2	5	262	Copper	Non-Magnetic		Pos: 0.0574 Zero: 0.1149	0.0296 0.0591		
CBL-0013	BUS-0017 BUS-0019	Out	2	5	262	Copper	Non-Magnetic		Pos: 0.0574 Zero: 0.1149	0.0296 0.0591		
CBL-0014	BUS-0018 BUS-0106	In	2	1	262	Copper	Non-Magnetic		Pos: 0.0115 Zero: 0.0230	0.0059 0.0118		
CBL-0015	BUS-0018 BUS-0020	In	1	5	4/0	Aluminum	Magnetic	PVC	Pos: 0.2300 Zero: 0.7250	0.0846 0.2084		
CBL-0016	BUS-0020 CAP BANK	In	1	5	4/0	Aluminum	Magnetic	PVC	Pos: 0.2300 Zero: 0.7250	0.0846 0.2084		
CBL-0017	BUS-0106 BUS-0023	In	2	1	262	Copper	Non-Magnetic		Pos: 0.0115 Zero: 0.0230	0.0059 0.0118		
CBL-0018	BUS-0023 BUS-0024	In	3	30	350	Copper	Magnetic	PVC	Pos: 0.1641 Zero: 0.5169	0.2131 0.5247		
CBL-0019	PNL LPA CL2 PNL	In	1	50	10	Copper	Magnetic	PVC	Pos: 102.4306 Zero: 322.8125	7.4132 18.2552		
CBL-0020	PNL LPA PRESSURE RLF VALVE	In	1	140	8	Copper	Magnetic	PVC	Pos: 197.1181 Zero: 621.2258	18.3264 45.1111		
CBL-0021	BUS-0028 BLDG-A MSB MN DSC	In	1	75	750	Aluminum	Magnetic	PVC	Pos: 1.0352 Zero: 3.2624	1.1100 2.7337		
CBL-0022	BLDG-A MSB MN DSC BUS-0030	In	1	5	800	Copper	Busway	Epoxy	Pos: 0.0362 Zero: 0.2153	0.0276 0.1474		
CBL-0023	BUS-0030 BUS-0031	In	2	5	500	Copper	Magnetic	PVC	Pos: 0.0319 Zero: 0.1005	0.0506 0.1245		
CBL-0024	BLDG-A ATS BLDG-A MSB	In	2	400	750	Copper	Magnetic	PVC	Pos: 1.8750 Zero: 5.9028	3.8628 9.5052		
CBL-0025	BLDG-A MSB PNL EHA	In	1	45	1	Copper	Magnetic	PVC	Pos: 3.1250 Zero: 9.8477	1.1133 2.7402		
CBL-0026	BLDG-A MSB PNL HB	In	1	150	600	Copper	Magnetic	PVC	Pos: 1.6732 Zero: 5.2669	3.0143 7.4219		

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	----- Cable Description -----				Per Unit (100 MVA Base)			
					Size	Cond. Type	Duct Type	Insul	R pu	jX pu	Pos:	Zero:
CBL-0027	BLDG-A MSB MODULAR MN DSC	In	1	400	3/0	Copper	Magnetic	PVC	Pos: 13.9757 Zero: 44.0451	9.0104 22.1875		
CBL-0028	BLDG-A MSB ELEVATOR DSC	In	1	70	2	Copper	Magnetic	PVC	Pos: 6.1372 Zero: 19.3411	1.7773 4.3750		
CBL-0029	ELEVATOR DSC ELEVATOR CP	In	1	10	6	Copper	Magnetic	PVC	Pos: 2.2135 Zero: 6.9757	0.2973 0.7322		
CBL-0030	BLDG-A MSB BUS-0060	In	1	30	2	Copper	Magnetic	PVC	Pos: 2.6302 Zero: 8.2891	0.7617 1.8750		
CBL-0031	BLDG-A MSB BUS-0075	In	1	20	2	Copper	Magnetic	PVC	Pos: 1.7535 Zero: 5.5260	0.5078 1.2500		
CBL-0032	BLDG-A MSB PNL HA	In	1	20	4/0	Copper	Magnetic	PVC	Pos: 0.5556 Zero: 1.7509	0.4314 1.0625		
CBL-0033	PNL EHA PNL ELA	In	1	5	6	Copper	Magnetic	PVC	Pos: 1.1068 Zero: 3.4878	0.1487 0.3661		
CBL-0034	PNL EHA BUS-0042	In	1	5	2	Copper	Magnetic	PVC	Pos: 0.4384 Zero: 1.3815	0.1270 0.3125		
CBL-0035	2ND FLR ATS BUS-0045	In	1	20	2	Copper	Magnetic	PVC	Pos: 1.7535 Zero: 5.5260	0.5078 1.2500		
CBL-0036	BUS-0045 PNL EHA CONTACTOR CP	In	1	5	2	Copper	Magnetic	PVC	Pos: 0.4384 Zero: 1.3815	0.1270 0.3125		
CBL-0037	BUS-0045 CONTACTOR CP0	In	1	20	2	Copper	Magnetic	PVC	Pos: 1.7535 Zero: 5.5260	0.5078 1.2500		
CBL-0038	PNL HB BLDG EXT LTG CP	In	1	5	10	Copper	Magnetic	PVC	Pos: 2.5608 Zero: 8.0703	0.1853 0.4564		
CBL-0039	PNL HB BUS-0053	In	1	95	6	Copper	Magnetic	PVC	Pos: 21.0286 Zero: 66.2691	2.8244 6.9559		
CBL-0040	PNL HB OVERHEAD CRANE DSC	In	1	55	10	Copper	Magnetic	PVC	Pos: 28.1684 Zero: 88.7734	2.0386 5.0202		
CBL-0041	PNL HB CU 1ST FL DSC	In	1	35	10	Copper	Magnetic	PVC	Pos: 17.9253 Zero: 56.4922	1.2973 3.1947		
CBL-0042	PNL HB CU 2ND FL DSC	In	1	35	10	Copper	Magnetic	PVC	Pos: 17.9253 Zero: 56.4922	1.2973 3.1947		
CBL-0043	PNL HB STEAM CLEANER DSC	In	1	35	10	Copper	Magnetic	PVC	Pos: 17.9253 Zero: 56.4922	1.2973 3.1947		
CBL-0044	BUS-0053 COMP #1 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: 2.5608 Zero: 8.0703	0.1853 0.4564		
CBL-0045	PNL HB BUS-0108	In	1	15	2	Copper	Magnetic	PVC	Pos: 1.3151 Zero: 4.1445	0.3809 0.9375		
CBL-0046	BUS-0053 COMP #2 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: 2.5608 Zero: 8.0703	0.1853 0.4564		
CBL-0047	COMP #2 DSC COMP #2 CP	In	1	5	12	Copper	Magnetic	PVC	Pos: 4.0582 Zero: 12.7895	0.1975 0.4863		

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	----- Cable Description -----				Per Unit (100 MVA Base)		
					Size	Cond. Type	Duct Type	Insul	R pu	jX pu	
CBL-0048	BUS-0060 CU EAST #1 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0049	CU EAST #1 DSC CU EAST #1 CP	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0050	BUS-0060 CU EAST #2 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0051	CU EAST #2 DSC CU EAST #2 CP	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0052	BUS-0060 BUS-0068	In	1	40	2	Copper	Magnetic	PVC	Pos: Zero:	3.5069 11.0521	1.0156 2.5000
CBL-0053	BUS-0068 CU EAST #5 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0054	CU EAST #5 DSC CU EAST #5 CP	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0055	BUS-0068 CU EAST #7 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0056	CU EAST #7 DSC CU EAST #7 CP	In	1	15	10	Copper	Magnetic	PVC	Pos: Zero:	7.6823 24.2109	0.5560 1.3691
CBL-0057	BUS-0068 CU EAST #8 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0058	CU EAST #8 DSC CU EAST #8 CP	In	1	10	10	Copper	Magnetic	PVC	Pos: Zero:	5.1215 16.1406	0.3707 0.9128
CBL-0059	BUS-0068 CU EAST #9 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0060	CU EAST #9 DSC CU EAST #9 CP	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0061	BUS-0075 CU WEST #4 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0062	CU WEST #4 DSC CU WEST #4 CP	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0063	BUS-0075 CU WEST #6 DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0064	CU WEST #6 DSC CU WEST #6 CP	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0065	BUS-0075 BUS-0069	In	1	40	2	Copper	Magnetic	PVC	Pos: Zero:	3.5069 11.0521	1.0156 2.5000
CBL-0066	BUS-0069 CU WEST #3B DSC	In	1	5	10	Copper	Magnetic	PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0067	CU WEST #3B DSC CU WEST #3B CP	In	1	15	10	Copper	Magnetic	PVC	Pos: Zero:	7.6823 24.2109	0.5560 1.3691
CBL-0068	BUS-0069	In	1	5	10	Copper	Magnetic	PVC	Pos:	2.5608	0.1853

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	----- Cable Description -----			Per Unit (100 MVA Base)		
					Size	Cond. Type	Duct Type	Insul	R pu	jX pu
	CU WEST #10 DSC							Zero:	8.0703	0.4564
CBL-0069	CU WEST #10 DSC CU WEST #10 CP	In	1	15	10	Copper	Magnetic PVC	Pos: Zero:	7.6823 24.2109	0.5560 1.3691
CBL-0070	BUS-0069 CU WEST #11 DSC	In	1	5	10	Copper	Magnetic PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0071	CU WEST #11 DSC CU WEST #11 CP	In	1	5	10	Copper	Magnetic PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0072	BUS-0069 CU WEST #12 DSC	In	1	5	10	Copper	Magnetic PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0073	CU WEST #12 DSC CU WEST #12 CP	In	1	5	10	Copper	Magnetic PVC	Pos: Zero:	2.5608 8.0703	0.1853 0.4564
CBL-0074	PNL HA CU 3A DSC	In	1	40	10	Copper	Magnetic PVC	Pos: Zero:	20.4861 64.5625	1.4826 3.6510
CBL-0075	CU 3A DSC CU 3A CP	In	1	10	10	Copper	Magnetic PVC	Pos: Zero:	5.1215 16.1406	0.3707 0.9128
CBL-0076	PNL HA PNL HA CONTACTOR CP	In	1	5	12	Copper	Magnetic PVC	Pos: Zero:	4.0582 12.7895	0.1975 0.4863
CBL-0077	BUS-0109 PNL LC	In	1	10	4/0	Copper	Magnetic PVC	Pos: Zero:	1.4793 4.6621	1.1488 2.8291
CBL-0078	PNL LC PNL LC-1 GAS PUMP	In	1	140	6	Copper	Magnetic PVC	Pos: Zero:	165.0333 520.0814	22.1662 54.5904
CBL-0079	PNL LC BUS-0118	In	1	85	8	Copper	Magnetic PVC	Pos: Zero:	159.3357 502.1531	14.8137 36.4645
CBL-0080	PNL LC BUS-0113	In	1	70	8	Copper	Magnetic PVC	Pos: Zero:	131.2176 413.5378	12.1995 30.0296
CBL-0081	BUS-0113 208V REC DSC 1	In	1	1	10	Copper	Magnetic PVC	Pos: Zero:	2.7274 8.5956	0.1974 0.4861
CBL-0082	BUS-0113 208V REC DSC 2	In	1	1	10	Copper	Magnetic PVC	Pos: Zero:	2.7274 8.5956	0.1974 0.4861
CBL-0083	PNL LC WHSE SUPPLY FAN CP	In	1	5	12	Copper	Magnetic PVC	Pos: Zero:	21.6115 68.1097	1.0517 2.5899
CBL-0084	WHSE SUPPLY FAN CP WHSE SUPPLY FAN DSC	In	1	5	12	Copper	Magnetic PVC	Pos: Zero:	21.6115 68.1097	1.0517 2.5899
CBL-0085	PNL LC-1 GAS PUMP LEAK DET MONITOR CP	In	1	12	2	Copper	Magnetic PVC	Pos: Zero:	5.6028 17.6572	1.6226 3.9941
CBL-0086	BUS-0118 TIRE ALIGN DSC	In	1	30	10	Copper	Magnetic PVC	Pos: Zero:	81.8232 257.8680	5.9218 14.5826
CBL-0087	BUS-0118 MOHAWK LIFT DSC	In	1	30	10	Copper	Magnetic PVC	Pos: Zero:	81.8232 257.8680	5.9218 14.5826
CBL-0088	MOHAWK LIFT DSC MOHAWK DSC	In	1	50	10	Copper	Magnetic PVC	Pos: Zero:	136.3720 429.7800	9.8696 24.3043

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	----- Cable Description -----				Per Unit (100 MVA Base)		
					Size	Cond. Type	Duct Type	Insul	R pu	jX pu	
CBL-0089	COMP #1 DSC COMP #1 CP	In	1	5	12	Copper	Magnetic	PVC	Pos:	4.0582	0.1975
									Zero:	12.7895	0.4863

2-Winding Transformers

Xformer Name	In/Out Service	-----Primary & Secondary-----				Nominal kVA	Z PU (100 MVA Base)		
		Bus	Conn.	Volts	FLA		R pu	jX pu	
PNL LPA XFMR	In	BUS-0014	D	480	18	15.0	Pos:	135.1133	333.6867
		BUS-0015	D	240	36		Zero:	,600.0000	,600.0000
UTILITY 1 XFMR	In	BUS-0001	D	12,000	24	500.0	Pos:	1.7084	8.0200
		BUS-0002	WG	480	601		Zero:	1.7084	8.0200
UTILITY 2 XFMR	In	BUS-0003	D	12,000	11	225.0	Pos:	2.9840	11.6231
		BUS-0028	WG	480	271		Zero:	2.9840	11.6231
XFMR LC	In	BUS-0108	D	480	180	150.0	Pos:	7.8807	28.2547
		BUS-0109	WG	208	416		Zero:	7.8807	28.2547

5. Summary of Calculated Fault Currents

The summary on the following pages indicates the calculated sustained fault currents at each bus of interest within the system. The three-phase fault currents shown were used to predict the incident energy exposure levels. The data will represent the “normal” operating mode values and will not indicate values when in any other modes.

The potential fault currents have been calculated by the PTW computer program using the method of symmetrical components, and the procedures of IEEE Standard 399-1986. The method of symmetrical components has been the accepted method for calculating unbalanced fault currents since the mid 1920’s. Data required for the calculations is derived from the physical construction of the power system. Although it is not required to have exact numbers, it is wise to be within roughly 5%. The one exception is the electrical impedance associated with the grounding system since the ground paths are nearly impossible to ascertain. Ground path numbers are derived from historical test results, and normally applied through the judicious use of experience.

Fault Location Bus Name	Bus Voltage	3-Phase Amps	3-Phase MVA	3P X/R	SLG Amps	SLG MVA	SLG X/R	Mom Amps	-----3P Asym Amps-----		
									3 Cycles	5 Cycles	8 Cycles
BUS-0008	480	9,770	8.12	17.09	9,651	2.67	14.22	15,088	10,793	10,014	9,797
BUS-0009	480	9,812	8.16	17.81	9,713	2.69	15.08	15,218	10,930	10,096	9,846
BUS-0014	480	14,578	12.12	2.07	11,696	3.24	1.48	15,261	14,578	14,578	14,578
BUS-0015	240	653	0.27	2.46	0	0.00	Infinite	702	653	653	653
BUS-0017	480	15,994	13.30	3.91	13,716	3.80	2.97	18,927	15,995	15,994	15,994
BUS-0018	480	15,933	13.25	3.85	13,636	3.78	2.92	18,791	15,934	15,933	15,933
BUS-0019	480	0	0.00	0.00	0	0.00	000.00	0	0	0	0
BUS-0020	480	15,638	13.00	3.47	13,256	3.67	2.61	18,018	15,638	15,638	15,638
BUS-0023	480	15,908	13.23	3.83	13,604	3.77	2.90	18,737	15,909	15,908	15,908
BUS-0024	480	15,588	12.96	3.73	13,118	3.64	2.78	18,257	15,589	15,588	15,588
BUS-0028	480	9,580	7.96	3.75	9,723	2.69	3.80	11,232	9,580	9,580	9,580
BUS-0030	480	8,622	7.17	3.08	8,253	2.29	2.72	9,680	8,622	8,622	8,622
BUS-0031	480	8,586	7.14	3.07	8,202	2.27	2.71	9,632	8,586	8,586	8,586
BUS-0033	480	7,327	6.09	6.17	6,427	1.78	4.40	9,617	7,344	7,328	7,327
BUS-0042	480	5,767	4.79	1.88	4,670	1.29	1.48	5,969	5,767	5,767	5,767
BUS-0045	480	5,426	4.51	1.64	4,274	1.18	1.27	5,543	5,426	5,426	5,426
BUS-0053	480	3,254	2.71	0.80	2,185	0.61	0.60	3,256	3,254	3,254	3,254
BUS-0060	480	6,012	5.00	2.03	4,952	1.37	1.61	6,279	6,012	6,012	6,012
BUS-0068	480	5,316	4.42	1.54	4,138	1.15	1.18	5,404	5,316	5,316	5,316
BUS-0069	480	5,481	4.56	1.63	4,323	1.20	1.26	5,596	5,481	5,481	5,481
BUS-0075	480	6,199	5.15	2.22	5,185	1.44	1.79	6,555	6,199	6,199	6,199
BUS-0106	480	15,921	13.24	3.84	13,620	3.77	2.91	18,764	15,922	15,921	15,921
BUS-0108	480	5,336	4.44	2.24	4,299	1.19	1.83	5,648	5,336	5,336	5,336
BUS-0109	208	5,365	1.93	2.86	6,273	0.75	3.00	5,931	5,365	5,365	5,365
BUS-0113	208	1,712	0.62	0.42	1,112	0.13	0.26	1,712	1,712	1,712	1,712
BUS-0118	208	1,466	0.53	0.36	933	0.11	0.23	1,466	1,466	1,466	1,466
CAP BANK	480	15,344	12.76	3.17	12,880	3.57	2.36	17,329	15,344	15,344	15,344

Fault Location Bus Name	Bus Voltage	3-Phase Amps	3-Phase MVA	3P X/R	SLG Amps	SLG MVA	SLG X/R	Mom Amps	-----3P Asym Amps-----		
									3 Cycles	5 Cycles	8 Cycles
CL2 PNL	240	565	0.23	1.43	0	0.00	Infinitic	572	565	565	565
COMP #1 CP	480	0	0.00	0.00	0	0.00	000.00	0	0	0	0
COMP #1 DSC	480	3,076	2.56	0.74	2,039	0.57	0.55	3,076	3,076	3,076	3,076
COMP #2 CP	480	2,827	2.35	0.66	1,842	0.51	0.49	2,827	2,827	2,827	2,827
COMP #2 DSC	480	3,076	2.56	0.74	2,039	0.57	0.55	3,076	3,076	3,076	3,076
CONTACTOR CP0	480	5,109	4.25	1.46	3,923	1.09	1.12	5,178	5,109	5,109	5,109
CU 1ST FL DSC	480	3,581	2.98	0.83	2,439	0.68	0.62	3,583	3,581	3,581	3,581
CU 2ND FL DSC	480	3,581	2.98	0.83	2,439	0.68	0.62	3,583	3,581	3,581	3,581
CU 3A CP	480	3,184	2.65	0.60	2,076	0.58	0.43	3,184	3,184	3,184	3,184
CU 3A DSC	480	3,614	3.00	0.70	2,419	0.67	0.50	3,615	3,614	3,614	3,614
CU EAST #1 CP	480	5,222	4.34	1.31	3,975	1.10	0.98	5,266	5,222	5,222	5,222
CU EAST #1 DSC	480	5,616	4.67	1.59	4,442	1.23	1.21	5,723	5,616	5,616	5,616
CU EAST #2 CP	480	5,222	4.34	1.31	3,975	1.10	0.98	5,266	5,222	5,222	5,222
CU EAST #2 DSC	480	5,616	4.67	1.59	4,442	1.23	1.21	5,723	5,616	5,616	5,616
CU EAST #5 CP	480	4,616	3.84	1.11	3,364	0.93	0.82	4,632	4,616	4,616	4,616
CU EAST #5 DSC	480	4,957	4.12	1.28	3,726	1.03	0.97	4,994	4,957	4,957	4,957
CU EAST #7 CP	480	4,013	3.34	0.87	2,784	0.77	0.64	4,016	4,013	4,013	4,013
CU EAST #7 DSC	480	4,957	4.12	1.28	3,726	1.03	0.97	4,994	4,957	4,957	4,957
CU EAST #8 CP	480	4,301	3.58	0.97	3,052	0.85	0.72	4,308	4,301	4,301	4,301
CU EAST #8 DSC	480	4,957	4.12	1.28	3,726	1.03	0.97	4,994	4,957	4,957	4,957
CU EAST #9 CP	480	4,616	3.84	1.11	3,364	0.93	0.82	4,632	4,616	4,616	4,616
CU EAST #9 DSC	480	4,957	4.12	1.28	3,726	1.03	0.97	4,994	4,957	4,957	4,957
CU WEST #10 CP	480	4,126	3.43	0.90	2,882	0.80	0.65	4,130	4,126	4,126	4,126
CU WEST #10 DSC	480	5,111	4.25	1.35	3,886	1.08	1.01	5,159	5,111	5,111	5,111
CU WEST #11 CP	480	4,757	3.95	1.15	3,501	0.97	0.85	4,777	4,757	4,757	4,757
CU WEST #11 DSC	480	5,111	4.25	1.35	3,886	1.08	1.01	5,159	5,111	5,111	5,111
CU WEST #12 CP	480	4,757	3.95	1.15	3,501	0.97	0.85	4,777	4,757	4,757	4,757

Fault Location Bus Name	Bus Voltage	3-Phase Amps	3-Phase MVA	3P X/R	SLG Amps	SLG MVA	SLG X/R	Mom Amps	-----3P Asym Amps-----		
									3 Cycles	5 Cycles	8 Cycles
CU WEST #12 DSC	480	5,111	4.25	1.35	3,886	1.08	1.01	5,159	5,111	5,111	5,111
CU WEST #3B CP	480	4,126	3.43	0.90	2,882	0.80	0.65	4,130	4,126	4,126	4,126
CU WEST #3B DSC	480	5,111	4.25	1.35	3,886	1.08	1.01	5,159	5,111	5,111	5,111
CU WEST #4 CP	480	5,393	4.48	1.38	4,158	1.15	1.04	5,449	5,393	5,393	5,393
CU WEST #4 DSC	480	5,798	4.82	1.70	4,653	1.29	1.31	5,940	5,798	5,798	5,798
CU WEST #6 CP	480	5,393	4.48	1.38	4,158	1.15	1.04	5,449	5,393	5,393	5,393
CU WEST #6 DSC	480	5,798	4.82	1.70	4,653	1.29	1.31	5,940	5,798	5,798	5,798
ELEVATOR CP	480	4,982	4.14	1.32	3,762	1.04	1.00	5,025	4,982	4,982	4,982
ELEVATOR DSC	480	5,316	4.42	1.54	4,138	1.15	1.18	5,404	5,316	5,316	5,316
GEN DSC	480	10,015	8.33	23.88	10,015	2.78	23.88	15,952	11,902	10,711	10,162
LEAK DET MONITOR CP	208	1,367	0.49	0.39	869	0.10	0.26	1,367	1,367	1,367	1,367
MCC	480	16,055	13.35	3.97	13,797	3.82	3.03	19,065	16,057	16,055	16,055
MODULAR MN DSC	480	3,637	3.02	1.30	2,609	0.72	1.02	3,666	3,637	3,637	3,637
MOHAWK DSC	208	687	0.25	0.20	414	0.05	Infinite	687	687	687	687
MOHAWK LIFT DSC	208	1,031	0.37	0.27	635	0.08	0.17	1,031	1,031	1,031	1,031
OVERHEAD CRANE DSC	480	2,840	2.36	0.62	1,840	0.51	0.45	2,840	2,840	2,840	2,840
PNL EHA	480	5,856	4.87	1.96	4,776	1.32	1.55	6,088	5,856	5,856	5,856
PNL EHA CONTACTOR CP	480	5,345	4.44	1.59	4,182	1.16	1.23	5,447	5,345	5,345	5,345
PNL ELA	480	5,674	4.72	1.77	4,549	1.26	1.37	5,834	5,674	5,674	5,674
PNL HA	480	6,374	5.30	2.60	5,427	1.50	2.18	6,921	6,374	6,374	6,374
PNL HA CONTACTOR CP	480	5,771	4.80	1.65	4,610	1.28	1.26	5,896	5,771	5,771	5,771
PNL HB	480	5,547	4.61	2.56	4,546	1.26	2.15	6,006	5,547	5,547	5,547
PNL LC	208	5,206	1.88	2.69	5,942	0.71	2.64	5,689	5,206	5,206	5,206
PNL LC-1 GAS PUMP	208	1,407	0.51	0.39	897	0.11	0.26	1,407	1,407	1,407	1,407
PNL LPA	240	651	0.27	2.41	0	0.00	Infinite	697	651	651	651
PRESSURE RLF VALVE	240	487	0.20	1.06	0	0.00	Infinite	488	487	487	487

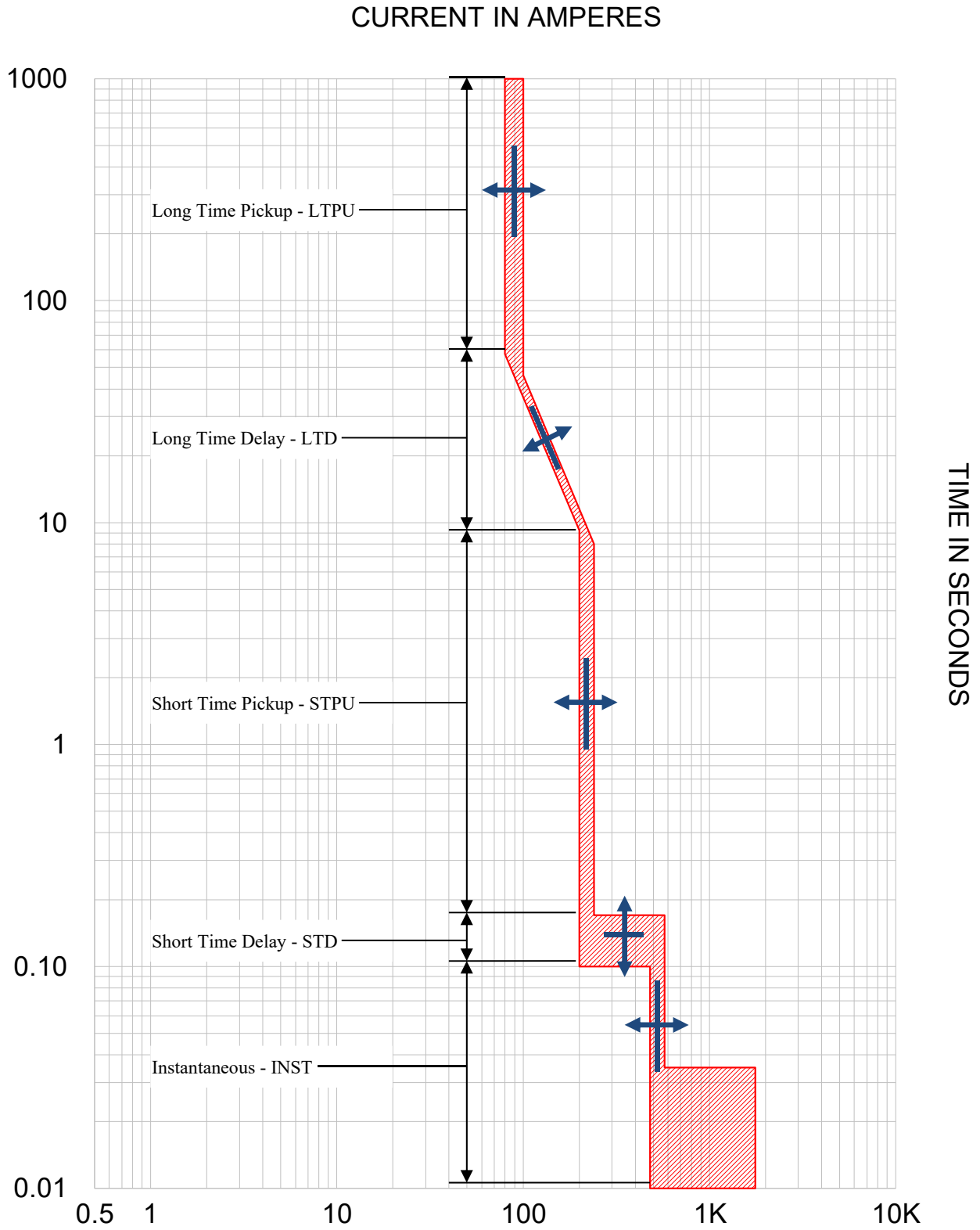
Fault Location Bus Name	Bus Voltage	3-Phase Amps	3-Phase MVA	3P X/R	SLG Amps	SLG MVA	SLG X/R	Mom Amps	-----3P Asym Amps-----		
									3 Cycles	5 Cycles	8 Cycles
STEAM CLEANER DSC	480	3,581	2.98	0.83	2,439	0.68	0.62	3,583	3,581	3,581	3,581
TIRE ALIGN DSC	208	1,031	0.37	0.27	635	0.08	0.17	1,031	1,031	1,031	1,031
WELL #23 MSB	480	16,250	13.51	4.05	14,129	3.92	3.17	19,393	16,251	16,250	16,250
WHSE SUPPLY FAN CP	208	4,274	1.54	1.27	3,954	0.47	0.84	4,304	4,274	4,274	4,274
WHSE SUPPLY FAN DSC	208	3,435	1.24	0.84	2,718	0.33	0.52	3,437	3,435	3,435	3,435

6. Coordination Curves and Device Listings

An ideally coordinated system would have the overcurrent protective device closest to a short circuit, or fault, condition detect the fault and open the circuit. In the event the closest device fails to operate, the next device between the fault and the power source would detect the fault and open the circuit. Realistically, complete coordination is often not achievable, but an attempt is made to come as close as practical.

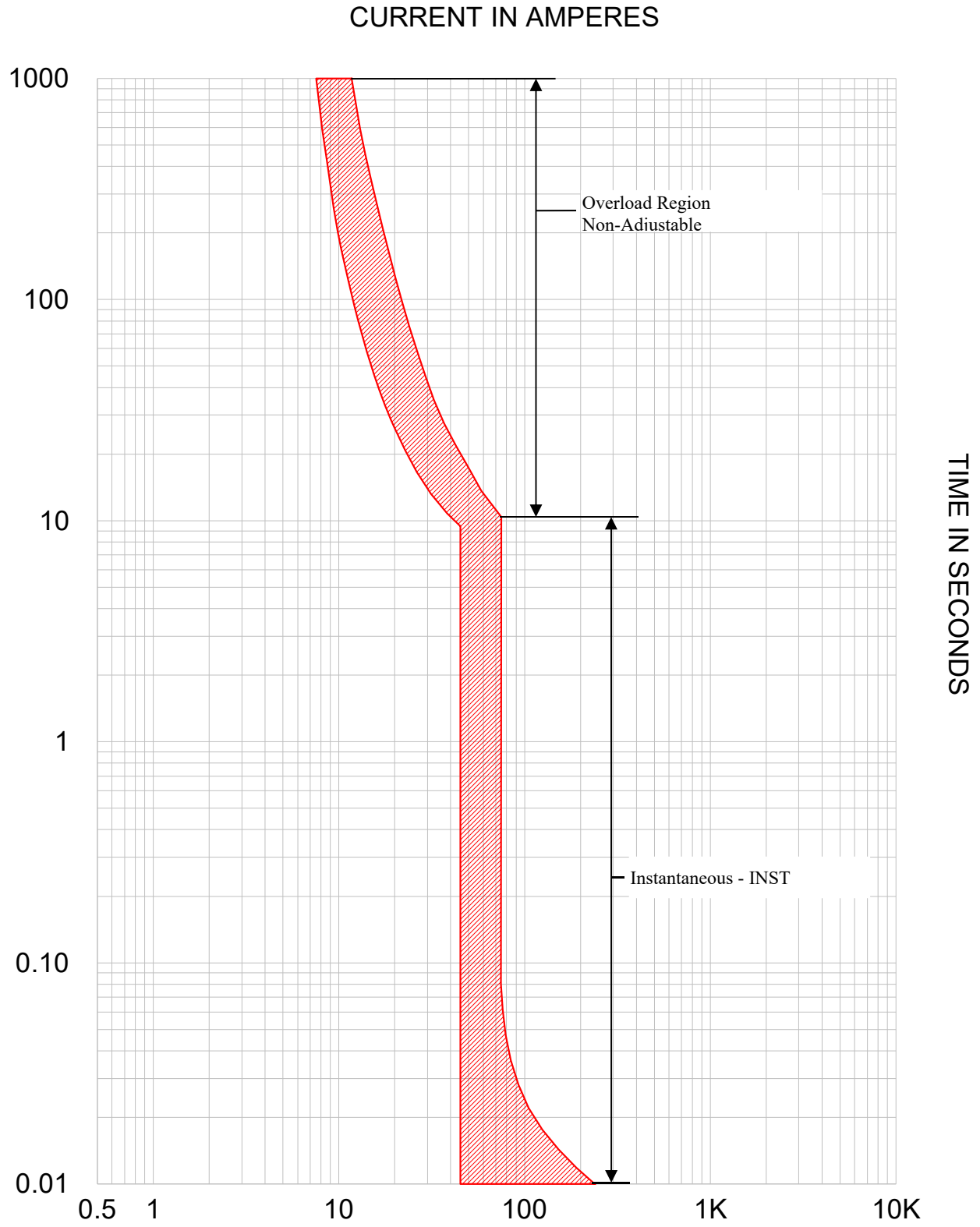
There are two main types of circuit breakers used within an electrical distribution system thermal magnetic and solid state with electronic tripping units. The solid-state breakers have electronic tripping units that allow for up to 5 points of adjustability along the curve. This can be seen in Figure 1 in the following pages. This figure outlines the name of each curve section that is referred to in the recommendations for both the arc flash and TCC sections. The solid-state breakers are often fully adjustable across the range making them very flexible for attaining coordination as well as reducing the incident energy exposure.

Figure 2 illustrates a thermal magnetic circuit breaker. The overload (Long-Time) characteristic of thermal-magnetic circuit breakers is not adjustable and has a wide tolerance compared to electronic trip units. This results in overlapping curves in the long-time region, and miscoordination for overload conditions; this is a typical scenario when trying to coordinate these types of breakers. The only region that has an option for adjustability is the instantaneous region. Small frame Circuit Breakers (less than ~100A) will often have fixed (non-adjustable) Instantaneous trip as well as fixed Long-Time trip. Because of the lack of adjustment on many thermal-magnetic Circuit Breakers SEAM Group may recommend acceptance of less than ideal coordination, unless replacement with an electronic Circuit Breaker allows a significant reduction in Arc Flash incident energy.



Electronic Trip.tcc Ref. Voltage: 480V Current in Amps x 10

Figure 1: Typical circuit breaker with configurable setting electronic trip



Thermal Magnetic.tcc Ref. Voltage: 480V Current in Amps x 10

Figure 2: Typical thermal magnetic circuit breaker

Figure 3 below illustrates a typical situation where there are devices that do not properly coordinate. The red ovals called out as #1 and #2 illustrate areas where circuit breakers SWGR 1 CB and SWGR 2 CB do not coordinate. The area in #1 calls out where SWGR 2 CB overlaps and is set higher (to the right) of SWGR 1 CB in the long-time pickup and long-time delay regions. Since SWGR 2 CB is downstream from SWGR 1 CB the curve for SWGR 2 CB should be to the left of circuit breaker SWGR 1 CB. The area in #2 also illustrates where the instantaneous settings of SWGR 2 CB are set higher than SWGR 1 CB. Areas #1 and #2 illustrate how there can be coordination problems even between breakers that have solid state electronic tripping units that have multiple zones of adjustment. The red ovals called out as #3 and #4 illustrate areas where circuit breakers PNL 1 MAIN and PNL 1 CB do not coordinate. The area in #3 illustrates where there is some overlap in the instantaneous region between the two devices. PNL 1 CB overlaps and in some areas, is set higher than the upstream main circuit breaker PNL 1 MAIN. Area #4 illustrates the overlap that is typical in the overload region for thermal magnetic breakers, this region is not adjustable and overlap between similarly sized circuit breakers is typical.

Figure 4 below illustrates a corrected version of the breaker settings that would improve coordination between the devices. The coordination between circuit breakers SWGR 1 CB and SWGR 2 CB in areas #1 and #2 have been corrected. There is no overlap in these regions and SWGR 2 CB curve now sits to the left of SWGR 1 CB. There will remain some overlap in the instantaneous region as is shown by area #3, the only way to achieve full coordination in this region would be to have a system impedance that would limit the fault current at SWGR 2 CB below the instantaneous setting of SWGR 1 CB (i.e. <14,400A). The coordination between PNL 1 MAIN and PNL 1 CB has been improved; the instantaneous of circuit breaker PNL 1 MAIN has been increased to reduce the amount of overlap in this region. Although it does not fully coordinate it does represent an increase in selectivity and is a typical situation. Area #4 again illustrates the overlap in the overload region of the circuit breakers that is typical for similarly sized thermal magnetic circuit breakers.

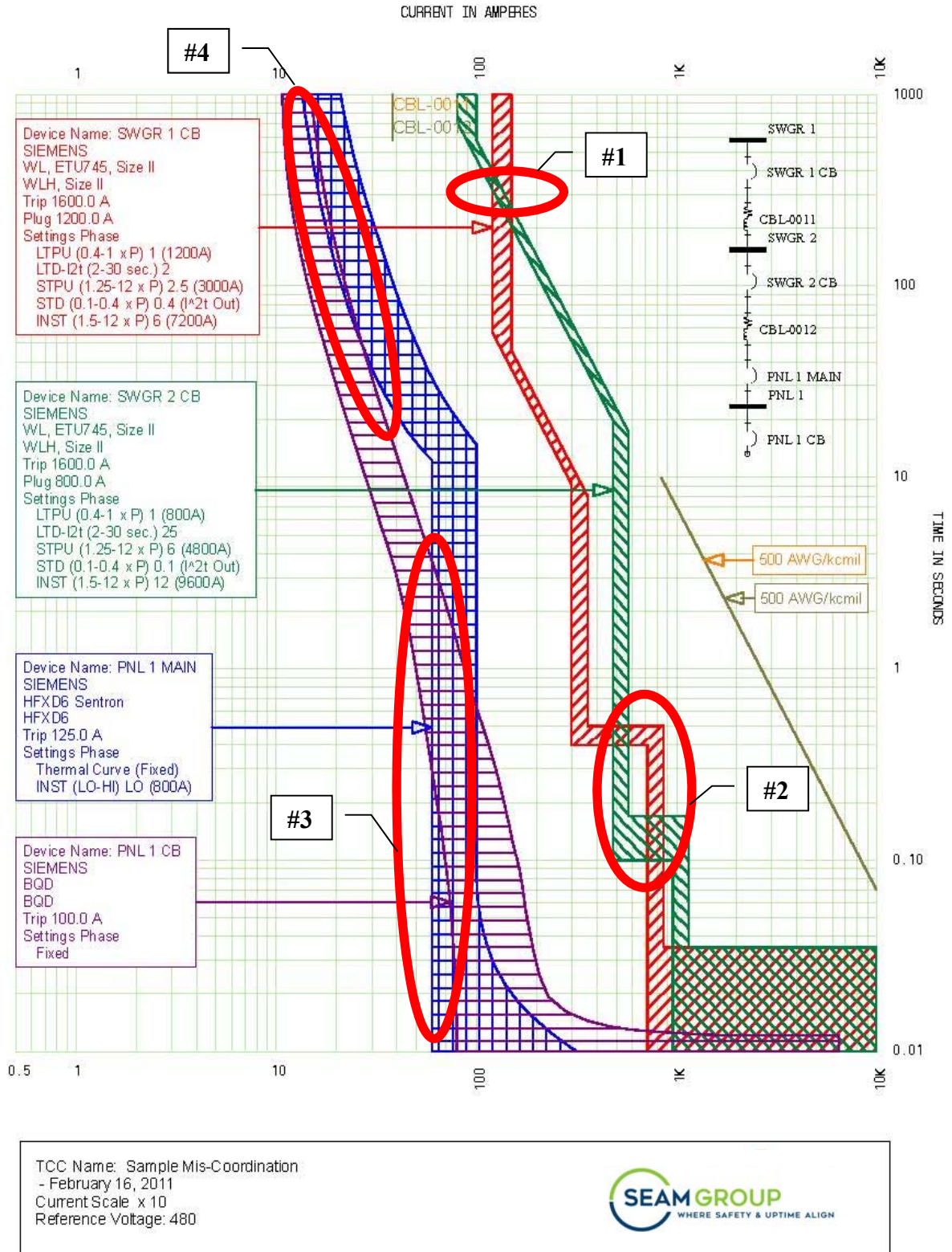


Figure 3: Sample TCC illustrating undesirable coordination

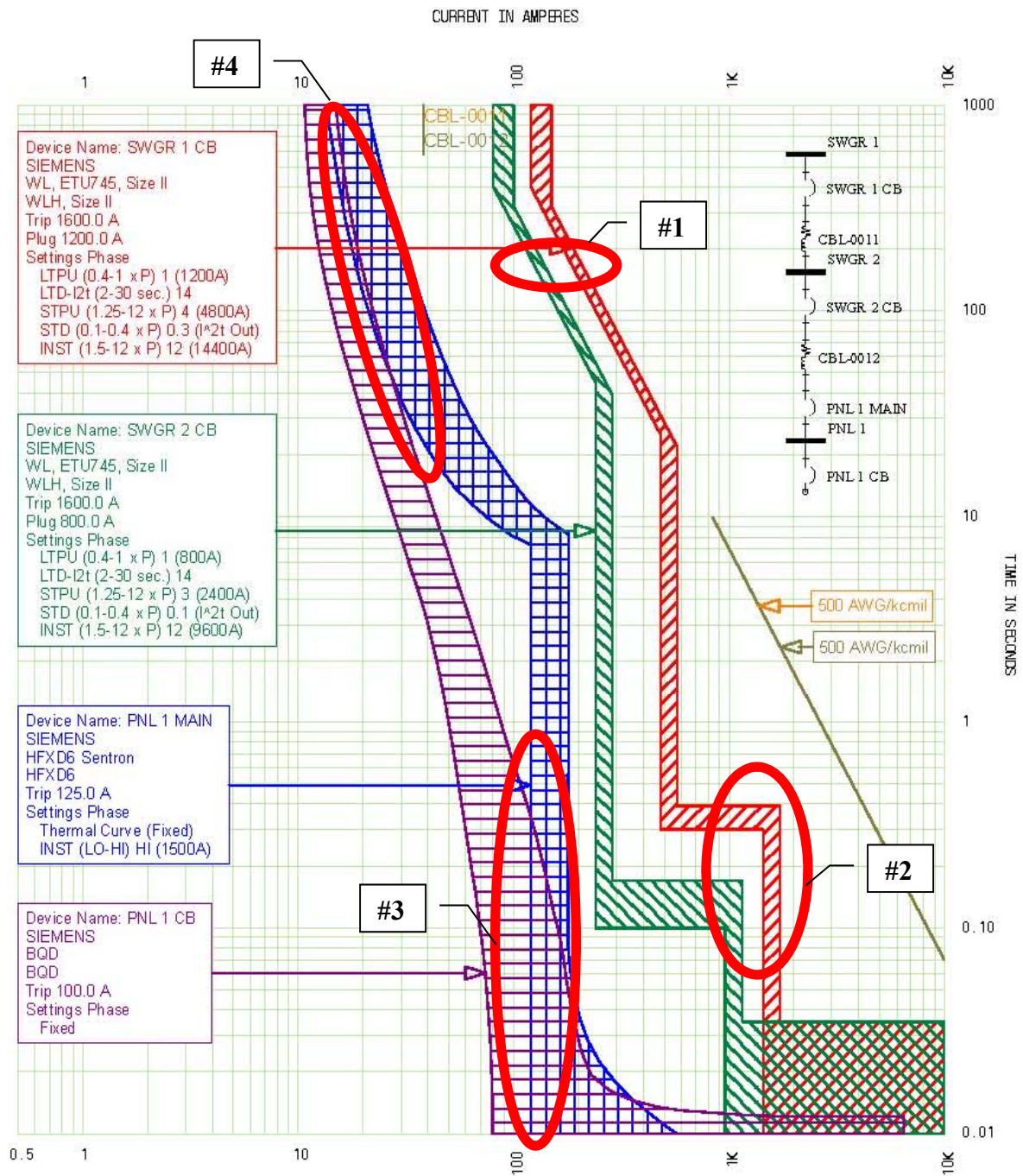


Figure 4: Sample TCC illustrating corrected coordination

Figure 5 illustrates a typical relay time current curve. These devices are often used at higher voltage levels or in the incoming primary distribution equipment for added control. Unlike a breaker a relay does not physically open the circuit - the relay acts as the trip unit/controller for an associated breaker that receives a signal from the relay to open. These relays sense the current flow in the circuit via current transformers (CT's) connected around the incoming or outgoing cables for the circuit to be monitored. The CT produces a reduced current proportional to the main circuit current flow via a magnetic field. This allows the relay to monitor/control high current circuits without having to be attached directly to the circuit. The curve in Figure 5 illustrates the basic curve style; however, with the newer programmable electronic relays the curve shape can become highly custom and the relays can also have additional protective features built into them that go beyond the basic overcurrent protection and coordination shown in this report. There are also older electro mechanical relays that will have the same basic curve shown in Figure 5, however these devices do not have the additional programming features of an electronic relay.

Figure 6 illustrates a typical fuse time current curve. A fuse contains a metal filament within a canister/cartridge that is then placed in line with the circuit. The fuse will then react to the current flow based on heat. If the current flow exceeds the value for which it was designed the fuse will "blow", i.e. the metal filament heats up and melts causing an opening in the circuit resulting in no current flow. A fuse has no adjustable settings similar to the fixed thermal magnetic breakers. The fuse curve is represented by an angled line that is shifted left or right based on the amperage rating of the device. One advantage of fuses that is that coordination is very easily achieved as long as the fuse models are the same and current ratings are different (i.e. 100A fuse would coordinate with 90A).

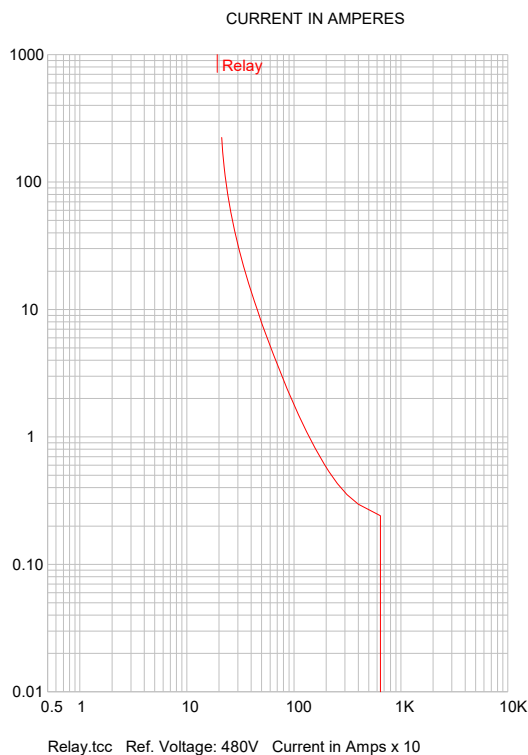


Figure 5: Typical Relay Curve

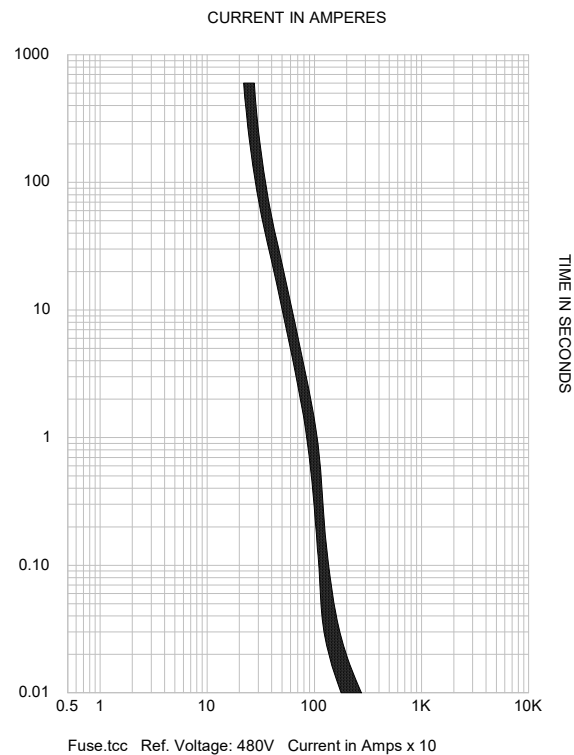
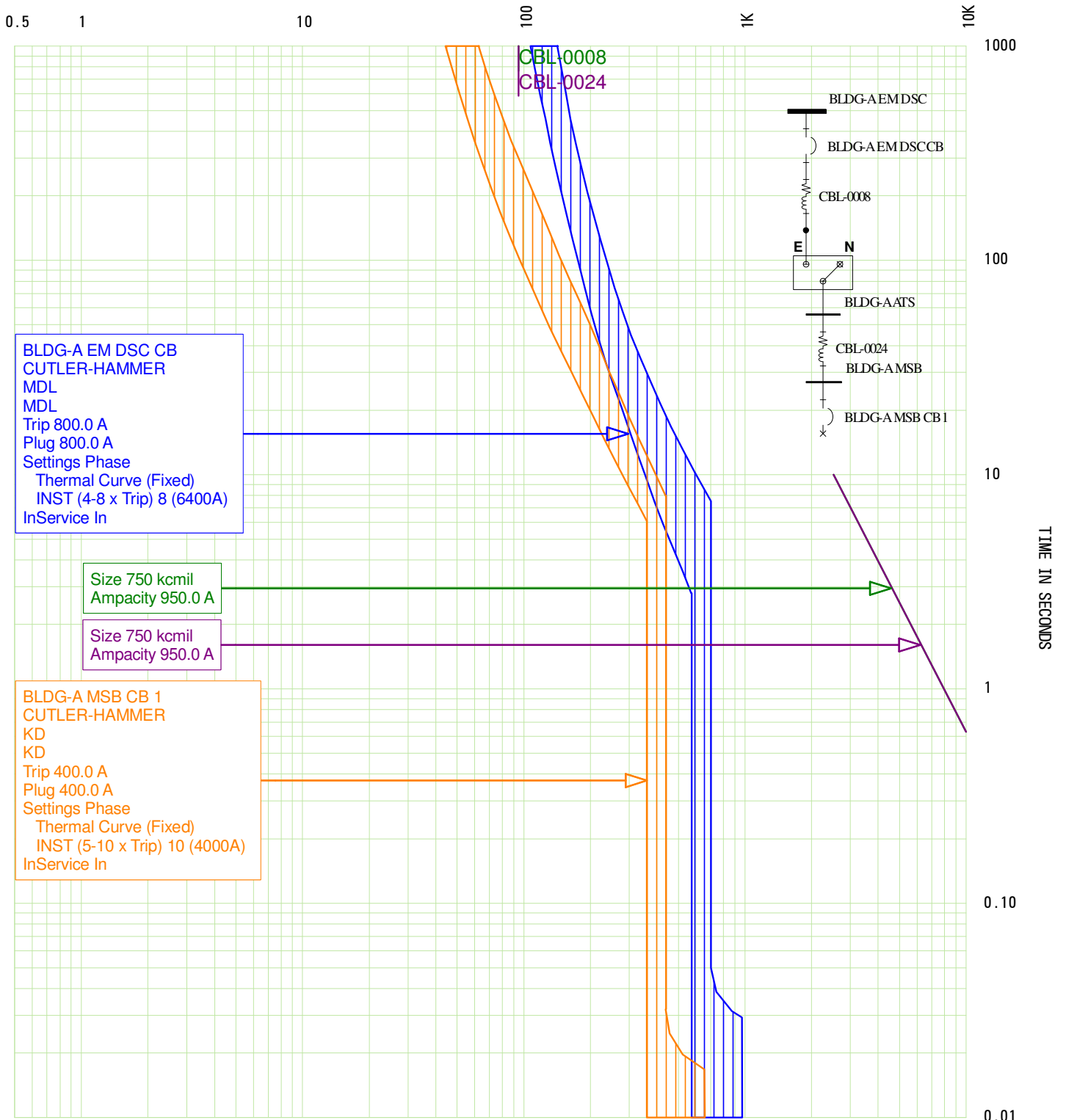


Figure 6: Typical Fuse Curve

The following time-current curves (TCCs) graphically depict the time vs. current characteristics for each overcurrent protective device shown, and the relationship of each device to the other devices that are in electrical series. Fuse and circuit breaker information was documented by SEAM Group during the data collection phase of this project. A TCC will be created to illustrate the largest device for each panel to consider worst case coordination situations for the system.

Each set of plotted curves shows at least two protective devices. Also shown are the fusing characteristics for any conductors being protected by the plotted devices. The plotted characteristics reflect the conditions that existed at the time data collection was completed. All recommendations presume the protective devices have been well and properly maintained to operate in accordance with the manufacturer's specifications. A single line diagram of the portion of the system being coordinated has been included on each curve as well as data blocks that illustrate the protective device manufacturer and model, along with the associated settings and ratings for the device.

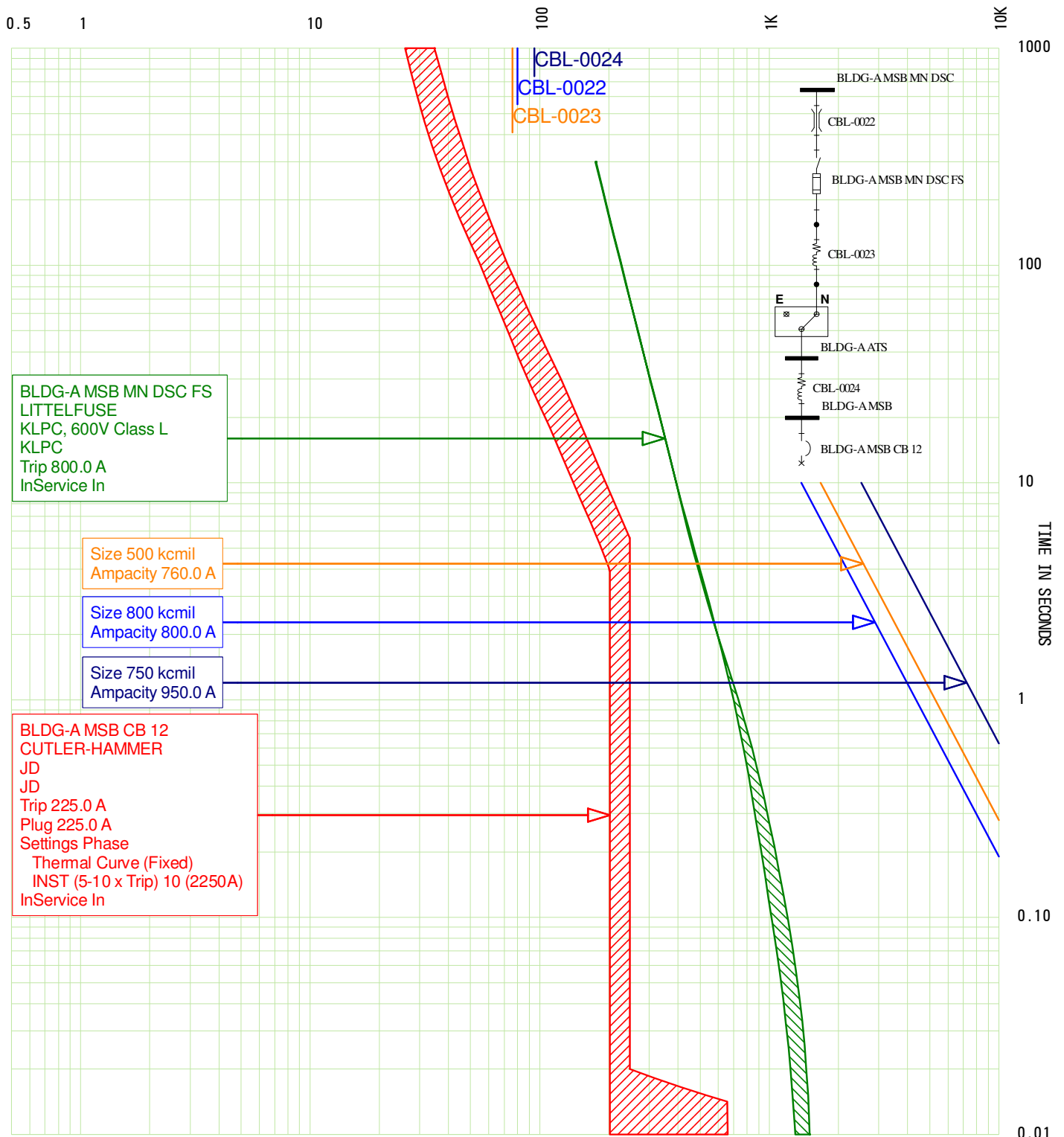
CURRENT IN AMPERES



TCC Name: BLDG-A EM DSC To BLDG-A MSB
 Jurupa Community Services District - Facility - April 2, 2019
 Current Scale x 10
 Reference Voltage: 480



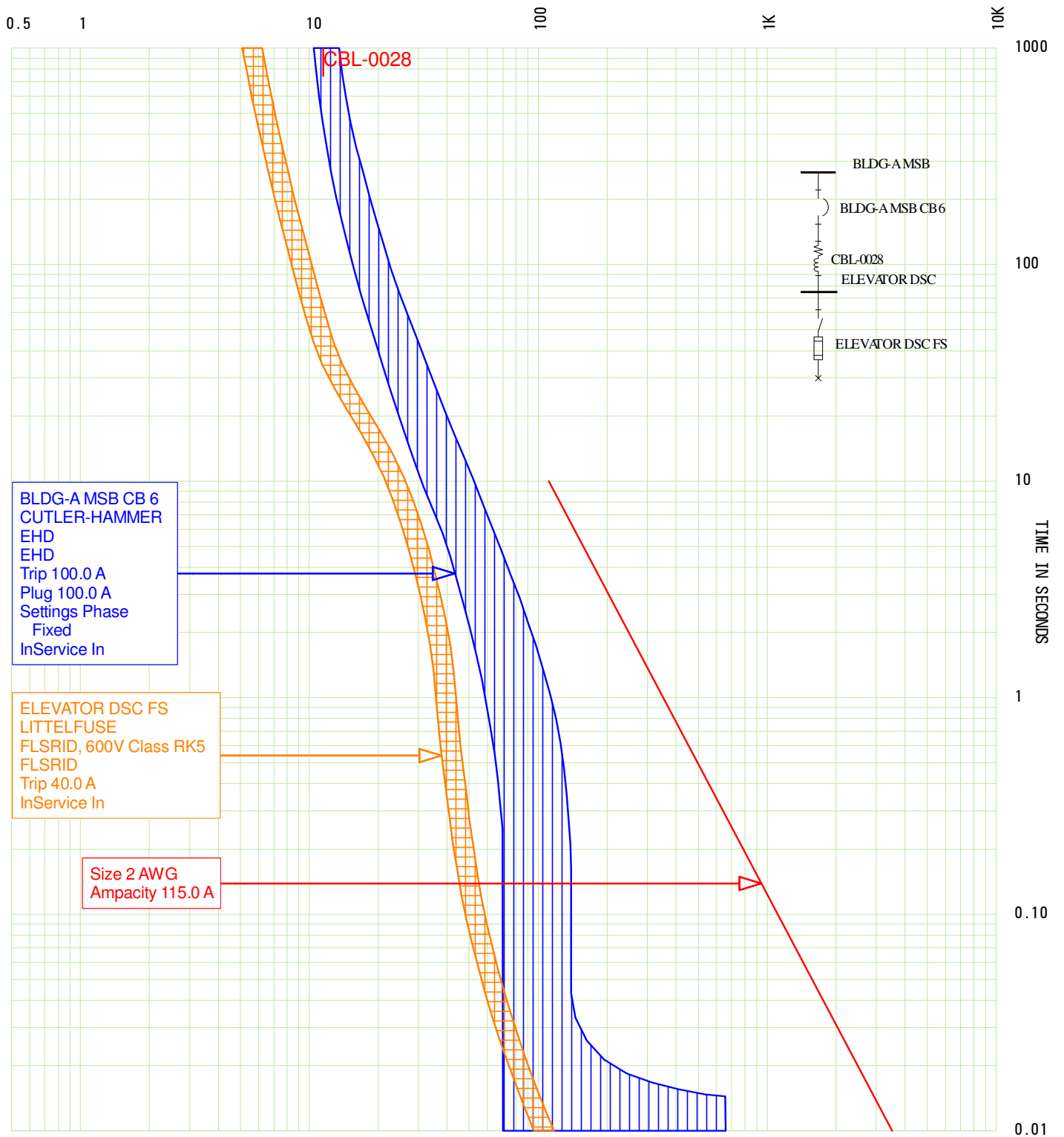
CURRENT IN AMPERES



TCC Name: BLDG-A MSB MN DSC To BLDG-A MSB
Jurupa Community Services District - Facility - April 2, 2019
Current Scale x 10
Reference Voltage: 480



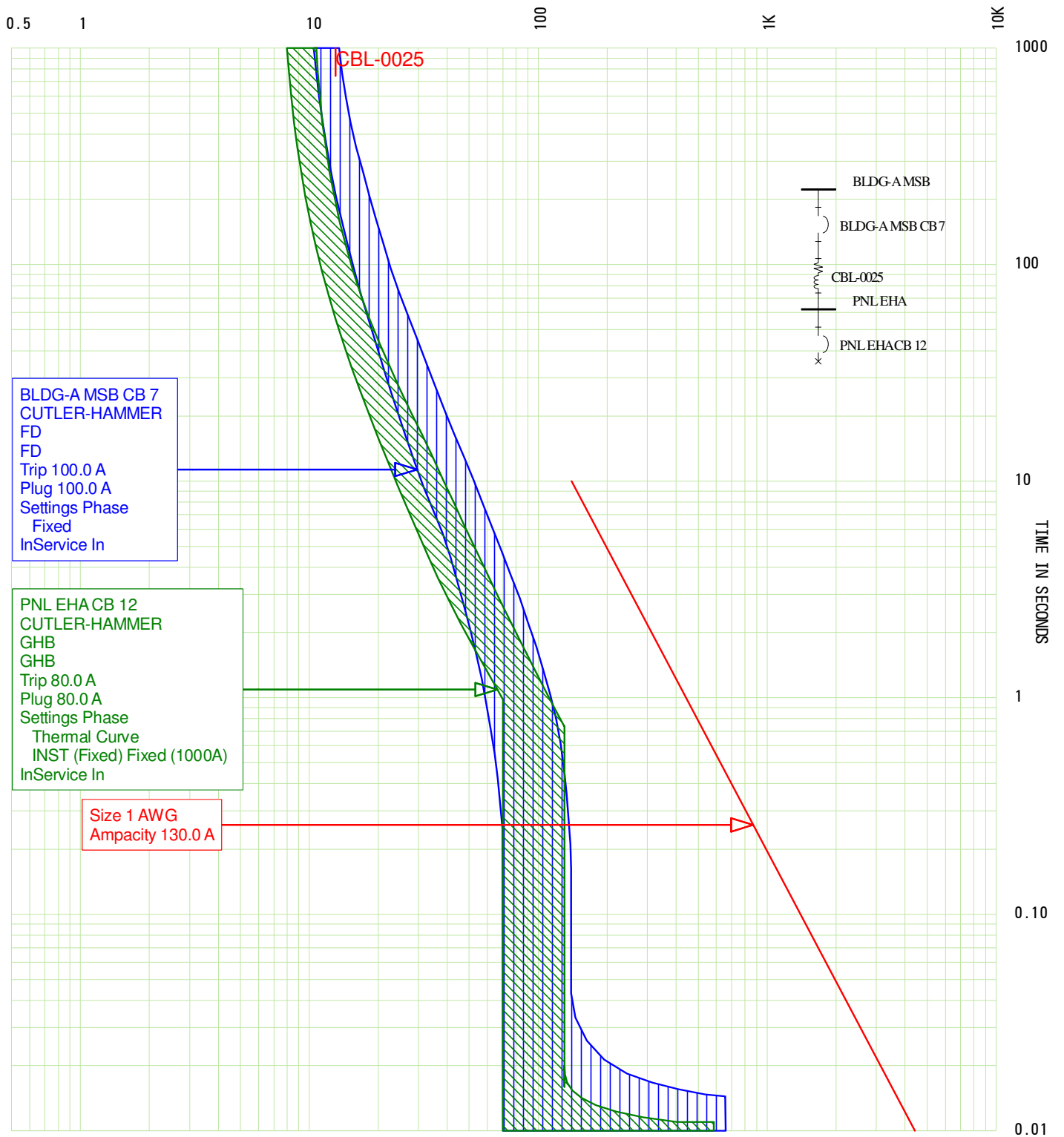
CURRENT IN AMPERES



TCC Name: BLDG-A MSB To ELEVATOR DSC
 Jurupa Community Services District - Facility - April 2, 2019
 Current Scale x 10
 Reference Voltage: 480



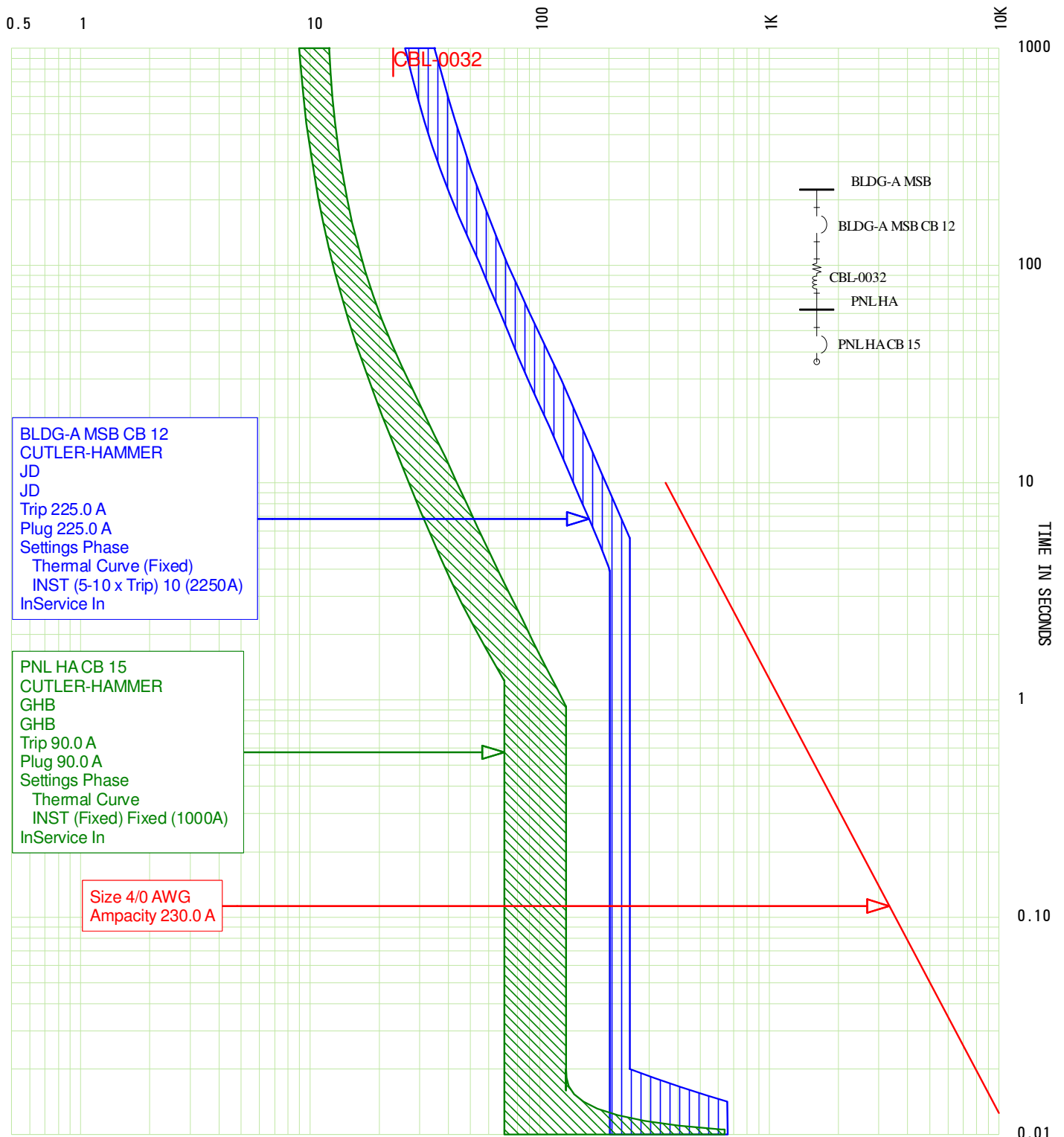
CURRENT IN AMPERES



TCC Name: BLDG-A MSB To PNL EHA
 Jurupa Community Services District - Facility - April 2, 2019
 Current Scale x 10
 Reference Voltage: 480



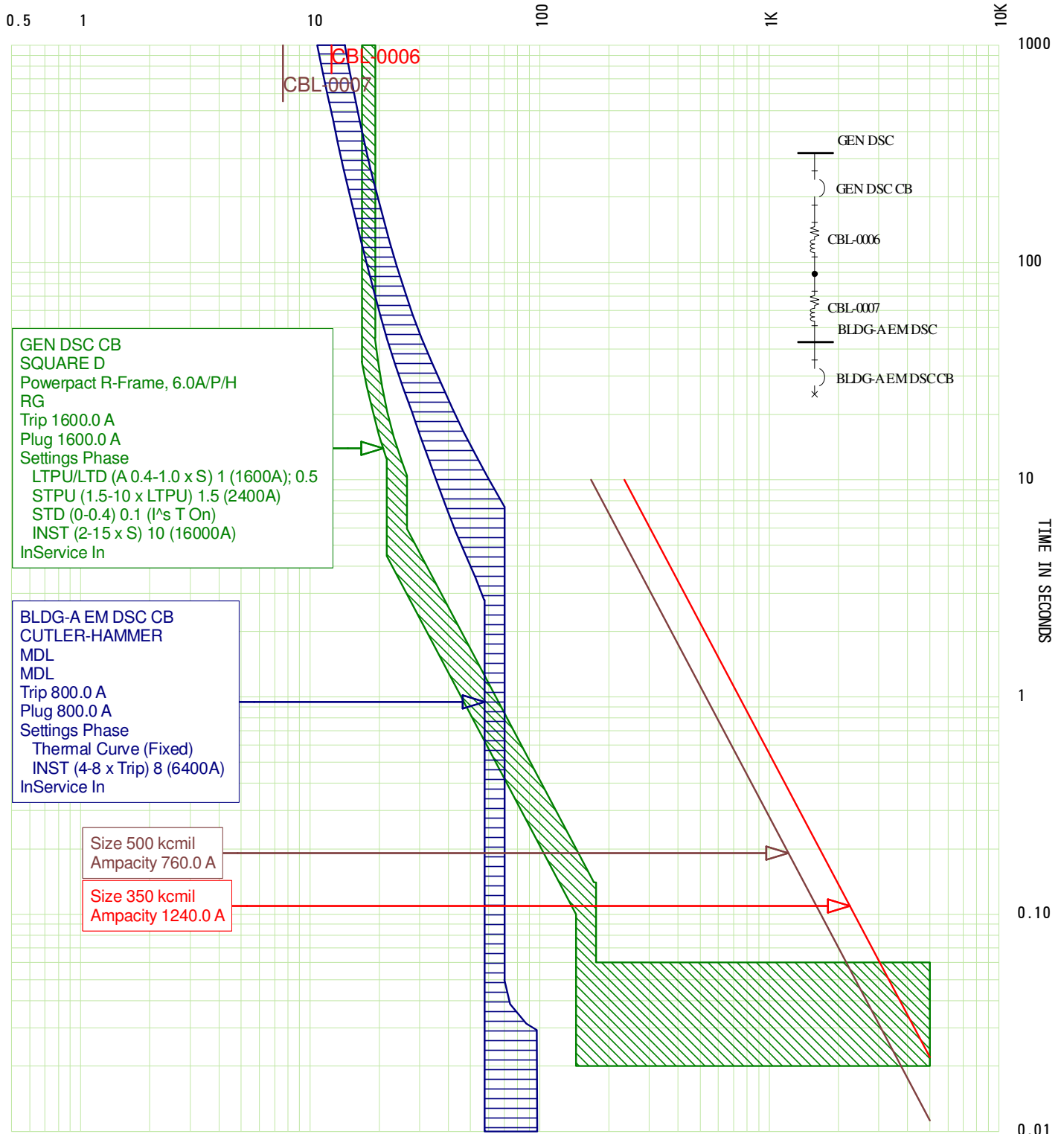
CURRENT IN AMPERES



TCC Name: BLDG-A MSB To PNL HA
 Jurupa Community Services District - Facility - April 2, 2019
 Current Scale x 10
 Reference Voltage: 480



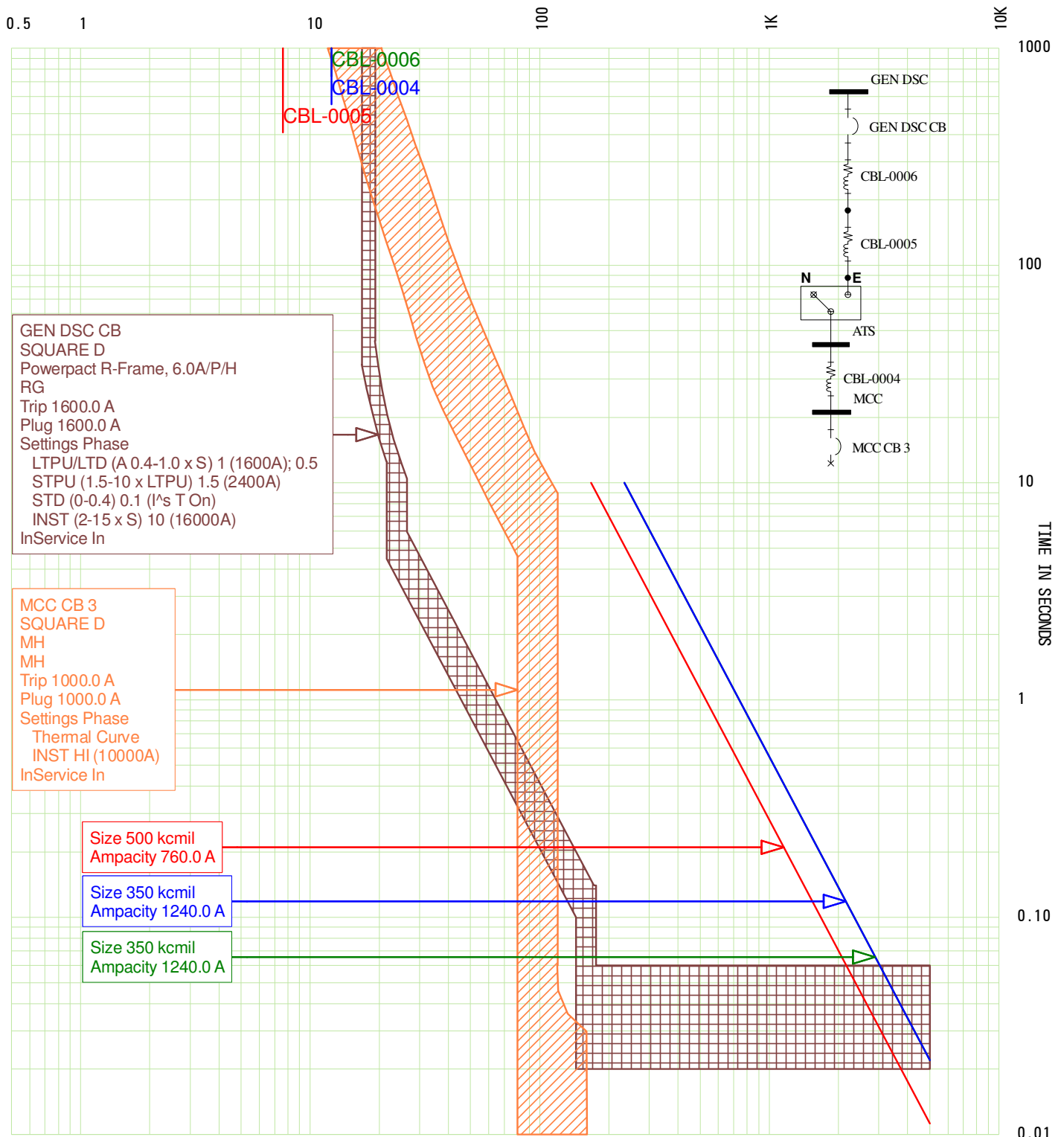
CURRENT IN AMPERES



TCC Name: GEN DSC To BLDG-A EM DSC
Jurupa Community Services District - Facility - April 2, 2019
Current Scale x 100
Reference Voltage: 480



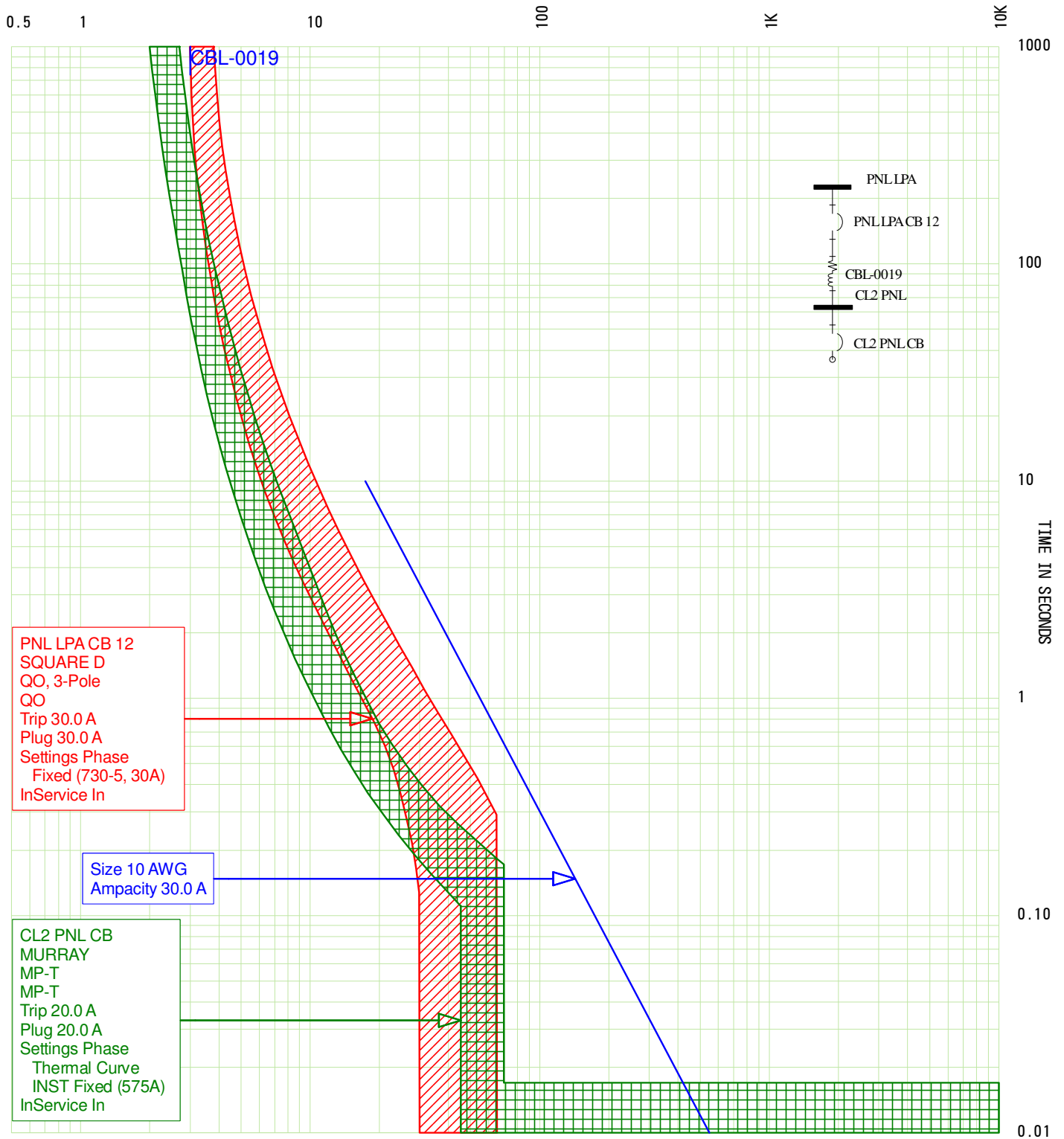
CURRENT IN AMPERES



TCC Name: GEN DSC To MCC
 Jurupa Community Services District - Facility - April 2, 2019
 Current Scale x 100
 Reference Voltage: 480



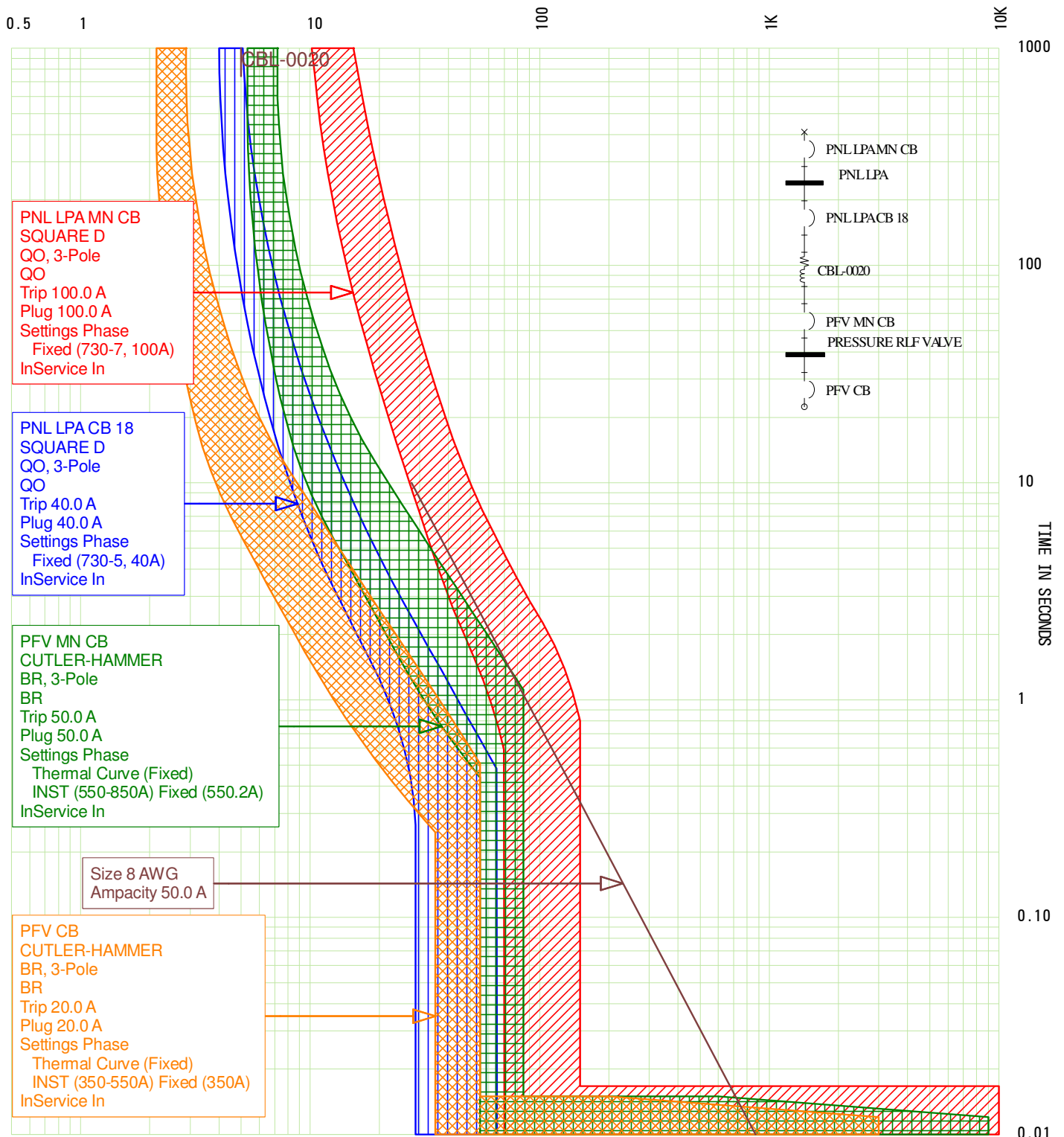
CURRENT IN AMPERES



TCC Name: PNL LPA To CL2 PNL
 Jurupa Community Services District - Facility - April 2, 2019
 Current Scale x 10
 Reference Voltage: 240



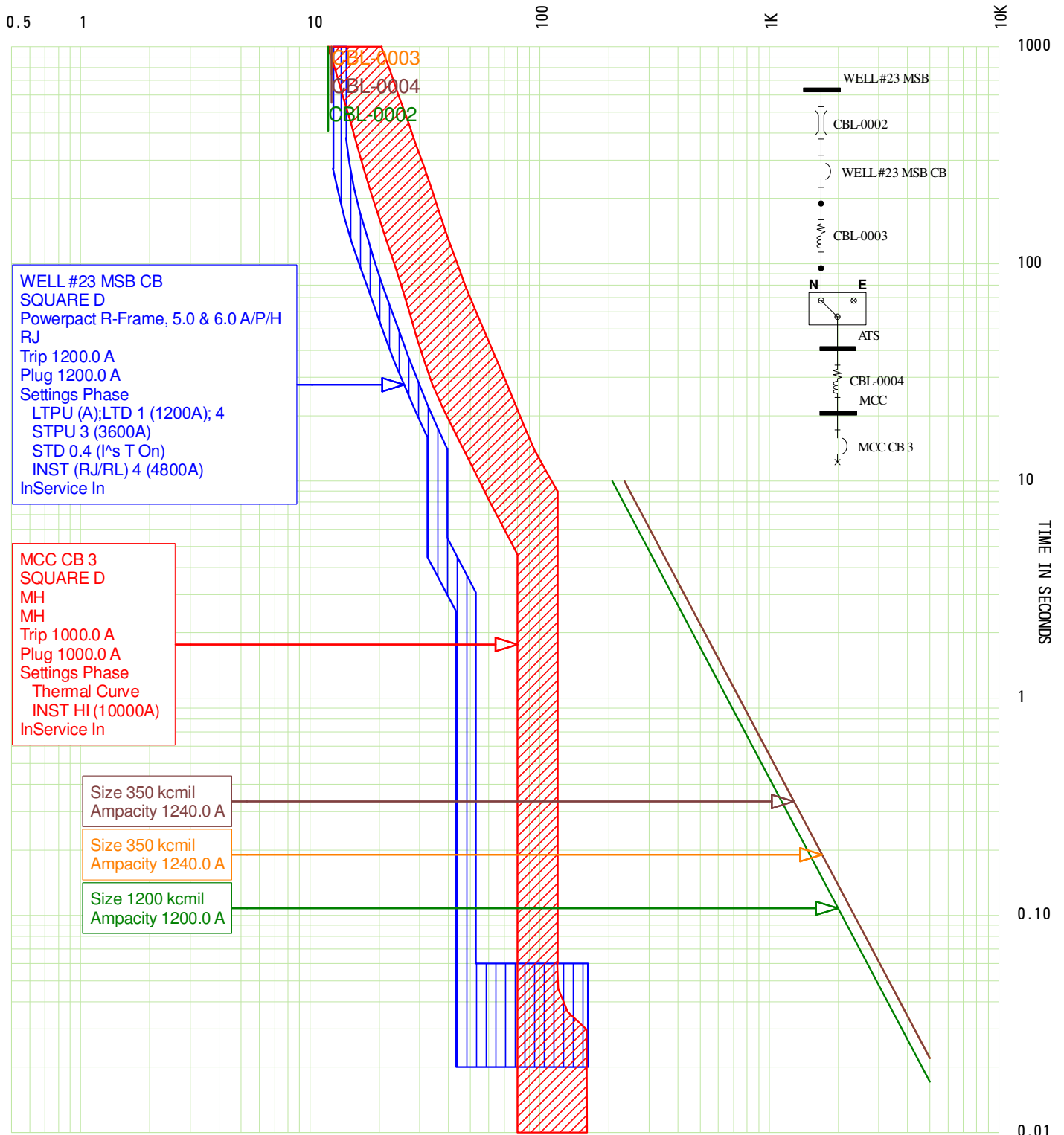
CURRENT IN AMPERES



TCC Name: PNL LPA To PRESSURE RLF VALVE
 Jurupa Community Services District - Facility - April 2, 2019
 Current Scale x 10
 Reference Voltage: 240



CURRENT IN AMPERES



TCC Name: WELL #23 MSB To MCC
 Jurupa Community Services District - Facility - April 2, 2019
 Current Scale x 100
 Reference Voltage: 480



Protective Device Settings

The following pages will outline the protective device type and settings for the devices as found during the on-site data collection process. The settings presented will not reflect any recommendations made for the protective devices in Section 3 Findings & Recommendations.

Jurupa Community Services District - Facility

Ground Fault

Prot Dev	Function	Connected Bus	Voltage	Manufacturer	Description	Frame Desc.	Frame	Sensor	Segments
WELL #23 MSB CB	Ground	BUS-0004	480	SQUARE D	GF, 600-1200AS, UL	RJ	2,500	1,200	GFPD (0.2-1.0 x S) B GFD (0-0.4) 0.4 I2T In

Jurupa Community Services District - Facility

Low Voltage Fuses

Prot Dev	Connected Bus	Voltage	Manufacturer	Type	Description	Cartridge	Cartridge Size	Trip
BLDG-A MSB MIN DSC FS	BUS-0030	480	LITTELFUSE	KLPC, 600V Class L	601-6000A	KLPC	800	800
COMP #1 DSC FS	COMP #1 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
COMP #2 DSC FS	COMP #2 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
CU 3A DSC FS	CU 3A DSC	480	GOULD SHAWMUT	TRS, 600V Class RK5	15-600A	TRS	30	30
CU EAST #1 DSC FS	CU EAST #1 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	30
CU EAST #2 DSC FS	CU EAST #2 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
CU EAST #5 DSC FS	CU EAST #5 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
CU EAST #7 DSC FS	CU EAST #7 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
CU EAST #8 DSC FS	CU EAST #8 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
CU EAST #9 DSC FS	CU EAST #9 DSC	480	GOULD SHAWMUT	TRS, 600V Class RK5	15-600A	TRS	25	20
CU WEST #10 DSC FS	CU WEST #10 DSC	480	BUSSMANN	FRS-R, 600V Class RK5	1-600A	FRS-R	15	15
CU WEST #11 DSC FS	CU WEST #11 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
CU WEST #12 DSC FS	CU WEST #12 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
CU WEST #3B DSC FS	CU WEST #3B DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	15
CU WEST #4 DSC FS	CU WEST #4 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	20
CU WEST #6 DSC FS	CU WEST #6 DSC	480	LITTELFUSE	FLSRID, 600V Class RK5	15-600A	FLSRID	30	15

Prot Dev	Connected Bus	Voltage	Manufacturer	Type	Description	Cartridge	Cartridge Size	Trip
ELEVATOR DSC FS	ELEVATOR DSC	480	LITTELFUSE	FLSRID, 600V Class RKS	15-600A	FLSRID	60	40

Project: Jurupa Community Serv Dst (Facility) -
 Jurupa Community Services District - Facility

Static Trip

Dev Name	Function	Bus	Voltage	Manufacturer	Frame Desc.	Frame Size	Sensor	Plug	LTPU	LTD	STPU	STD	I2T	INST
GEN DSC CB	Phase	GEN DSC	480	SQUARE D	RG	2,500	1,600	1,600	1	0.51	1.5	0.1	In	10
WELL #23 MSB CB	Phase	BUS-0004	480	SQUARE D	RJ	3,000	1,200	1,200	1	1	3	0.4	In	4

Jurupa Community Services District - Facility

LOW VOLTAGE THERMAL MAGNETIC MOLDED CASE BREAKER SETTINGS

DESIGNATION			FRAME		TRIP UNIT				
Location/Name	Function	Amps Frame	MFR	TYPE MODEL	Amps Sensor Plug	Description	TYPE/MODEL	INST SETTING	
BLDG-A EM DSC CB	Phase	800	CUTLER-HAMMER	MDL	800 800	300-800A	MDL	Thermal Curve (Fixed INST (4-8 x Trip) 8	
BLDG-A MSB CB 1	Phase	400	CUTLER-HAMMER	KD	400 400	100-400A	KD	Thermal Curve (Fixed INST (5-10 x Trip) 10	
BLDG-A MSB CB 10	Phase	125	CUTLER-HAMMER	FD	125 125	15-225A	FD	Fixed	
BLDG-A MSB CB 11	Phase	250	CUTLER-HAMMER	JD	250 250	70-250A	JD	Thermal Curve (Fixed INST (5-10 x Trip) 10	
BLDG-A MSB CB 12	Phase	225	CUTLER-HAMMER	JD	225 225	70-250A	JD	Thermal Curve (Fixed INST (5-10 x Trip) 10	
BLDG-A MSB CB 3	Phase	250	CUTLER-HAMMER	HJD	250 250	70-250A	HJD	Thermal Curve (Fixed INST (5-10 x Trip) 5	
BLDG-A MSB CB 4	Phase	200	CUTLER-HAMMER	JD	200 200	70-250A	JD	Thermal Curve (Fixed INST (5-10 x Trip) 8.50	
BLDG-A MSB CB 6	Phase	100	CUTLER-HAMMER	EHD	100 100	15-100A	EHD	Fixed	
BLDG-A MSB CB 7	Phase	100	CUTLER-HAMMER	FD	100 100	15-225A	FD	Fixed	
BLDG-A MSB CB 8	Phase	125	CUTLER-HAMMER	FD	125 125	15-225A	FD	Fixed	
CL2 PNL CB	Phase	20	MURRAY	MP-T	20 20	15-40A, 2-3 poles	MP-T	Thermal Curve INST Fixed	
MCC CB 2-1	Phase	60	SQUARE D	GJL	60 60	15-100A	GJL	Fixed	
MCC CB 2-4	Phase	40	SQUARE D	FH	40 40	15-100A	FH	Fixed	

DESIGNATION			FRAME		TRIP UNIT			
Location/Name	Function	Amps Frame	MFR	TYPE MODEL	Amps Sensor Plug	Description	TYPE/MODEL	INST SETTING
MCC CB 3	Phase	1,000	SQUARE D	MH	1,000 1,000	125-1200A	MH	Thermal Curve INST HI
PFV CB	Phase	20	CUTLER-HAMMER	BR	20 20	15-100A	BR, 3-Pole	Thermal Curve (Fixed) INST (350-550A) Fixed
PFV MN CB	Phase	60	CUTLER-HAMMER	BR	50 50	15-100A	BR, 3-Pole	Thermal Curve (Fixed) INST (550-850A) Fixed
PNL EHA CB 12	Phase	80	CUTLER-HAMMER	GHB	80 80	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL EHA CB 3	Phase	40	CUTLER-HAMMER	GHB	40 40	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HA CB	Phase	20	CUTLER-HAMMER	GHB	20 20	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HA CB 15	Phase	90	CUTLER-HAMMER	GHB	90 90	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HA CB 28	Phase	20	CUTLER-HAMMER	GHB	20 20	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HB CB 10	Phase	70	CUTLER-HAMMER	GHB	70 70	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HB CB 15	Phase	30	CUTLER-HAMMER	GHB	30 30	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HB CB 16	Phase	20	CUTLER-HAMMER	GHB	20 20	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HB CB 21	Phase	30	CUTLER-HAMMER	GHB	30 30	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HB CB 27	Phase	30	CUTLER-HAMMER	GHB	30 30	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HB CB 50-52	Phase	20	CUTLER-HAMMER	GHB	20 20	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HB CB 58	Phase	90	CUTLER-HAMMER	GHB	90 90	15-100A, 2-3 Pole	GHB	Thermal Curve INST (Fixed) Fixed
PNL HB MN CB	Phase	400	CUTLER-HAMMER	HKD	400 400	100-400A	HKD	Thermal Curve (Fixed) INST (5-10 x Trip) 10

DESIGNATION			FRAME		TRIP UNIT			
Location/Name	Function	Amps Frame	MFR	TYPE MODEL	Amps Sensor Plug	Description	TYPE/MODEL	INST SETTING
PNL LC CB 33	Phase	60	CUTLER-HAMMER	BAB	60 60	10-125A	BAB, 2-Pole	Fixed
PNL LC CB 34	Phase	50	CUTLER-HAMMER	BAB	50 50	10-125A	BAB, 2-Pole	Fixed
PNL LC CB 35	Phase	50	CUTLER-HAMMER	BAB	50 50	10-125A	BAB, 2-Pole	Fixed
PNL LC CB 36	Phase	20	CUTLER-HAMMER	BAB	20 20	10-125A	BAB, 2-Pole	Fixed
PNL LC MN CB	Phase	400	CUTLER-HAMMER	HKD	400 400	100-400A	HKD	Thermal Curve (Fixed INST (5-10 x Trip) 10
PNL LC-1 GAS PUMP CB 9	Phase	20	CUTLER-HAMMER	BR	15 15	15-100A	BR, 3-Pole	Thermal Curve (Fixed INST (350-550A) Fixed
PNL LPA CB 12	Phase	30	SQUARE D	QO	30 30	15-100A	QO, 3-Pole	Fixed (730-5, 30A)
PNL LPA CB 18	Phase	40	SQUARE D	QO	40 40	15-100A	QO, 3-Pole	Fixed (730-5, 40A)
PNL LPA MN CB	Phase	100	SQUARE D	QO	100 100	15-100A	QO, 3-Pole	Fixed (730-7, 100A)

7. Incident Energy Summary and Calculations Methods

The arc flash risk assessment is done to conform to OSHA recommendations described in 29CFR 1910.333. Procedures for arc flash risk assessments are described in both NFPA Standard 70E-2018 and IEEE Standard 1584-2002-2004a. IEEE Standard 1584-2002-2004a describes a method for calculating the potential incident energy exposure is based on the anticipated “bolted” fault current. The results reported herein have been calculated using the more conservative, interpreted as more rigid, IEEE Standard 1584-2002-2004a.

IEEE Standard 1584-2002-2004a states that equipment rated below 240V need not be considered unless it involves a transformer larger than 125 KVA in its immediate supply. The reason for this exclusion is the inability of such small capacity systems to initiate and support arcing conditions. NFPA Standard 70E-2018 references the IEEE 1584 standard for use in the incident energy calculations. Since NFPA Standard 70E is recognized as the guiding document, SEAM Group has applied the limits from IEEE 1584.

The PTW arc flash incident energy analysis follows the NFPA 70E 2018 and IEEE 1584 2002 methods for determining the arc flash boundary distance and the incident energy that workers may be exposed to when working on or near electrical equipment. The incident energy analysis combines short circuit calculations, empirical equations and protective device operating times to estimate incident energy and protective clothing requirements at typical working distances.

The incident energy analysis report assumes the following criteria:

- Trip time is determined from the first upstream device to clear the fault as determined by the TCC curve
- Worker is stationary during the entire arc flash incident (constant working distance)
- Induction motors continuous sub-transient current for 5 cycles and motors less than 50HP ignored
- Interrupting device is rated for the available short circuit current (no equipment damage is considered)
- Ground fault and motor over load devices are not included
- For multi-function protective devices, only the first function is used to determine the trip time
- Reports only the larger incident energy based on 85% and 100% tolerances applied to the calculating arcing fault current
- A maximum trip time of 2 seconds is used assuming that a worker would be removing himself from the area within that time frame.
- The IEEE 1584 – 2002/2004a Edition standard equations were used as the basis for the calculations

The default values for equipment categories and gap, along with working distances used by PTW are indicated in Tables 7.1 and 7.2 below:

Table 7.1 Bus Gap Distances

Gap (mm)	Class of Equipment	Voltage
32	Switchgear	≤ 1kV
25	MCCs & Panelboards	≤ 1kV
102	Switchgear	1 – 5kV
153	Switchgear	>5kV
13	All Cable	Any
104	Open Air	1 – 5kV
153	Open Air	>5kV

Table 7.2 Working Distances

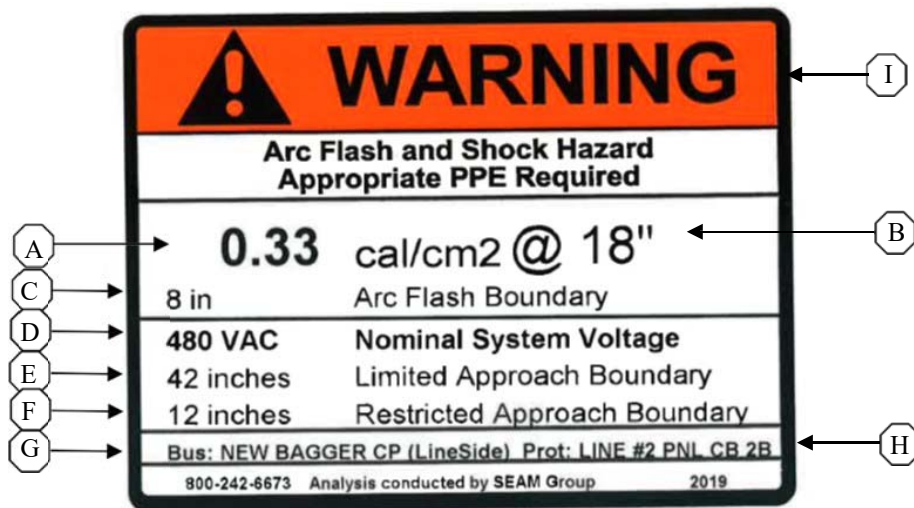
Working Distance	Equipment Type	Voltage
24 inches (610mm)	Switchgear	≤1kV
18 inches (455mm)	Panel	≤1kV
36 inches (910mm)	Switchgear	>1 & <35 kV
72 inches (1829mm)	Switchgear	>35kV
18 inches (455mm)	All others	-

The arc flash report in the following pages outlines the following:

- Arc flash Boundary - the distance from exposed live parts within which a person could receive 2nd degree burns
- Working Distance – the distance between the arc source and the worker’s face or chest
- Incident Energy – the amount of energy on a surface at a specific distance from the flash

Along with determining the incident energy exposure levels and arc flash boundaries in a facility through an incident energy analysis, the customer must also determine the appropriate PPE that should be worn by their “Qualified Electrical Workers.” When energized work must be performed, SEAM Group recommends using the NFPA 70E 2018, PPE selection Table 130.5(G) for guidance. The customer simply needs to reference the equipment label provided to determine the incident energy exposure level and wear the PPE with an incident energy rating greater than the value indicated on the label, along with the additional safety equipment as outlined in the PPE table included with this report.

Equipment found to have an incident energy rating at or above 40 cal/cm² is considered “Dangerous”. PPE is available to protect against the thermal portion of the available incident energy; however, this PPE may not be sufficient to protect a worker from the shock wave produced by the incident. SEAM Group recommends de-energizing the equipment whenever possible to reduce the risk. Operation of electrical equipment found to be above 40 cal/cm² is possible assuming the equipment is in normal operating conditions as outlined in 2018 NFPA 70E 130.2(A)(4). SEAM Group also recommends that PPE be worn when the normal operation of any device is conducted to provide protection to the worker in the case of an arc flash incident.



- (A) **PPE – Incident Energy** – The incident energy value that determines the required PPE as outlined in NFPA 70E 130.5(C)(1) and as referenced in the arc flash table in Section 7.
- (B) **Working Distance** – The distance from the arc source and the worker’s face or chest
- (C) **Arc Flash Protection Boundary** – When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur. The Boundary distance overrides the Approach distances
- (D) **Bus Voltage Rating** – Voltage rating at the equipment being analyzed.
- (E) **Limited Approach** – An approach limit at a distance from an exposed live part within which a shock hazard exists. This is the closest approach distance for an unqualified worker unless additional protective measures are used; an unqualified worker may only enter this area if accompanied by a qualified worker at all times.
- (F) **Restricted Approach** – An approach limit at a distance from an exposed live part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the live part. This is the closest approach distance for a qualified worker unless additional protective measures are used.
- (G) **Bus** – “Bus” represents the actual equipment being analyzed (i.e. Switchgear, MCC, Panel, Disconnect, etc)
- (H) **Protective Device** – Protective device that is clearing the fault for the associated equipment, this may not always be the next upstream device due to coordination
- (I) **Warning** – Label alert statement, “WARNING” for incident energy exposure between 0 and 40 cal/cm² and “DANGEROUS” for anything above an incident energy of 40 cal/cm²

SEAM Group will apply all labels with an incident energy exposure of 1.2 cal/cm² and above at the time of the report delivery. At this time, SEAM Group will also deliver all of the labels with an incident energy below 1.2 cal/cm² required for the specific project. The labels with an incident energy below 1.2 cal/cm² should be applied by the owner at their convenience, within the first 3 months. These labels will be identical to the labels with an incident energy above 1.2 cal/cm² that SEAM Group will have already applied. The Bus Name (Item A) is the name of the equipment to which the label should be affixed to in the field. For example, if the bus name designates DSC AHU-1 then the label should be affixed to the disconnect supplying Air Handling Unit #1.

Please note that the protective device name (Item H referenced in the label example on the previous page) designates the device that is responsible for clearing the fault condition and may not logically be the first upstream device supplying the bus name indicated on the label. This can be because the immediate upstream device does not coordinate with the device that is downstream of it, resulting in the upstream device clearing the fault faster. For instance, you have circuit breaker SWB-1 CB5A in SWB-1 that supplies PNL-1 that contains a circuit breaker PNL-1 CB2 that supplies a downstream load RTU-1. If circuit breaker SWB-1 CB5A in SWB-1 operates faster than PNL-1 CB2 in PNL-1, then these two devices are not properly coordinated and the arc flash label will indicate that circuit breaker SWB-1 CB5A in SWB-1 is the protective device for RTU-1 and not PNL-1 CB2 in PNL-1. This can also be a result of an alternate system configuration being supplied via transfer switch. SEAM Group reviews all possible system configurations when doing the arc flash analysis and reports the worst-case scenario, thus the protective device shown on the label may be the result of an alternate scenario where the particular bus is fed from an alternate feed in the system (i.e. main-tie-main configuration, ATS's, etc).

The labels provided are for panels, disconnects, MCC's, etc, with an internal bus that would require service by onsite personnel. SEAM Group does not provide labels for motors, transformers, or individual MCC buckets or individual breakers in a given piece of equipment. The label provided for the stated "Bus" applies to the entire piece of equipment (i.e. all sections of a given MCC, switchgear, or switchboard), unless otherwise noted.

Buss ducts and their associated buss duct plugs will be labeled based on the plug with the highest incident energy value (worst case). The buss duct(s) will receive placard style labels approximately every 20 feet.

The table beginning on the next page shows arc flash incident energy exposure levels calculated for the existing system. Included in the table are the critical distances, the fault currents, and the incident energies for the indicated working distance for each bus analyzed. Arc flash hazard warning labels for the equipment have been created from this table. Label colors are: safety orange for incident energies between 0 and 40 cal/cm² and Red for incident energies above 40 cal/cm². Labels were provided for all devices analyzed for this report. Labels with an incident energy greater than 1.2 cal/cm² will be applied at the time of the report delivery. Labels with an incident energy less than 1.2 cal/cm² will be provided to the owner to label all remaining equipment as outlined in the report. Labels should be applied to disconnects, panels, switchgear, motor control centers, etc. In addition to labels with an incident energy less than 1.2 cal/cm² outlined in the report, labels indicating an incident energy below 1.2 cal/cm² should also be placed on the first disconnect or panel downstream from any transformer that is rated less than 125 kVA with a 240 V or less secondary. These labels with an incident energy less than 1.2 cal/cm² at 240 V were applied by SEAM Group during the data collection process.

Jurupa Community Facility - Jurupa, CA

Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)
208V REC DSC 1	PNL LC CB 35	0.208	1.68	1.68	1.25	0.01	PNL	25	2	18	0.03
208V REC DSC 2	PNL LC CB 35	0.208	1.68	1.68	1.25	0.01	PNL	25	2	18	0.03
2ND FLR ATS	PNL EHA CB 12	0.48	6.02	6.02	4.25	0.0087	PNL	25	4	18	0.11
ATS	GEN DSC CB	0.48	12.94	9.77	5.24	1.508	PNL	25	119	18	26.46
BLDG EXT LTG CP	PNL HB CB 50-52	0.48	5.45	5.45	3.91	0.0087	PNL	25	4	18	0.1
BLDG-A ATS	BLDG-A MSB MN DSC FS	0.48	8.59	8.59	5.76	2	PNL	25	145	18	36.55
BLDG-A EM DSC	GEN DSC CB	0.48	12.83	9.70	5.21	1.525	PNL	25	119	18	26.66
BLDG-A MSB	BLDG-A MSB MN DSC FS	0.48	6.58	6.58	4.59	2	PNL	25	125	18	28.6
BLDG-A MSB MN DSC	MaxTripTime @2.0s	0.48	8.64	8.64	5.79	2	PNL	25	145	18	36.78
CL2 PNL	PNL LPA CB 12	0.24	0.56	0.56	0.56	0.3863	PNL	25	6	18	0.13
COMP #1 CP	COMP #1 DSC FS	0.48	2.93	2.93	2.30	0.0042	PNL	25	2	18	0.03
COMP #1 DSC	PNL HB CB 10	0.48	3.20	3.20	2.47	0.0095	PNL	25	3	18	0.07
COMP #2 CP	COMP #2 DSC FS	0.48	2.93	2.93	2.30	0.0042	PNL	25	2	18	0.03
COMP #2 DSC	PNL HB CB 10	0.48	3.20	3.20	2.47	0.0095	PNL	25	3	18	0.07
CU 1ST FL DSC	PNL HB CB 15	0.48	3.74	3.74	2.83	0.009	PNL	25	3	18	0.08
CU 2ND FL DSC	PNL HB CB 21	0.48	3.74	3.74	2.83	0.009	PNL	25	3	18	0.08
CU 3A CP	CU 3A DSC FS	0.48	3.32	3.32	2.56	0.0042	PNL	25	2	18	0.03
CU 3A DSC	PNL HA CB 28	0.48	3.78	3.78	2.86	0.009	PNL	25	3	18	0.08

Jurupa Community Facility - Jurupa, CA

Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)
CU EAST #1 CP	CU EAST #1 DSC FS	0.48	5.49	5.49	3.93	0.0042	PNL	25	3	18	0.05
CU EAST #1 DSC	BLDG-A MSB CB 8	0.48	5.88	5.88	4.17	0.0163	PNL	25	6	18	0.21
CU EAST #2 CP	CU EAST #2 DSC FS	0.48	5.49	5.49	3.93	0.0042	PNL	25	3	18	0.05
CU EAST #2 DSC	BLDG-A MSB CB 8	0.48	5.88	5.88	4.17	0.0163	PNL	25	6	18	0.21
CU EAST #5 CP	CU EAST #5 DSC FS	0.48	4.84	4.84	3.53	0.0042	PNL	25	2	18	0.04
CU EAST #5 DSC	BLDG-A MSB CB 8	0.48	5.20	5.20	3.75	0.0167	PNL	25	6	18	0.19
CU EAST #7 CP	CU EAST #7 DSC FS	0.48	4.21	4.21	3.13	0.0042	PNL	25	2	18	0.04
CU EAST #7 DSC	BLDG-A MSB CB 8	0.48	5.20	5.20	3.75	0.0167	PNL	25	6	18	0.19
CU EAST #8 CP	CU EAST #8 DSC FS	0.48	4.51	4.51	3.32	0.0042	PNL	25	2	18	0.04
CU EAST #8 DSC	BLDG-A MSB CB 8	0.48	5.20	5.20	3.75	0.0167	PNL	25	6	18	0.19
CU EAST #9 CP	CU EAST #9 DSC FS	0.48	4.84	4.84	3.53	0.0042	PNL	25	2	18	0.04
CU EAST #9 DSC	BLDG-A MSB CB 8	0.48	5.20	5.20	3.75	0.0167	PNL	25	6	18	0.19
CU WEST #10 CP	CU WEST #10 DSC FS	0.48	4.33	4.33	3.21	0.0042	PNL	25	2	18	0.04
CU WEST #10 DSC	BLDG-A MSB CB 10	0.48	5.36	5.36	3.85	0.0166	PNL	25	6	18	0.2
CU WEST #11 CP	CU WEST #11 DSC FS	0.48	5.00	5.00	3.62	0.0042	PNL	25	2	18	0.05
CU WEST #11 DSC	BLDG-A MSB CB 10	0.48	5.36	5.36	3.85	0.0166	PNL	25	6	18	0.2
CU WEST #12 CP	CU WEST #12 DSC FS	0.48	5.00	5.00	3.62	0.0042	PNL	25	2	18	0.05
CU WEST #12 DSC	BLDG-A MSB CB 10	0.48	5.36	5.36	3.85	0.0166	PNL	25	6	18	0.2

Jurupa Community Facility - Jurupa, CA

Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Equip Type	Gap (mm)	Arc Flash Boundary (ft)	Working Distance (in)	Incident Energy (cal/cm2)
CU WEST #3B CP	CU WEST #3B DSC FS	0.48	4.33	4.33	3.21	0.0042	PNL	25	2	18	0.04
CU WEST #3B DSC	BLDG-A MSB CB 10	0.48	5.36	5.36	3.85	0.0166	PNL	25	6	18	0.2
CU WEST #4 CP	CU WEST #4 DSC FS	0.48	5.67	5.67	4.04	0.0042	PNL	25	3	18	0.05
CU WEST #4 DSC	BLDG-A MSB CB 10	0.48	6.07	6.07	4.28	0.0162	PNL	25	6	18	0.21
CU WEST #6 CP	CU WEST #6 DSC FS	0.48	5.67	5.67	4.04	0.0042	PNL	25	3	18	0.05
CU WEST #6 DSC	BLDG-A MSB CB 10	0.48	6.07	6.07	4.28	0.0162	PNL	25	6	18	0.21
ELEVATOR CP	ELEVATOR DSC FS	0.48	5.22	5.22	3.76	0.0042	PNL	25	3	18	0.05
ELEVATOR DSC	BLDG-A MSB CB 6	0.48	5.56	5.56	3.97	0.0158	PNL	25	6	18	0.19
GEN DSC	MaxTripTime @2.0s	0.48	13.15	10.01	6.57	2	PNL	25	159	18	42.63
LEAK DET MONITOR CP	PNL LC CB 33	0.208	1.68	1.68	1.24	0.01	PNL	25	2	18	0.03
MCC	GEN DSC CB	0.48	12.90	9.73	5.22	1.52	PNL	25	119	18	26.57
MODULAR MN DSC	BLDG-A MSB CB 4	0.48	3.77	3.77	2.85	0.0182	PNL	25	5	18	0.16
MOHAWK DSC	PNL LC CB 34	0.208	1.18	1.18	0.97	0.01	PNL	25	2	18	0.03
MOHAWK LIFT DSC	PNL LC CB 34	0.208	1.49	1.49	1.14	0.01	PNL	25	2	18	0.03
OVERHEAD CRANE DSC	PNL HB CB 16	0.48	2.95	2.95	2.31	0.0093	PNL	25	3	18	0.06
PNL EHA	BLDG-A MSB CB 7	0.48	6.10	6.10	4.30	0.0154	PNL	25	6	18	0.21
PNL EHA CONTACTOR CP	PNL EHA CB 12	0.48	5.59	5.59	3.99	0.0088	PNL	25	4	18	0.11
PNL ELA	PNL EHA CB 3	0.48	5.93	5.93	4.20	0.0086	PNL	25	4	18	0.11

Jurupa Community Facility - Jurupa, CA

Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/ Delay Time (sec.)	Equip Type	Gap (mm)	Arc Flash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)
PNL HA	BLDG-A MSB CB 12	0.48	6.61	6.61	4.60	0.0159	PNL	25	7	18	0.23
PNL HA CONTACTOR CP	PNL HA CB	0.48	6.05	6.05	4.27	0.0086	PNL	25	4	18	0.11
PNL HB (PNL HB MN CB LineSide)	BLDG-A MSB MN DSC FS	0.48	5.55	5.55	3.96	2	PNL	25	113	18	24.42
PNL LC (PNL LC MN CB LineSide)	PNL HB CB 58	0.208	5.21	5.21	2.34	1.606	PNL	25	70	18	11.08
PNL LC-1 GAS PUMP	PNL LC CB 33	0.208	1.70	1.70	1.25	0.01	PNL	25	2	18	0.04
PNL LPA (PNL LPA MN CB LineSide)	MCC CB 2-4	0.24	0.65	0.65	0.65	2	PNL	25	14	18	0.76
PRESSURE RLF VALVE	PNL LPA CB 18	0.24	0.49	0.49	0.49	0.832	PNL	25	8	18	0.24
PRESSURE RLF VALVE (PFV MN CB LineSide)	PNL LPA CB 18	0.24	0.49	0.49	0.49	0.832	PNL	25	8	18	0.24
STEAM CLEANER DSC	PNL HB CB 27	0.48	3.74	3.74	2.83	0.009	PNL	25	3	18	0.08
TIRE ALIGN DSC	PNL LC CB 34	0.208	1.49	1.49	1.14	0.01	PNL	25	2	18	0.03
WELL #23 MSB	MaxTripTime @2.0s	0.48	16.25	13.12	8.27	2	PNL	25	185	18	54.55
WHSE SUPPLY FAN CP	PNL LC CB 36	0.208	4.27	4.27	2.39	0.01	PNL	25	3	18	0.07
WHSE SUPPLY FAN DSC	PNL LC CB 36	0.208	3.43	3.43	2.05	0.01	PNL	25	3	18	0.06

ARC FLASH PPE

Information Gathered from NFPA 70E-2018 Edition



INCIDENT ENERGY ANALYSIS METHOD*

PROTECTIVE CLOTHING AND PPE	INCIDENT ENERGY EXPOSURE		
	<1.2 cal/cm ²	≥1.2 to 12 cal/cm ²	>12 cal/cm ²
Protective Clothing, non-melting (in accordance with ASTM F 1506) or untreated natural fiber, long sleeve shirt and pants or coveralls	✓		
Safety glasses	✓	✓	✓
Hard hat	✓	✓	✓
Hearing protection	✓	✓	✓
Leather footwear	✓	✓	✓
Rubber insulating gloves with leather protectors for arc and shock protection	✓	✓	✓
Arc rated long sleeve shirt and arc rated pants or arc rated coverall		✓	
Arc rated face shield and arc rated balaclava		✓	
Arc rated arc flash suit hood, jacket and pants			✓
Undergarments shall be made of a non-melting material in accordance with ASTM F 1506	✓	✓	✓

*This table is for use only when an incident energy analysis has been completed. If incident energy exposure has not been determined, refer to NFPA 70E-2018 Edition for PPE Category Method



<1.2 cal/cm²



≥ 1.2 to 12 cal/cm²



> 12 cal/cm²

EXAMPLE LABEL
(Not actual size)

WARNING	
Arc Flash and Shock Hazard Appropriate PPE Required	
25.1 cal/cm² @ 18"	
9 ft 7 in	Arc Flash Boundary
480 VAC	Nominal System Voltage
42 inches	Limited Approach Boundary
12 inches	Restricted Approach Boundary
Bus: MSB Prot: MaxTrip Time@2.0s	
800-242-6673 Analysis conducted by SEAM Group 12/31/19	

DISCLAIMER: This PPE guide and any information contained within is for reference purposes only and not meant to replace any regulation, code or standard. For detailed information regarding appropriate PPE selection, please refer to NFPA 70E-2018 Edition.

8. Single-Line Drawings

The single-line drawings that follow show the system topology and the calculated sustained fault currents for the plant.

















The three-phase and line-to-ground fault currents are shown at each bus on the included drawings. These fault current values will represent the normal operating mode only and will not reflect emergency or alternate configuration fault currents. These represent the pertinent data used for the short circuit interrupting evaluation as well as the values used for the incident energy analysis (Please note that in some instances the worst-case values may actually be based on the alternate scenario fault current). Protective device information indicating the manufacturer and device size are also shown for customer reference.

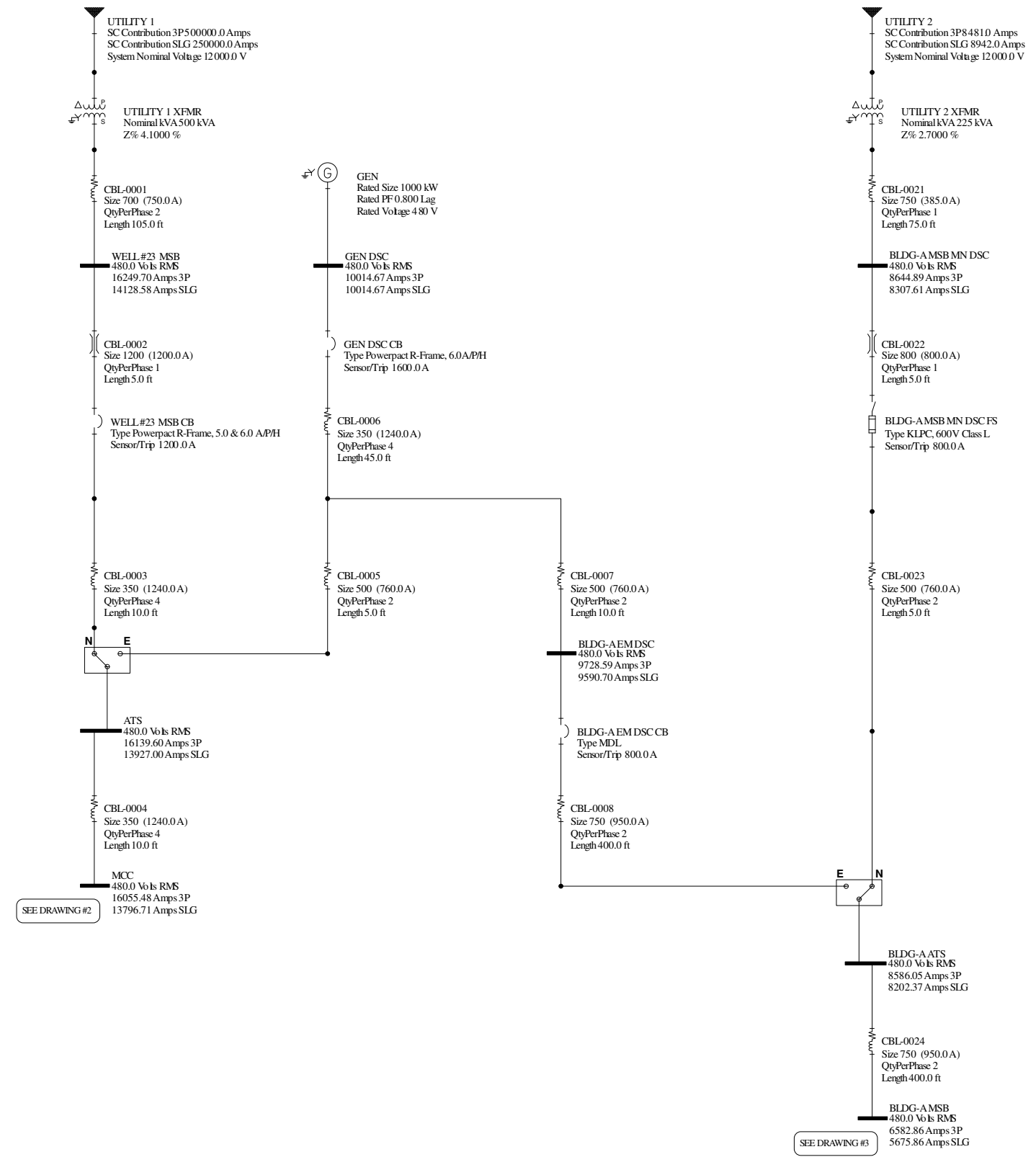
Single-line drawings have been provided on a USB drive in .dxf format that is compatible with AUTOCAD and also in PDF format. The annotated drawings show circuit breaker and fuse data, cable data, transformer data, and fault currents.

Table 8 Drawing Schedule

Drawing Name	Major Buses
Drawing #1	WELL #23 MSB
Drawing #2	MCC * PNL LPA
Drawing #3	BLDG-A MSB * PNL EHA * PNL HA
Drawing #4	PNL HB
Drawing #5	CU EAST DSC(s) * CU WEST DSC(s)

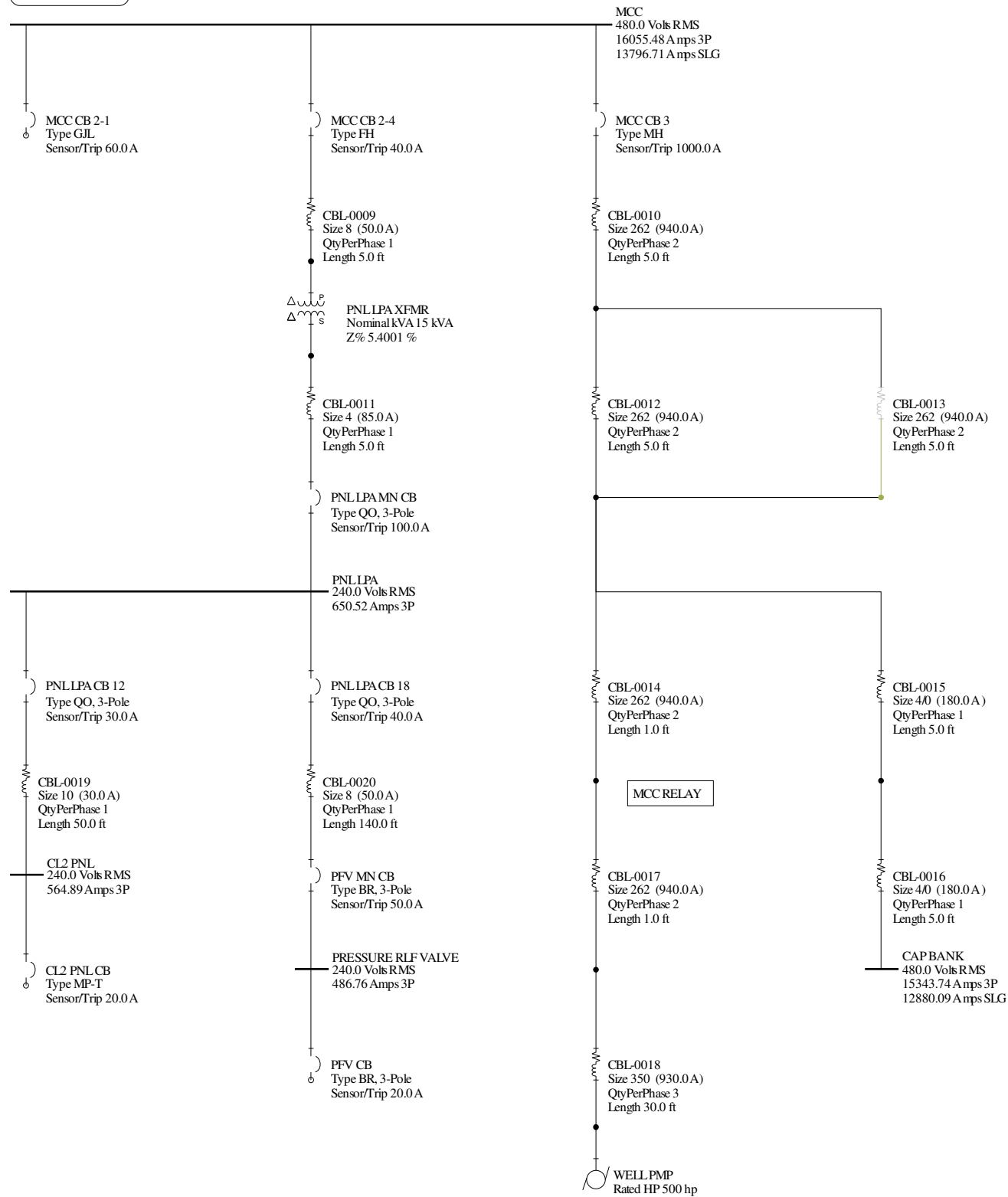
LEGEND

	PANEL / MCC / SWITCHGEAR		FUSED SWITCH
	CONDUCTOR		NON-FUSED SWITCH
	TRANSFORMER		RELAY
	TRANSMISSION LINE		HIGH-VOLTAGE CIRCUIT BREAKER
	UTILITY FEED		TRANSFER SWITCH
	GENERATOR		VARIABLE FREQUENCY DRIVE
	MOTOR		UNINTERRUPTIBLE POWER SUPPLY
	LOW VOLTAGE CIRCUIT BREAKER		BUSWAY



Jurupa Community Services District - Facility
 Drawing #1
 April 2, 2019
 Calculated Fault Currents Shown at Busses
 are Derived from Base Scenario (S0)

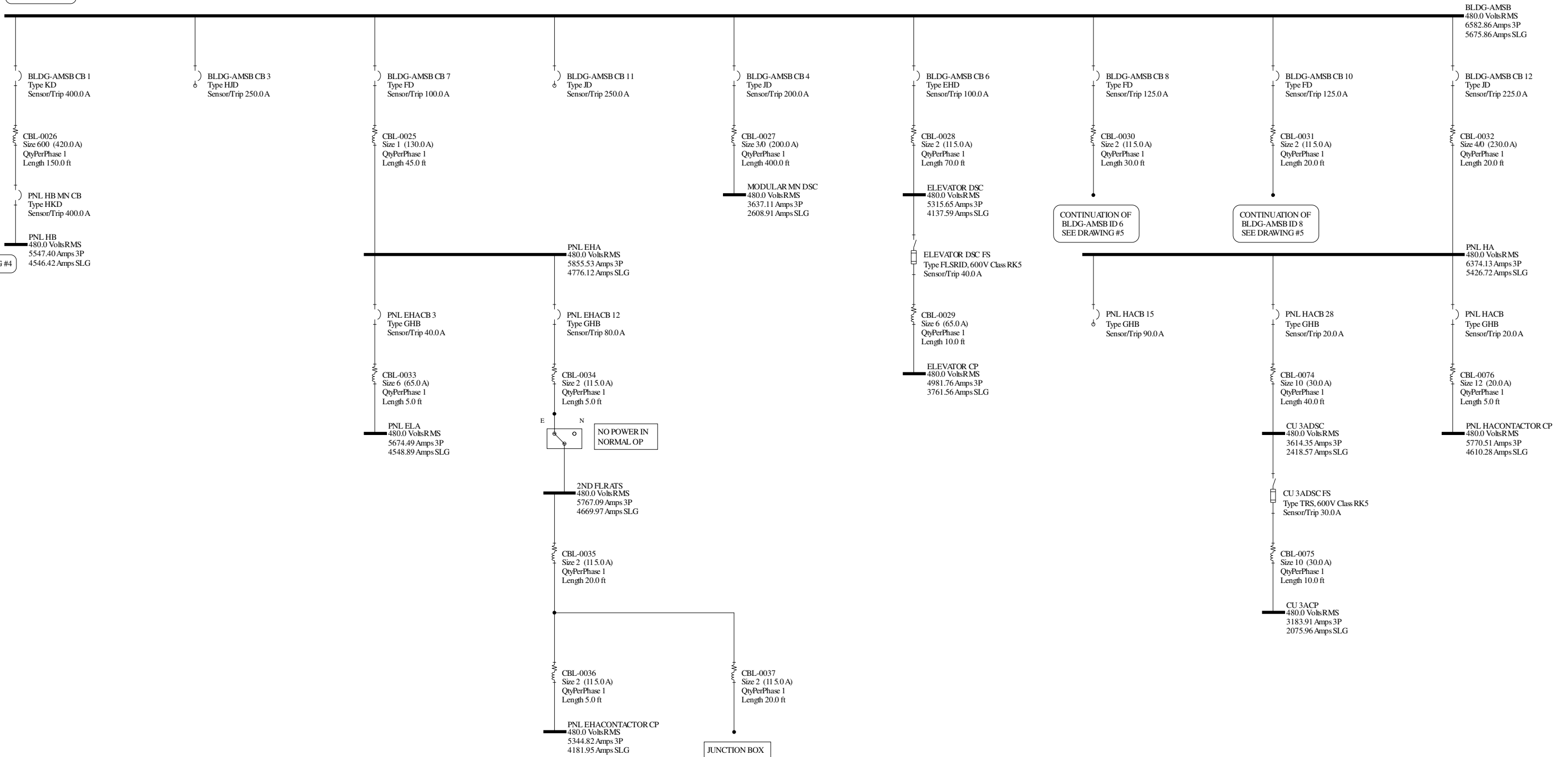
SEE DRAWING #1



Jurupa Community Services District - Facility
Drawing #2
April 2, 2019
Calculated Fault Currents Shown at Busses
are Derived from Base Scenario (S0)

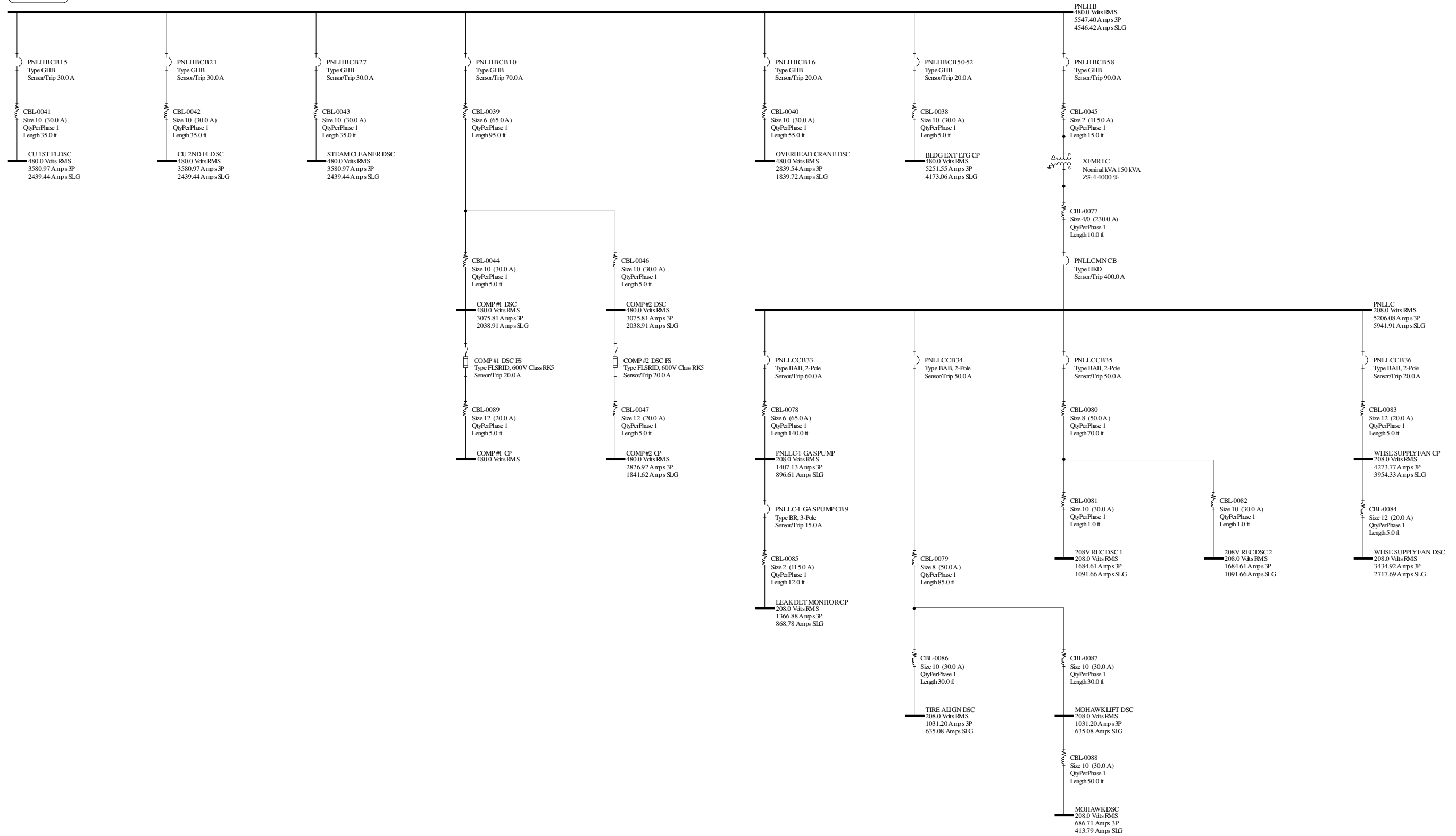
SEE DRAWING #1

SEE DRAWING #4



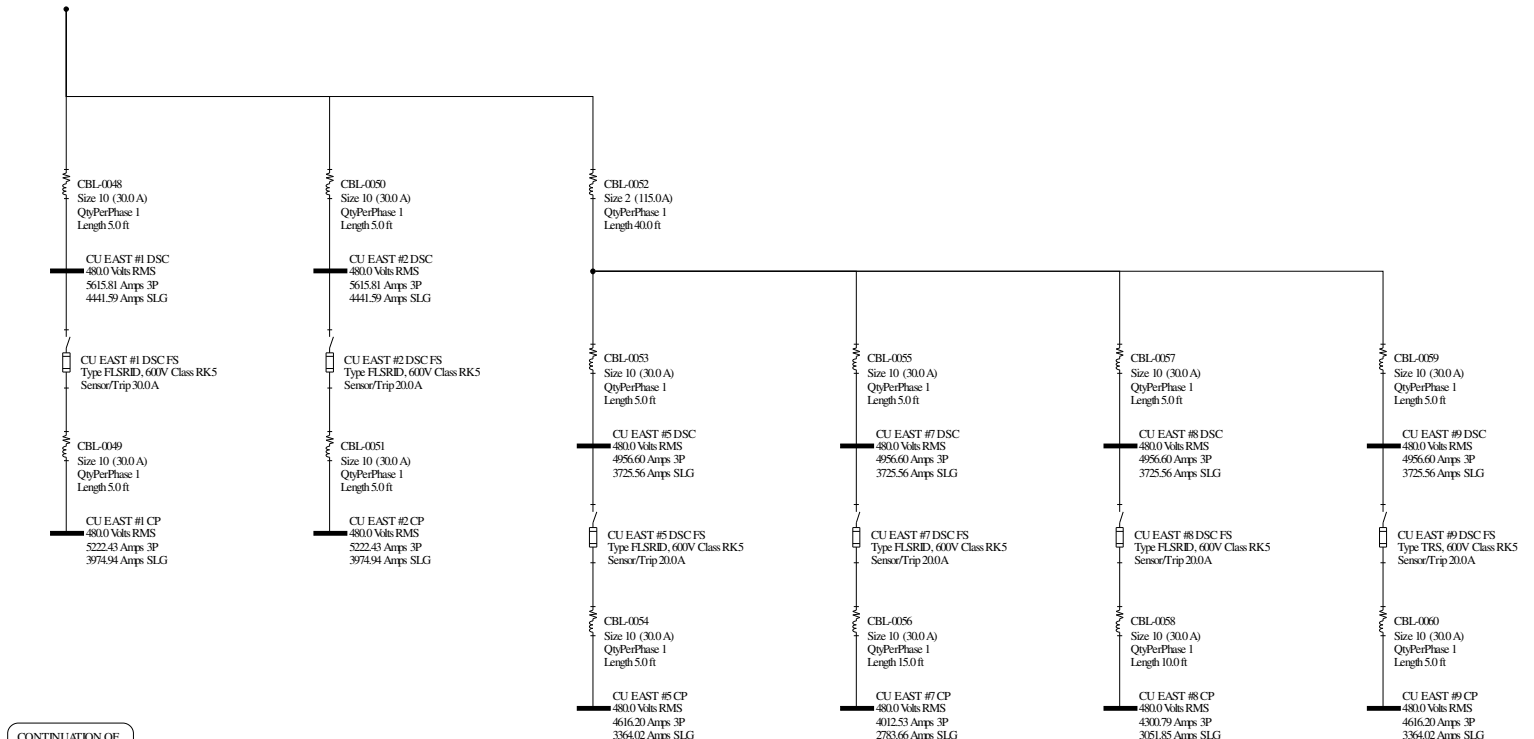
Jurupa Community Services District - Facility
 Drawing #3
 April 2, 2019
 Calculated Fault Currents Shown at Busses
 are Derived from Base Scenario (S0)

SEE DRAWING #3

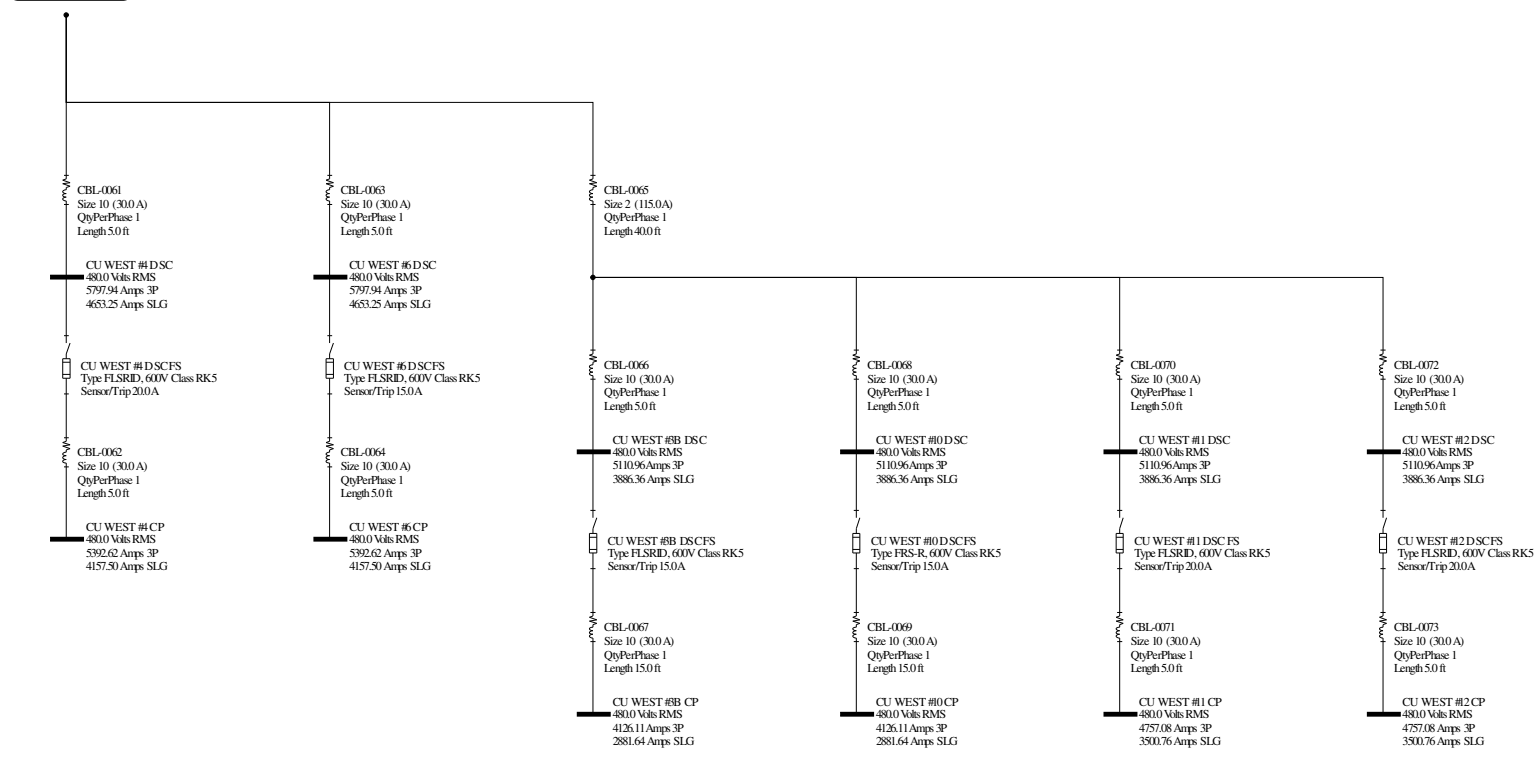


Jurupa Community Services District - Facility
 Drawing #4
 April 2, 2019
 Calculated Fault Currents Shown at Busses
 are Derived from Base Scenario (S0)

CONTINUATION OF
BLDG-AMSB ID 6
SEE DRAWING #3



CONTINUATION OF
BLDG-AMSB ID 8
SEE DRAWING #3



Jurupa Community Services District - Facility
Drawing #5
April 2, 2019
Calculated Fault Currents Shown at Busses
are Derived from Base Scenario (S0)

9. Appendix

Appendix – September 21, 2017

APPENDIX – FIELD TECHNICIAN FORM

Project: Jurupa Community Services District
Location: Jurupa Valley, CA



Assumptions & Collection Notes:

- Checked in with David and Jamie.

- Collected a total of 65 locations / sites...see attached list.

- All sites were collected per panel schedule.

- Checked out with David/ Jamie.

Additional data provided while on-site (drawings, test reports, etc.) - YES NO

In most cases data collection can be accomplished without interruption of facility operations. In the rare case where the data cannot be gathered due to our inability to access panels due to operational needs, panels located in areas requiring special security clearance, panels located in clean rooms, panels located in hazardous areas requiring specialized training, or other situations beyond our control, it would be necessary for the facility to gather that data and forward it to us.

Your facility's panelboards, bus ducts, motor control centers, disconnects, switchgear, etc, should be properly labeled per the National Electrical Code prior to our arrival. These labels should indicate, among other things, the name of the enclosure and what each of the fuses or circuit breakers are feeding. If there are unlabeled or mislabeled over-current protective devices it is the responsibility of the facility to rectify these if they are to be included in the analysis.

It is understood and accepted that the information on panel schedules and equipment labels was correct. It is understood and accepted that the assigned escort was knowledgeable of the facility electrical system and information received regarding the termination of loads was correct.

Lewellyn Technology must receive customer provided feedback outlining any outstanding information or questions as listed on this form within 3 weeks of the completion of the data collection in order to ensure timely project completion. We understand this may not always be possible and request that you contact our office within this timeframe to accommodate new scheduling if required. Delays in required information could result in delayed final project delivery.

Field Technician: MICKY SAMI

Date: 11 / 09 / 2016

Facility contact: [Signature]

Date: 11 / 09 / 2016

Printed name: Jaime Godoy

	FACILITY
1	BLDG A, B, MODULAR and Well # 23
	PARKS
2	AMERICAN HEROES PARK
3	CEDAR CREEK PARK
4	DAIRYLAND PARK
5	DEER CREEK PARK
6	EASTVALE COMMUNITY PARK
7	EASTVALE COMMUNITY CENTER
8	HALF MOON PARK
9	HARADA HERIAGE PARK
10	JAMES HUBER PARK
11	McKUNE FAMILY PARK
12	MOUNTAIN VIEW PARK
13	ORCHARD PARK
14	PROVIDENCE RANCH PARK
15	RIVER WALK PARK
16	SYMPHONY PARK
	SEWER
17	CHANDLER LIFT STATION
18	HAMNER LIFT STATION
19	RIVER ROAD LIFT STATION

20	44TH ST LIFT STATION
21	FLORINE LIFT STATION
22	LAKESIDE LIFT STATION
23	LINARES LIFT STATION
24	REGIONAL LIFT STATION
25	SKY COUNTRY 1 LIFT STATION
26	SKY COUNTRY 2 LIFT STATION
27	SKY COUNTRY 3 LIFT STATION
28	CLAY LIFT STATION
29	CLIFF VALLEY LIFT STATION
	WATER
30	AGATE BOOSTER STATION
31	ARMSTRONG BOOSTER STATION
32	CFD BOOSTER STATION
33	CLAY BOOSTER STATION
34	56TH ST BOOSTER STATION
35	INDIAN HILLS I BOOSTER STATION
36	JEWEL ST BOOSTER STATION
37	LIVE OAK BOOSTER STATION
38	BENEDICT RESERVOIRS
39	INDIAN HILLS II BOOSTER STATION
40	PEDLEY RESERVOIRS
41	SUNNYSLOPE RESERVOIRS
42	HIGH SCHOOL IRRIGATION WELL
43	IRRIGATION WELL 3,5 & 21
44	IRRIGATION WELL 40

Appendix A

Sheet1

45	IRRIGATION WELL 41
46	IRRIGATION WELL 42
47	VAN LEEUWEN IRRIGATION WELL
48	WELL 6
49	WELL 8
50	WELL 11
51	WELL 12
52	WELL 14
53	WELL 15
54	WELL 16
55	WELL 17
56	WELL 18
57	WELL 19
58	WELL 20
59	WELL 22
60	WELL 24
61	WELL 25
62	ROGER TEAGARDEN ION EXCHANGE PLANT
63	BAIN
64	WELL 27
65	WELL 28

APPENDIX – UTILITY DATA PROVIDED

Date of Response: 8/23/2017



Response to Letter of Request for Short Circuit Current Value for Panel Sizing and Protection Coordination

Disclaimer:

SCE provides the information contained in this letter on an "as is" basis without warranty of any kind, either express or implied. This disclaimer of liability applies to any claim or cause of action for damages or injuries occurring as a result of any error, omission, deletion or defect in the content of the information provided, including, but not limited to, negligence, breach of contract, or tort. Under no circumstances shall SCE or any of its parent or affiliate companies, employees, directors or shareholders be liable to any party for (i) any direct, indirect, special, punitive, incidental, exemplary, consequential, or any other damages arising in any way out of the availability, use or reliance on the information provided; or (ii) any claim attributable to errors, omissions or other inaccuracies in the information provided herein.

The values provided above are maximum Short Circuit values, based on current distribution system conditions. Utility distribution systems are dynamic, and the electrical characteristics of the system can vary significantly due to abnormal conditions, upgrades, modifications, and temporary or permanent reconfigurations. Therefore, the Short Circuit values provided above are subject to change frequently and without notice. SCE does not guarantee to hold the system parameters represented in this information constant. Consequently, SCE recommends that all electrical work on the service panel main breaker should be done in a de-energized condition to eliminate arc flash hazard at this location.

To: Customer: Jurupa Community Service
Dist
 Address: 11201 Harrel St
 City, Zip: Jurupa Valley, CA 91752

From: Southern California Edison (SCE) - Engineering & Technical Services - Field Engineering

Engineer: Rebecca Sandoval
 Address: 3 Innovation Way
 City, Zip: Pomona, CA 91768

Subject: Southern California Edison's Contribution to Short Circuit Current at the Point-of-Connection of the SCE's Service Conductors to the Customer's Service Entrance Facilities (see disclaimer above)

Project: Name: Jurupa Community Service Dist
 Address: 11201 Harrel St
 City, Zip: Jurupa Valley, CA 91752
 Structure #: P5464154

-
- (1) The voltage and service configuration to be utilized for this project will be 480 volts 3 phase 0 wire, to serve your 800 Ampere main switchboard
- (2) SCE's contribution to Short Circuit Current, **at the time of calculation**, is approximately 8,481 Amperes (3-phase) and 8,942 Amperes (phase-ground). **The 3-phase X/R = 2.04 and the phase-ground X/R = 2.12.**

Service Conductors: 3 runs of 350 Size (Al Cu)

Distance from Transformer: 85 feet

Transformer: 225 kVA, 3 phase, %Z = 2.7

Existing Transformer New Transformer

Comments:

- (3) SCE's **maximum** contribution to Short Circuit Current is approximately 15,235 Amperes (3-phase), and 15,774 Amperes (phase-ground). These maximum Short Circuit Current values are based on SCE's largest transformer capable of serving your 800 Ampere main service switchboard (at 100% rating).

Service Conductors: 4 runs of 350 Size (Al Cu)

Distance from Transformer: 85 feet

Transformer: 750 kVA, 3 phase, %Z = 5.32

Comments:

Update Guidelines

SEAM Group can provide consulting services to modify, add, and maintain the integrity of your Arc Flash Risk Assessment.

ARC FLASH SERVICES:

- Engineering and/or consulting services
- On-site work (as required)
- Label re-prints are \$3.00/label
- One complete report hard copy reprint included (additional copies \$100/each)

FEE SCHEDULE:

- Please contact us for accurate service rates at 800.242.6673 or seamgroup.com
- All invoices require payment Net 30 days.
- You may purchase consulting time in 5-hour blocks

ADDITIONAL SERVICES:

- Electrical Safety Program Development
- Safety Training
- Infrared Thermography (IR)
- LOTO Procedure Writing
- LVPM-Low Voltage Preventative Maintenance
- Arc Flash Hazard Mitigation

SEAM GROUP ARC FLASH UPDATE GUIDELINES

The following document will outline the information required to maintain and keep your arc flash study up to date.

What information would cause a change in my arc flash?

There are multiple items that can affect the results of your arc flash evaluation. Obviously if there is any new equipment added that will require an arc flash label then these items will have to be added to the existing arc flash study. Another instance is that if any circuit is moved from one location to another, then the new component information (wire, protective device) would need to be verified to make sure nothing has changed. Any time a cable size (including going from single to parallel cables) or cable distance is modified then the model would need to be updated to reflect the difference. Also any replacement of a protective device or any change in a protective devices settings needs to be noted as this can also change the arc flash rating of the associated device. Replacement of any transformer can also affect the arc flash study results.

What's required to be included in a Study?

An arc flash study should include any equipment that service personnel would enter/open to perform maintenance operations. This would include panelboards, switchboards, switchgear, MCC's, disconnects, and control panels.

Where do I indicate/illustrate the changes?

We often advise a customer to utilize the one-line drawings included in the original study to markup where equipment has been added or to mark out equipment that has been deleted. If the above required information for the devices can be clearly indicated on the one lines that is fine, otherwise the pertinent component data can be provided as a supplement to the marked up one lines. This allows for quick and easy reference for SEAM Group to know where the changes were made in the system so there isn't a misinterpretation of customer provided information without a one line.

What if I just implemented a recommendation in the study?

If the system change was an implementation of a particular recommendation in the report, then this recommendation can be referenced by the customer and SEAM Group can ask any additional clarification questions required.

Any other particular information needed?

When indicating new equipment that has been added please provide the proper equipment name as you would want it to appear in the report, indicate if it is a panel, disconnect, control panel, etc., and also indicate the circuit number for the protective device that is supplying the device.

SEAM GROUP ARC FLASH UPDATE GUIDELINES

I'm still confused, or my situation doesn't match anything here?

If you still have a question or your particular situation does not match a particular situation outlined here just contact SEAM Group and talk to one of our engineers for guidance!

Required Individual Component Information

Cables—Required information for cables includes the cable distance, the cable size, and if there are multiple cables in parallel for the particular circuit.

Protective Devices

Thermal Magnetic Circuit Breakers—Required information for thermal magnetic circuit breakers includes the manufacturer, model, size (amperage), and the instantaneous setting of the circuit breaker. (Please note that not all thermal magnetic circuit breakers will have adjustable instantaneous settings, often times if the breaker is <100A it will not have adjustable settings).

Electronic Trip Circuit Breakers—Similar to the thermal magnetic circuit breakers above, electronic trip circuit breakers are typically your larger frame circuit breakers used in switchboards and switchgear. The same manufacturer, model, and size (please note these breakers can have a frame amperage rating and then a separate plug amperage rating) information is required but the settings can be a bit more detailed as seen below:

- Trip Function: LSIG, LS, or LI
- Please note that there could be a separate trip unit model number which can be different than the circuit breaker model number
- L - Long Time Pickup
 - Long Time Delay
- S - Short Time Pickup
 - Short Time Delay
- I - Instantaneous Pickup
- G - Ground Pickup
 - Ground Delay

Fuses—Required information for fuses include Manufacturer, Model, and amperage rating.