COORDINATED POWER ENGINEERING, INC.
520 McCormick Drive, Suite D
Glen Burnie, Maryland 21061
Phone 410-694-9494 Fax 410-694-0085

November 8, 2022

Shepherd Electric Supply
7401 Pulaski Highway
Baltimore, Maryland 21237

FOR RECORD Revised for Alt HEQ1 and 2- ECB's for RTU's 3 & 4.

NOT ACCEPTABLE
✓ REVIEWED
REVIEW AS CORRECTED
REVISE AND RESUBMIT

DOSTER
2100 International Park Dr.
Birmingham, AL 35243

Doster has reviewed this submittal only to confirm that it appears to include the submittal information required by the applicable Contract Documents. Doster's review does not modify or waive any requirements of the submitter's contract or the Contract Documents, and does not constitute acceptance of variances between the submittal and the requirements of the submitter's contract or the Contract Documents, including the applicable plans and specifications.

REVIEWED BY: Matt ALexander
SUBMITTAL NO.: 26 0572 HEQ1
DATE: 11/11/2022

Attention: Mr. Kevin Vaeth

Project Name:

Study Type: Revised Short-Circuit, Coordination & Arc Flash Hazard Study
CPE Report No.: 21870

Dear Mr. Vaeth:

Attached is the Revised Short-Circuit, Coordination & Arc Flash Hazard Study for the electrical distribution system at the above referenced project. The report has been revised to reflect most resubmittals for Panel HEQ1, as follows:

- Panel HEQ1 remains rated 25kA at 480V.
- Feeder breakers to RTU-3 and RTU-4 are revised to ABB XT4-N (Ekip Dip LSI Trip Unit) rated 25kA at 480V. Curve Sheet #3 (Page 3-16) and the Settings Table (Page 5-4) are revised accordingly.

Changes associated with these revisions are highlighted for visibility. Please do not hesitate to contact me if there are any questions or concerns.

SSOE

☑ No Exceptions Taken ☐ Exceptions Noted

If checked below, fabrication and/or incorporation into the work MAY NOT be undertaken.

☐ Revise and Resubmit ☐ Rejected

A-E review is for general conformance with information given and design intent of the contract documents. Markings or comments shall not be construed as relieving the Contractor from compliance with the project Contract Documents, nor departures therefrom. The Contractor remains responsible for details and accuracy; for confirming and correlating all quantities and dimensions; for verification of field conditions; for substantiating information that pertains to the fabrication process; for the means, methods, techniques, sequences and procedures of construction; and for coordination of the Work with all trades.

☐ For Information Only

By Wilson, Ryan Date 11/18/2022

STATE OF MARYLAND
CARL EDWARD RAGER
No. 23185
REGISTERED
PROFESSIONAL ENGINEER

Best Regards,
Coordinated Power Engineering, Inc.

Carl E. Rager, P.E.
Electrical Engineer

Professional Certification: I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 23185, Expiration Date: August 7, 2023.

REVISED ELECTRICAL DISTRIBUTION SYSTEM

SHORT-CIRCUIT, COORDINATION

& ARC FLASH HAZARD STUDY

CPE REPORT NO. 21870

November – 2022

PREPARED BY:

MARAUD GORJIAN
ELECTRICAL ENGINEER

REVIEWED BY:

CARL E. RAGER, P.E.
ELECTRICAL ENGINEER

TABLE OF CONTENTS

1. INTRODUCTION

1.1 About the Study

Coordinated Power Engineering (CPE) performs Short-Circuit and Coordination Studies to ensure safe, reliable and dependable electrical power. CPE accomplishes this by assuring that the system properly provides continuous electrical power during normal operating conditions, and safely minimizes the extent of outages during short-circuits (faults) or overload conditions.

The basis of this analysis is that a three-phase bolted fault can occur at anytime, anywhere on the system. CPE analyses the protective devices within the scope of the project for proper interrupting capability by comparing the manufacturer's published interrupting ratings with the calculated available fault levels. Minimized outage occurs when protective devices selected and set properly to coordinate through the available fault levels. CPE makes every effort in its recommendations to minimize the duration in which a fault or overload is present on the system, thereby reducing the risk of equipment damage.

CPE's report contains a Short-Circuit Analysis and a Coordination Study. The report includes recommendations and critical comments to maximize system performance and safety. Each report contains a system electrical one-line-diagram (single-line diagram) depicting the equipment within the scope of the project, as well as computer model input and output data.

CPE maintains the report's electrical system data in computer files, and can easily study future changes or additions to this system simply by adding and updating information. Updating this study as system changes and modifications occur will assure accurate and fast availability of the new system's information.

1.2 Short-Circuit Analysis

CPE performs a Short-Circuit Analysis to determine the available (worst-case) fault levels at all critical locations on the electrical distribution system. Since faults can occur at any location, we must analyze the interrupting capability of all protective devices and equipment to ensure that they are all able to withstand the available fault levels.

Section 2 of this report contains the Short-Circuit Analysis. The report describes all parameters having an impact on the analysis in explicit detail. The report highlights any shortcomings in Section 2 and recommends solutions to interrupting capability problems in Section 5, "Recommendations and Comments."

Cable and motor impedance values used in the fault current calculations are obtained by using the software package's "Libraries". These values are based on the size and installation of the cable or the horsepower of the motor. Impedances are developed in accordance with applicable standards. Transformer impedance values are based on the design criteria or the actual values as published by the manufacturer.

1.3 Coordination Study

CPE performs a Protective Device Coordination Study to devise settings and sizes for protective equipment to ensure proper protection of all electrical equipment and to isolate fault situations to the effected circuit. CPE considers electrical equipment to be properly protected when protective devices are set or sized according to the National Electrical Code and ANSI/IEEE standards. Protective device settings that allow enough clearing time between the operations of successive protective devices provide coordinated operation.

CPE provides coordination curve sheets and an analysis of the protection and coordination of each protective device shown in Section 3 "Coordination Study" of this report. Section 5 "Recommendations and Comments" provides the recommended settings and sizes of protective devices.

CPE uses Power* Tools™ for Windows of SKM Systems Analysis, Inc. software to generate graphs and plots of time-current characteristic curves. All coordination curve sheets contain a single-line diagram of the equipment portrayed on the curve sheet and a description of each protective device including the manufacturer, size, type, and recommended settings. The report may also depict recommendations to enhance coordination or ensure proper protection.

1.4 Arc Flash Study

Arc Flash Evaluation is a program that calculates the incident energy and arc flash boundary for each location of the power system. The study automatically reads the short circuit duties at each bus and through each protective device. The arcing fault current through the protective devices is then calculated from the bolted fault value and used to automatically find the time duration of the arc from the time current coordination (TCC) curves. Incident energy and arc flash boundaries are calculated based on the bus 3 phase fault current and arcing duration. Clothing requirements are specified from IEEE/NFPA Standard's personal protective equipment table. The Arc Flash evaluation standard is NFPA 70E - 2018 with calculations based on IEEE 1584 - 2018. See Section 4 of this report for the "Arc Flash Hazard Study".

1.5 Recommendations and Comments

Section 5 of the report contains the recommended settings of protective devices in tabular form, along with recommendations for improved system performance, operation and safety.

Implementation of the recommendations resulting from the study is crucial to maximize electrical distribution system safety and reliability. Where applicable and noted, recommendations will include alternate solutions that require additional investigation, such as feasibility and cost estimation studies, before implementation.

1.6 Single–Line Diagram

The Appendix contains a single-line representation of the simplified electrical distribution system within the scope of this project. This single-line has been generated in AutoCAD format.

2. SHORT-CIRCUIT ANALYSIS

2.1 Fault Current Considerations

This study summarizes the computer calculations of the most significant electrical distribution system three-phase and phase-to-ground short circuit currents

Unless otherwise noted, calculations comply with **IEEE Standard 141-1993 Red-Book, IEEE Recommended Practices For Electric Power Distribution For Industrial Plants; ANSI/IEEE Standard 242-2001 Buff-Book, IEEE Recommended Practices For Protection and Coordination of Industrial and Commercial Power Systems;** and the **IEEE Standard 399-1997 Brown-Book, IEEE Recommended Practices For Power Systems Analysis.**

2.2 Available Fault Current

The available fault current for this project, as provided to CPE, is 32,175A three-phase at the 480V utility transformer secondary terminals.

Two modes of short-circuit calculations have been performed. Mode 1 is the system when powered by the utility and Mode 2 is the system when powered by the 480V 1000kW standby generator.

In addition to the available fault level, motor contributions on the low-voltage distribution system are included in the calculations based on the connected and estimated motor loads. Motor impedances are obtained by utilizing the fault program "Library" of typical impedance values, which are based on the motor horsepower or kVA rating.

2.3 Tabulation of Available Fault Current Compared to Device Interrupting Capacity

The following is the tabulation of the available short-circuit currents and device interrupting capacities. The "Remarks" column of the tabulation indicates whether the device or panel has sufficient interrupting capacity. Section 5 of this study provides recommendations and comments.

TABULATION OF AVAILABLE FAULT CURRENT VS INTERRUPTING CAPACITY

LOCATION	MFR & TYPE	VOLT (L-L)	FAULT (MODE 1/2)	DEVICE A.I.C.	REMARKS
ATS-CR	ASCO ATS	480V	29 / 17KA	42KA	OK
ATS-EQ	ASCO ATS	480V	33 / 19KA	50KA	OK
ATS-LS	ASCO ATS	480V	24 / 15KA	42KA	OK
ATS-OPT	ASCO ATS	480V	33 / 19KA	50KA	OK
CB-GEN	SQD RG Bkr	480V	-- / 21KA	35KA	OK
CB-GLC	GE THQC Bkr	240V	2 / 2KA	10KA	OK
CB-LEQK	ABB XT4-N Bkr	208V	3 / 3KA	65KA	OK
CB-LK1	ABB XT5-N Bkr	208V	7 / 7KA	65KA	OK
DS-DSWH1/2	Class R Fuses	480V	<21 / 12KA	200KA	OK
DS-OAU-1	Class R Fuses	480V	9 / 8KA	200KA	OK
DS-RTU-1/2/3/4/5	Class R Fuses	480V	<13 / 9KA	200KA	OK
DS-TXLEQ2	Class R Fuses	480V	7 / 6KA	200KA	OK
ECB-RTU-3/4	ABB XT4N Bkr	480V	19 / 12KA	25KA	OK
GEN-LC	SQD Loadcenter	240V	1 / 1KA	10KA	OK
H1	ABB Panel	480V	28 / 16KA	35KA	OK
H2	ABB Panel	480V	15 / 10KA	25KA	OK
H3	ABB Panel	480V	8 / 7KA	25KA	OK
HCR1	ABB Panel	480V	26 / 15KA	42KA	OK
HCR2	ABB Panel	480V	12 / 8KA	25KA	OK
HDEQ	ABB Panel	480V	32 / 18KA	42KA	OK
HDN	ABB SWBD	480V	32 / 18KA	35KA	OK
HEM	ABB SWBD	480V	15 / 20KA	25KA	OK
HEQ1	ABB Panel	480V	19 / 12KA	25KA	OK
HEQ2	ABB Panel	480V	11 / 9KA	25KA	OK
HLS1	ABB Panel	480V	9 / 7KA	42KA	OK
L1	ABB Panel	208V	7 / 7KA	10KA	OK
L2	ABB Panel	208V	7 / 6KA	10KA	OK

TABULATION OF AVAILABLE FAULT CURRENT VS INTERRUPTING CAPACITY

LOCATION	MFR & TYPE	VOLT (L-L)	FAULT (MODE 1/2)	DEVICE A.I.C.	REMARKS
L3	ABB Panel	208V	4 / 4KA	10KA	OK
LCR1	ABB Panel	208V	2 / 2KA	10KA	OK
LCR2	ABB Panel	208V	4 / 4KA	10KA	OK
LCR3	ABB Panel	208V	3 / 3KA	10KA	OK
LEQ1	ABB Panel	208V	5 / 4KA	10KA	OK
LEQ2	ABB Panel	208V	4 / 4KA	10KA	OK
LEQ3	ABB Panel	208V	3 / 3KA	10KA	OK
LEQK	ABB Panel	208V	3 / 3KA	10KA	OK
LK1	ABB Panel	208V	6 / 5KA	10KA	OK
LLS1	ABB Panel	208V	2 / 1KA	10KA	OK
MSB	ABB SWBD	480V	34 / --KA	42KA	OK
VFDs (RTU-1/2/3/4/5)	Johnson Controls VFD	480V	<12 / 9KA	65KA	OK

SHORT-CIRCUIT CALCULATION SUMMARY: BUS FAULT (MODE 1)

********** F A U L T A N A L Y S I S S U M M A R Y **********

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT 3 PHASE	X/R	LINE/GRND	X/R
ATS-CR	480.	28848.3	2.5	24432.13	1.8
ATS-EQ	480.	32289.3	4.5	28941.14	3.5
ATS-LS	480.	23981.8	1.8	18788.74	1.3
ATS-OPT	480.	32681.0	4.8	29674.48	3.9
CB-GLC	240.	1063.0	2.1	1060.31	2.0
CB-LEQK	208.	2653.1	2.4	2656.69	2.2
CB-LK1	208.	6587.8	2.9	6723.88	2.7
DS-DSWH1	480.	18258.2	1.2	12746.05	0.9
DS-DSWH2	480.	20603.5	1.4	14916.32	1.0
DS-OAU-1	480.	8856.7	0.6	5429.90	0.5
DS-RTU-1	480.	12157.2	0.9	7877.35	0.7
DS-RTU-2	480.	9408.4	0.8	5892.69	0.6
DS-RTU-3	480.	12024.9	1.0	7733.89	0.7
DS-RTU-4	480.	8491.2	0.7	5204.18	0.5
DS-RTU-5	480.	8761.4	0.7	5411.81	0.5
DS-TXLEQ2	480.	6915.8	0.5	4248.67	0.4
ECB-RTU-3	480.	18406.9	1.7	13202.16	1.2
ECB-RTU-4	480.	18407.0	1.7	13202.18	1.2
GEN-LC	240.	951.0	1.5	878.20	1.3
H1	480.	27790.1	2.5	23210.32	1.9
H2	480.	14542.9	1.0	9872.32	0.7
H3	480.	7640.1	0.7	4836.38	0.6
HCR1	480.	25936.0	2.0	20846.75	1.4
HCR2	480.	11111.7	1.1	7485.82	0.9
HDEQ	480.	31052.5	3.9	27147.42	2.9
HDN	480.	31397.1	4.2	27955.13	3.3
HEQ1	480.	18528.2	1.7	13320.94	1.2
HEQ2	480.	10714.0	0.8	6796.02	0.6
HLS1	480.	8705.7	0.8	5586.82	0.6
L1	208.	6587.8	2.9	6723.88	2.7
L2	208.	6098.9	2.3	6373.83	2.3
L3	208.	3274.5	1.8	3395.71	1.8
LCR1	208.	1691.6	2.3	1683.27	2.2
LCR2	208.	3754.1	2.4	3880.56	2.4
LCR3	208.	2233.9	1.0	1721.11	0.7
LEQ1	208.	4103.5	2.8	4123.63	2.7
LEQ2	208.	3581.0	1.8	3759.74	2.0
LEQ3	208.	2145.0	0.9	1690.16	0.7

SHORT-CIRCUIT CALCULATION SUMMARY: BUS FAULT (MODE 1)

********** F A U L T A N A L Y S I S S U M M A R Y **********

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT 3 PHASE	X/R	LINE/GRND	X/R
LEQK	208.	2121.7	1.4	1840.18	1.1
LK1	208.	5255.1	1.7	4641.48	1.3
LLS1	208.	1008.3	1.8	1006.06	1.7
MSB	480.	33850.0	5.5	31277.19	4.7
VFD-RTU-1	480.	11230.8	0.9	7193.17	0.6
VFD-RTU-2	480.	8841.3	0.8	5499.73	0.6
VFD-RTU-3	480.	11158.2	0.9	7087.97	0.7
VFD-RTU-4	480.	8035.4	0.7	4896.54	0.5
VFD-RTU-5	480.	8275.9	0.7	5079.58	0.5

********** FAULT ANALYSIS REPORT COMPLETED **********

SHORT-CIRCUIT CALCULATION SUMMARY: BUS FAULT (MODE 2)

********** F A U L T A N A L Y S I S S U M M A R Y **********

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT 3 PHASE	X/R	LINE/GRND	X/R
ATS-CR	480.	13515.3	3.5	16561.54	1.9
ATS-EQ	480.	14172.8	4.7	18445.83	2.7
ATS-LS	480.	12555.7	2.8	14077.29	1.5
ATS-OPT	480.	14141.6	4.7	18531.53	2.8
CB-GEN	480.	14586.0	5.2	20382.04	3.4
CB-GLC	240.	1041.4	2.1	1045.55	2.0
CB-LEQK	208.	2540.7	2.4	2578.64	2.3
CB-LK1	208.	5916.2	3.0	6229.68	2.8
DS-DSWH1	480.	11067.8	2.0	10401.42	1.0
DS-DSWH2	480.	11739.2	2.3	11719.05	1.2
DS-OAU-1	480.	7138.0	1.0	5051.90	0.5
DS-RTU-1	480.	8918.4	1.3	7044.87	0.7
DS-RTU-2	480.	7508.9	1.0	5444.44	0.6
DS-RTU-3	480.	8722.9	1.5	6904.29	0.8
DS-RTU-4	480.	6896.6	1.1	4862.99	0.6
DS-RTU-5	480.	7018.3	1.1	5025.48	0.6
DS-TXLEQ2	480.	5812.6	0.8	3990.89	0.5
ECB-RTU-3	480.	11075.6	2.5	10739.88	1.4
ECB-RTU-4	480.	11075.6	2.5	10739.88	1.4
GEN-LC	240.	934.4	1.6	868.79	1.3
H1	480.	13200.8	3.3	15710.04	1.8
H2	480.	9552.0	1.5	8314.55	0.9
H3	480.	6135.2	1.0	4453.60	0.6
HCR1	480.	12913.8	2.9	14873.86	1.6
HCR2	480.	7951.5	1.6	6593.68	1.0
HDEQ	480.	14001.3	4.4	17750.72	2.5
HDN	480.	13915.5	4.4	17832.14	2.6
HEM	480.	14357.2	4.9	19222.95	3.0
HEQ1	480.	11075.6	2.5	10739.88	1.4
HEQ2	480.	8056.9	1.3	6152.33	0.7
HLS1	480.	6827.8	1.1	5151.46	0.7
L1	208.	5916.2	3.0	6229.68	2.8
L2	208.	5524.9	2.4	5931.64	2.4
L3	208.	3105.3	1.9	3269.02	1.9
LCR1	208.	1644.9	2.3	1651.36	2.2
LCR2	208.	3531.0	2.4	3713.95	2.4
LCR3	208.	2165.2	1.0	1696.06	0.7
LEQ1	208.	3838.2	2.9	3936.45	2.7

SHORT-CIRCUIT CALCULATION SUMMARY: BUS FAULT (MODE 2)

********** F A U L T A N A L Y S I S S U M M A R Y **********

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT 3 PHASE	X/R	LINE/GRND	X/R
LEQ2	208.	3383.7	1.9	3606.97	2.0
LEQ3	208.	2083.8	0.9	1666.60	0.7
LEQK	208.	2053.8	1.5	1806.98	1.1
LK1	208.	4835.1	1.8	4420.63	1.3
LLS1	208.	992.3	1.8	995.13	1.7
VFD-RTU-1	480.	8476.1	1.2	6507.08	0.6
VFD-RTU-2	480.	7178.6	1.0	5112.86	0.5
VFD-RTU-3	480.	8319.9	1.4	6403.06	0.8
VFD-RTU-4	480.	6622.1	1.0	4600.19	0.6
VFD-RTU-5	480.	6734.3	1.0	4745.32	0.6

********** FAULT ANALYSIS REPORT COMPLETED **********

COORDINATION CURVE SHEET INDEX

COORDINATION CURVE SHEET INDEX (continued)

3. DESCRIPTION OF COORDINATION

3.1 General

The Coordination Study includes coordination curve sheets that reflect the time-current characteristics of the actual devices being installed under this contract. A sufficient number of curve sheets will illustrate the level of protection and coordination afforded by the overcurrent protective devices within the scope of this project. CPE establishes protective device settings and sizes to provide proper protection in accordance with the NEC and ANSI/IEEE guidelines, and in conjunction with manufacturer's stipulations. Section 5 of this report includes tabulations of the recommended device sizes or settings.

3.2 Limits of Coordination

The 480V SWBD MSB main breaker and 480V Generator main breaker, as sized/set to properly protect the associated downstream equipment and to maximize coordination with the downstream protective devices, have been maintained as the upper limits of coordination for this project.

3.3 Coordination Curve Sheet Outline

An outline that describes in explicit detail the protection and coordination of the devices represented on the curve sheet accompanies the provided coordination curve sheets. The bases for the protection and coordination evaluation are as follows.

3.3.1 Coordination with Upstream Device(s)

Coordination is achieved between successive devices when any level of fault current occurring on the load side of the downstream device will be interrupted by that device without disturbing any upstream device. A separation of the time-current characteristics on a coordination curve sheet illustrates coordination. Adequate clearing time between successive devices at the maximum level ensures complete coordination. ANSI/IEEE standards define adequate clearing times based on the types of devices employed. Clearing times are achieved where possible, and where not completely possible, the best possible settings are provided. In some instances, a proper level of coordination may require changes. The lack of coordination may be permitted to exist if the operation of either device causes the same outage (i.e., transformer primary fuse and secondary main breaker) or if no reasonable alternative exists (i.e., instantaneous region of thermal-magnetic molded-case circuit breakers).

3.3.2 Cable Protection

Articles 240 and 310 of the National Electrical Code define the feeder protective device size or setting requirements to properly protect the cable. The basis of the cable ampacity is the 75°C insulation class, unless otherwise provided.

3.3.3 Cable Insulation Protection

To ensure that the insulation associated with the feeder cables can withstand maximum through-fault currents, the coordination curve sheets show the cable insulation withstand curves. These withstand curves should lie above and to the right of the corresponding upstream protective device, ensuring properly protected cables.

3.3.4 Switchboard, Panelboard and Motor Control Center (MCC) Protection

A main or feeder protective device provides protection for a load center if the size or setting of the device is in accordance with Article 408-36 and other applicable articles of the National Electrical Code.

3.3.5 Transformer Protection

The primary and secondary protective devices provide proper transformer protection if the required level of protection is in accordance with the NEC and ANSI/IEEE standards. The National Electrical Code requires that transformer primary and secondary protective devices be sized or set in accordance with Article 450. Article 450 provides limits of overload rating for the protective device based on the transformer full load capacity. The coordination curve sheets show graphically the ANSI/IEEE requirement for ensuring proper transformer protection. ANSI transformer withstand curves are plotted based upon the formula in ANSI C57.109-1985, "Guide for Transformer Through-Fault Current Duration," that applies to liquid-filled transformers, and IEEE C57.12.59-1989, "IEEE Guide for Dry-Type Transformer Through-Fault Current Duration." Transformer protection is provided in accordance with ANSI/IEEE if the plotted withstand curve lies above and to the right of the associated primary and secondary protective devices

3.3.6 Transformer Inrush

The transformer inrush point shown on the coordination curve sheet reflects the worst-case magnitude of current required to magnetize the transformer. In order to ensure that nuisance operation of a protective device will not occur, all time-current characteristics for the devices on the primary side of the transformer should lie above and to the right of the plotted inrush point.

3.3.7 Maximum Fault Current Magnitude

The end point of each time-current characteristic is plotted at the maximum fault current magnitude to which the protective device may be subjected, as determined by the fault current calculations. Coordination is ensured by obtaining adequate clearing times for fault currents through to the maximum level.

3.3.8 Ground-Fault Coordination

As in Section 3.3.1 above, adequate clearing time between successive ground-fault devices illustrates proper ground-fault coordination. However, when establishing ground-fault settings, the actual ground-fault currents may be substantially less than those determined by the fault current calculations. The actual ground-fault currents depend on the nature of the fault path. With this in mind, the settings of the ground-fault devices are as low as possible. Also to be considered is coordination between the upstream ground-fault devices and downstream single-pole protective devices.

3.3.9 Motor Starting Profile/Motor Protection

Where applicable, plotting a motor starting profile will illustrate the capability of the system protective devices to allow the motor to start properly without a nuisance operation. The time-current characteristics for all upstream protective devices should lie above and to the right of the motor starting profile to ensure proper motor starting. Correspondingly, CPE analyzes the system to ensure that the associated motor protective device(s) properly protects the motor from overloads and short-circuits, in accordance with Article 430 of the National Electrical Code.

3.4 Single-Line Diagram and Protective Device Description

Each coordination curve sheet contains a single-line diagram of the portion of the system depicted by the time-current characteristics, along with a description of the devices. Each protective device shown on a coordination curve sheet has a unique designation that ties the single-line, the device description, the time-current characteristics, and the coordination outline together. Typically, protective device characteristics have alphabetized designations. Devices shown at the same level may have designations with subscripts, that are A_1 and A_2. Devices shown as recommended or existing may also have subscripts, such as B_R and B_E.

3.5.1 COORDINATION CURVE SHEET No. 1

This curve sheet represents coordination of the following devices:

(A1) 480V SWBD MSB main breaker
(B1) 480V feeder breaker to ATS-OPT (Normal)
(C1) 480V feeder breaker to Panel H2
(D1) 480V feeder breaker to Transformer TX-L2
(E1) 208V Panel L2 main breaker
(F1) 208V largest feeder breaker in Panel L2

(A1) 480V SWBD MSB main breaker

This device, as sized/set to properly protect the associated downstream equipment and to maximize coordination with downstream protective devices, has been maintained as the upper limit of coordination for this curve sheet.

Cable Insulation: Good, as detailed by withstand curve (C001).

Cable Protection: Good, the 2000A pickup properly protects the 7 sets of 750kcmil (AL) feeder cables.

Switchboard Protection: Good, the 2000A pickup properly protects 2000A SWBD MSB.

(B1) 480V feeder breaker to ATS-OPT (Normal)

Cable Insulation: Good, as detailed by withstand curves (C035) and (C036).

Cable Protection: Good, the 1600A pickup properly protects the 5 sets of 600kcmil (AL) feeder cables.

ATS Protection: Good, the 1600A pickup properly protects 1600A ATS-OPT.

Switchboard Protection: Good, the 1600A pickup properly protects 1600A SWBD HDN.

Coordination:

Coordination has been achieved between devices (A1) and (B1) for faults less than the instantaneous setting of device (A1). Faults occurring on the load side of any feeder breaker in SWBD MSB in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

3.5.1 COORDINATION CURVE SHEET No. 1 (continued)

(C1) 480V feeder breaker to Panel H2

Cable Insulation: Good, as detailed by withstand curve (C046).

Cable Protection: Good, the 400A pickup properly protects the 2 sets of 250kcmil (AL) feeder cables.

Panel Protection: Good, the 400A pickup properly protects 400A Panel H2.

Coordination:

Proper coordination has been achieved between devices (B1) and (C1). Faults or overloads occurring on the load side of any feeder breaker in SWBD HDN would be interrupted and cleared by the involved device without disturbing any upstream device.

(D1) 480V feeder breaker to Transformer TX-L2

Cable Insulation: Good, as detailed by withstand curve (C047).

Cable Protection: Good, the 225A pickup properly protects the 1 set of 300kcmil (AL) feeder cables.

Transformer Protection: ANSI – Good, in conjunction with the secondary main breaker.
NEC – Good, the 225A pickup is 166% of the transformer capacity.

Transformer Inrush: Nuisance operation of device (D1) will not occur.

Coordination:

Coordination has been achieved between devices (C1) and (D1) for faults less than the instantaneous setting of device (C1). Faults occurring on the load side of any feeder breaker in Panel H2 in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

Note: An additional TCC continues the circuit on Page 3-10, displaying devices (E1) and (F1).

(E1) 208V Panel L2 main breaker

Transformer Protection: ANSI – Good, in conjunction with the primary breaker.
NEC – Good, the 400A breaker is 128% of the transformer capacity.

Cable Insulation: Good, as detailed by withstand curve (C048).

3.5.1 COORDINATION CURVE SHEET No. 1 (continued)

Cable Protection: Good, the 400A breaker properly protects the 2 sets of 250kcmil (AL) feeder cables.

Panel Protection: Good, the 400A breaker properly protects 400A Panel L2.

Coordination:

A lack of coordination exists between devices (D1) and (E1) in the area of overlap of the time-current characteristics. This is not considered to be a serious lack of coordination since the same outage results regardless of which device operates.

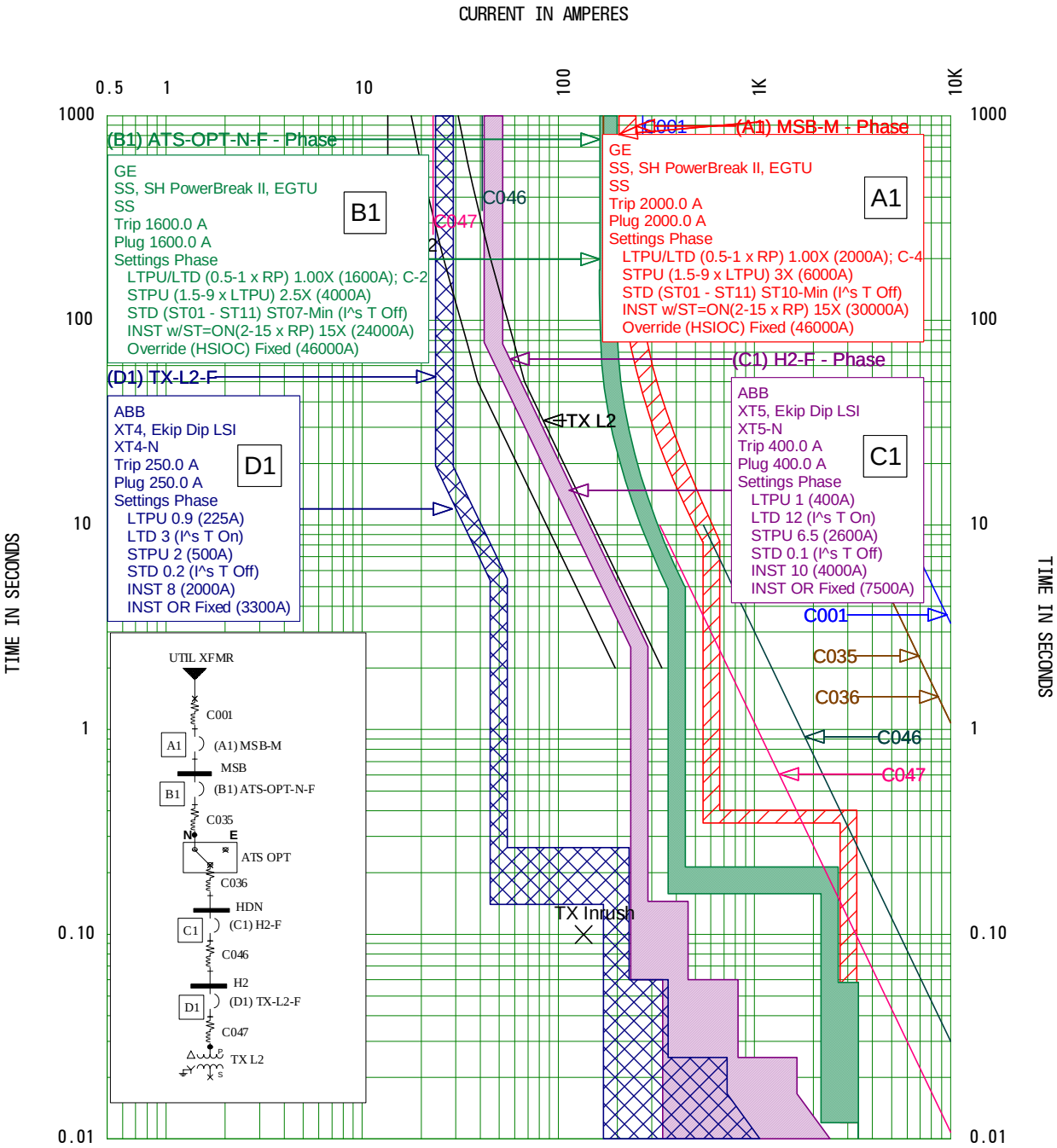
(F1) 208V largest feeder breaker in Panel L2

Coordination:

Coordination has been achieved between device (F1) and upstream devices (D1) and (E1) for faults less than the instantaneous settings of devices (D1) and (E1). Faults occurring on the load side of any feeder breaker in Panel L2 in excess of these levels may cause all three devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder devices in Switchboards MSB and HDN, as well as Panels H2 and L2

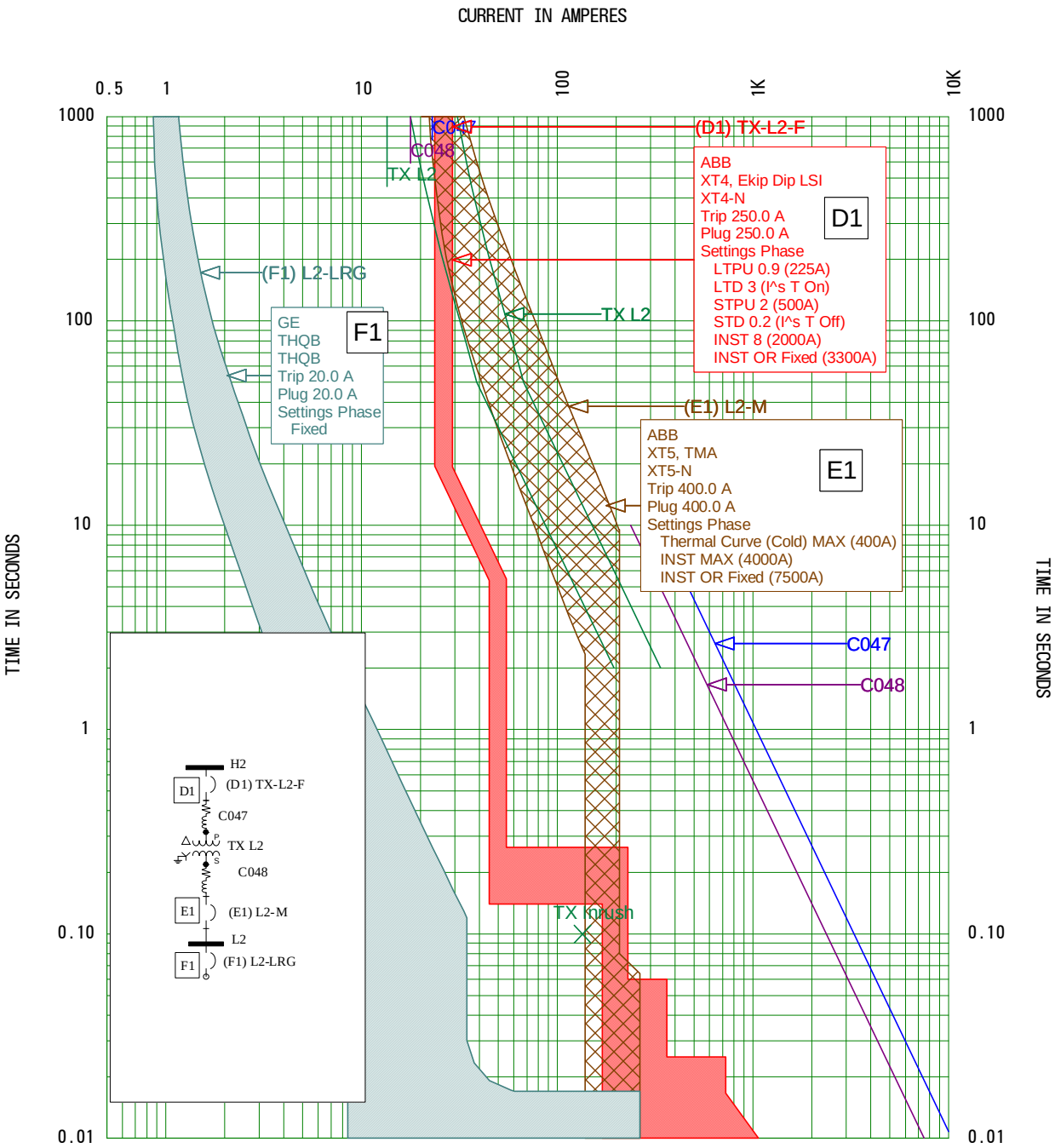


TCC Name: 01A - MSB TO H2
Oneline: TCC1A
July 30, 2021 4:22 PM

Current Scale x 10

Reference Voltage: 480

Coordinated Power Engineering, Inc.



TCC Name: 01B - H2 TO L2
Oneline: TCC1B
July 20, 2021 8:48 AM

Current Scale x 10

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.2 COORDINATION CURVE SHEET No. 2

This curve sheet represents coordination of the following devices:

(C1) 480V feeder breaker to Panel H2
(D2) 480V feeder breaker to Panel H3
(E2) 480V feeder breaker to Transformer TX-L3
(F2) 208V Panel L3 main breaker
(H2) 208V largest feeder breaker in Panel L3

Device (C1), as discussed on Curve Sheet No. 1, has been maintained as the upper limit of coordination for this curve sheet.

(D2) 480V feeder breaker to Panel H3

Cable Insulation: Good, as detailed by withstand curve (C049).

Cable Protection: Good, the 225A pickup properly protects the 1 set of 300kcmil (AL) feeder cables.

Panel Protection: Good, the 225A pickup properly protects 225A Panel H3.

Coordination:

Coordination has been achieved between devices (C1) and (D2) for faults less than the instantaneous setting of device (C1). Faults occurring on the load side of any feeder breaker in Panel H2 in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

(E2) 480V feeder breaker to Transformer TX-L3

Cable Insulation: Good, as detailed by withstand curve (C050).

Cable Protection: Good, the 90A pickup properly protects the #4 AWG (CU) feeder cables.

Transformer Protection: ANSI – Good, in conjunction with the secondary main breaker.
NEC – Good, the 90A pickup is 166% of the transformer capacity.

Transformer Inrush: Nuisance operation of device (E2) will not occur.

Coordination:

Coordination has been achieved between devices (D2) and (E2) for faults less than the instantaneous setting of device (D2). Faults occurring on the load side of any feeder breaker in Panel H3 in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

3.5.2 COORDINATION CURVE SHEET No. 2 (continued)

(F2) 208V Panel L3 main breaker

Transformer Protection: ANSI – Good, in conjunction with the primary breaker.
NEC – Good, the 150A breaker is 120% of the transformer capacity.

Cable Insulation: Good, as detailed by withstand curve (C051).

Cable Protection: Good, the 150A breaker properly protects the #3/0 AWG (AL) feeder cables.

Panel Protection: Good, the 150A breaker properly protects 225A Panel L3.

Coordination:

A lack of coordination exists between devices (E2) and (F2) in the area of overlap of the time-current characteristics. This is not considered to be a serious lack of coordination since the same outage results regardless of which device operates.

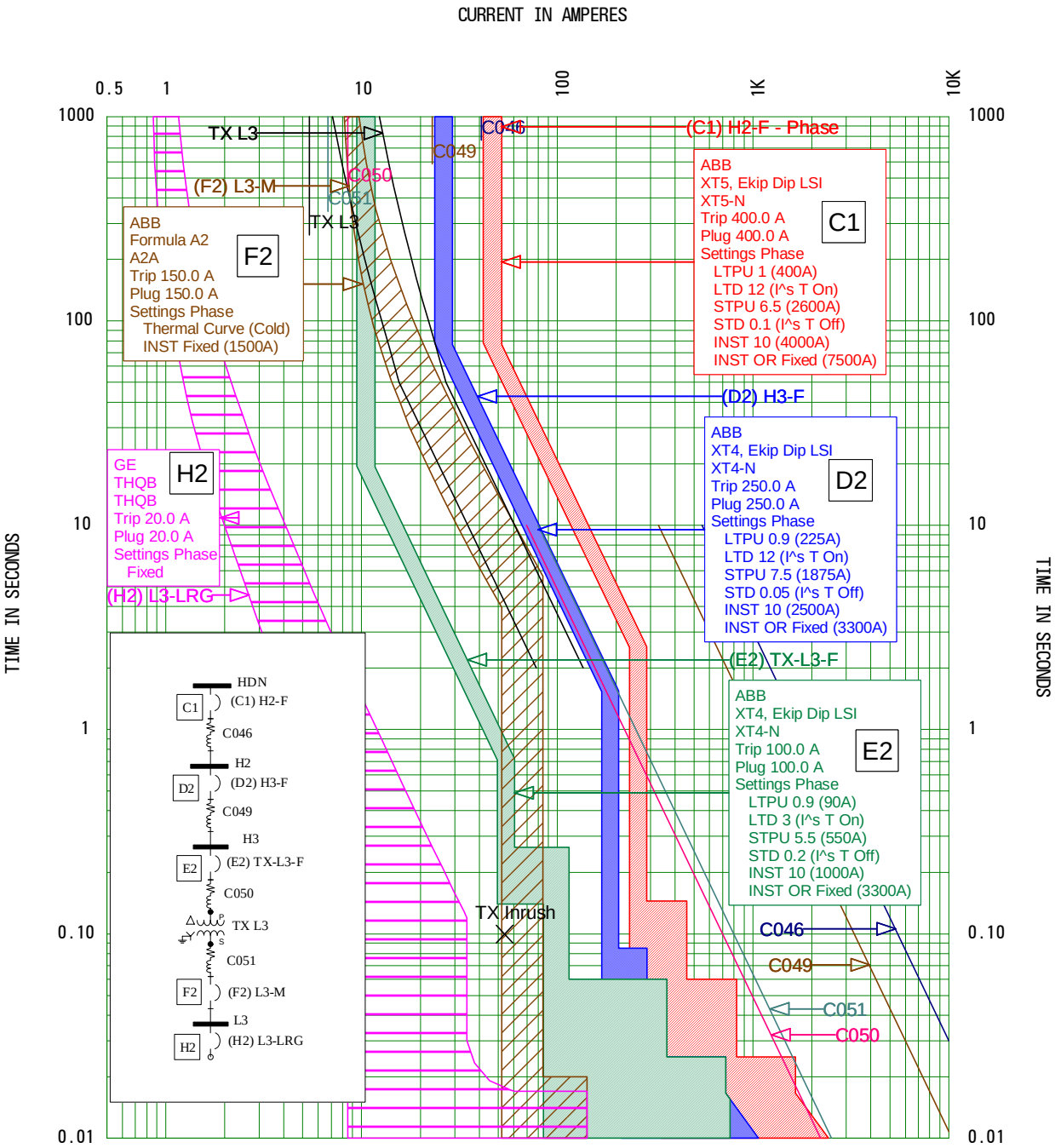
(H2) 208V largest feeder breaker in Panel L3

Coordination:

Coordination has been achieved between device (H2) and upstream devices (E2) and (F2) for faults less than the instantaneous settings of devices (E2) and (F2). Faults occurring on the load side of any feeder breaker in Panel L3 in excess of these levels may cause all three devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder devices in Panels H3 and L3.



TCC Name: 02 - HDN TO L3
Oneline: TCC2
July 20, 2021 8:52 AM

Current Scale x 10

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.3 COORDINATION CURVE SHEET No. 3

This curve sheet represents coordination of the following devices:

(A1) 480V SWBD MSB main breaker
(B3) 480V feeder breaker to ATS-EQ (Normal)
(C3) 480V feeder breaker to Panel HEQ1
(D3) 480V feeder breaker to RTU-2
(E3) 480V RTU-2 fused disconnect

Device (A1), as discussed on Curve Sheet No. 1, has been maintained as the upper limit of coordination for this curve sheet.

(B3) 480V feeder breaker to ATS-EQ (Normal)

Cable Insulation: Good, as detailed by withstand curves (C009) and (C010).

Cable Protection: Good, the 1200A pickup properly protects the 4 sets of 500kcmil (AL) feeder cables.

ATS Protection: Good, the 1200A pickup properly protects 1200A ATS-EQ.

Panel Protection: Good, the 1200A pickup properly protects 1200A Panel HDEQ.

Coordination:

Coordination has been achieved between devices (A1) and (B3) for faults less than the instantaneous setting of device (A1). Faults occurring on the load side of any feeder breaker in SWBD MSB in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

(C3) 480V feeder breaker to Panel HEQ1

Cable Insulation: Good, as detailed by withstand curve (C020).

Cable Protection: Good, the 600A pickup properly protects the 2 sets of 500kcmil (AL) feeder cables.

Panel Protection: Good, the 600A pickup properly protects 600A Panel HEQ1.

Coordination:

Coordination has been achieved between devices (B3) and (C3) for faults less than the instantaneous setting of device (B3). Faults occurring on the load side of any feeder breaker in Panel HDEQ in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

3.5.3 COORDINATION CURVE SHEET No. 3 (continued)

(D3) 480V feeder breaker to RTU-2

Cable Insulation: Good, as detailed by withstand curve (C021).

Cable Protection: Good, the 150A pickup properly protects the #3/0 AWG (AL) feeder cables.

Coordination:

Coordination has been achieved between devices (C3) and (D3) for faults less than the instantaneous setting of device (C3). Faults occurring on the load side of any feeder breaker in Panel HEQ1 in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

(E3) 480V RTU-2 fused disconnect

Motor Starting/Protection: Devices (D3) and (E3) provides proper motor short-circuit protection while permitting the motor to start without a nuisance operation.

Cable Insulation: Good, as detailed by withstand curve (C022).

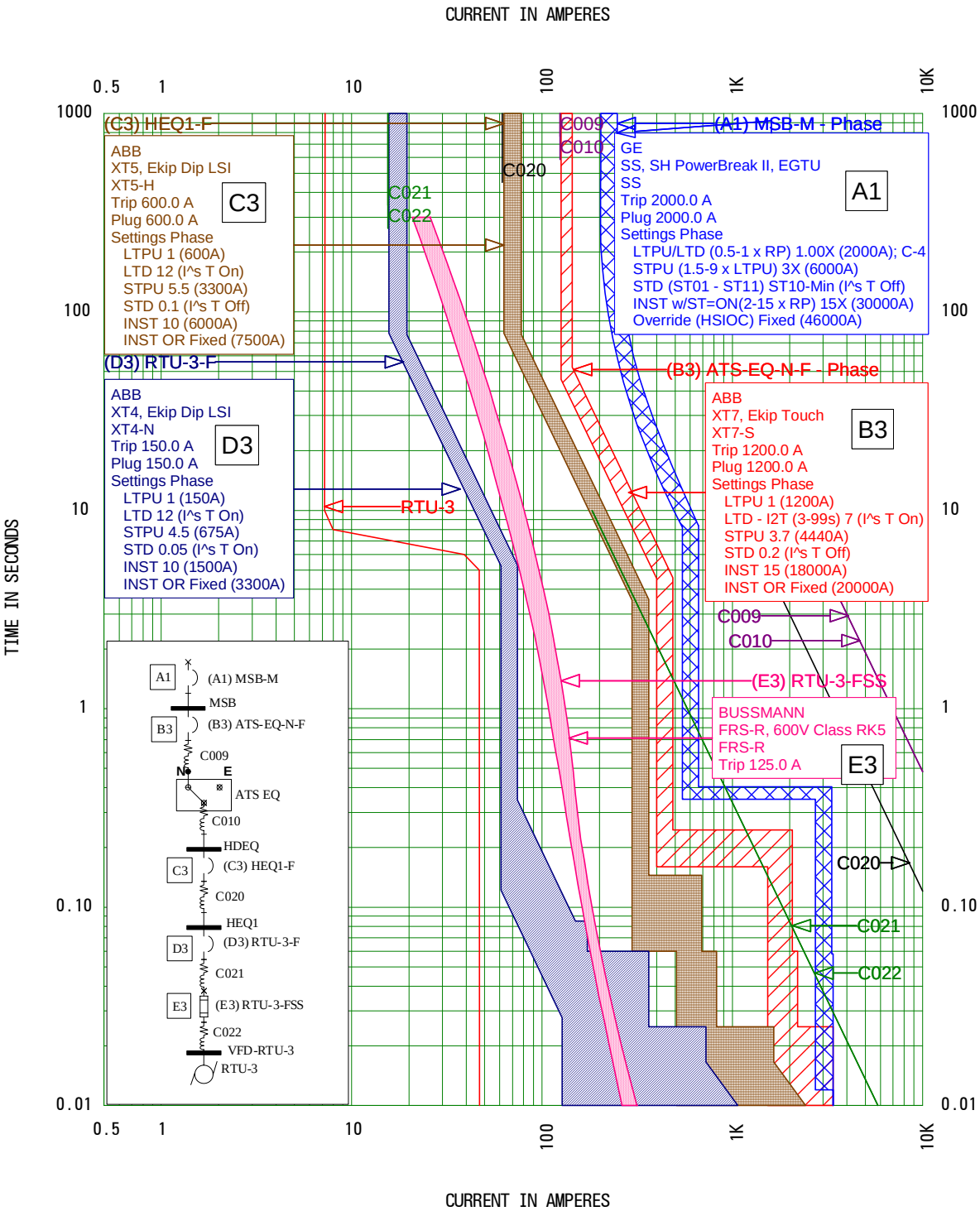
Cable Protection: Good, the 125A fuse properly protects the #3/0 AWG (AL) feeder cables.

Coordination:

A lack of coordination exists between devices (D3) and (E3) in the area of overlap of the time-current characteristics. This is not considered to be a serious lack of coordination since the same outage results regardless of which device operates.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder devices in Panels HDEQ and HEQ1.



TCC Name: 03 - MSB TO RTU-3	Current Scale x 10	Reference Voltage: 480
Oneline: TCC3		
November 8, 2022 12:04 PM		Coordinated Power Engineering, Inc.

3.5.4 COORDINATION CURVE SHEET No. 4

This curve sheet represents coordination of the following devices:

(B3) 480V feeder breaker to ATS-EQ (Normal)
(C4) 480V feeder breaker to Panel HEQ2
(D4) 480V feeder breaker to RTU-5
(E4) 480V RTU-5 fused disconnect

Device (B3), as discussed on Curve Sheet No. 3, has been maintained as the upper limit of coordination for this curve sheet.

(C4) 480V feeder breaker to Panel HEQ2

Cable Insulation: Good, as detailed by withstand curve (C028).

Cable Protection: Good, the 400A pickup properly protects the 2 sets of 250kcmil (AL) feeder cables.

Panel Protection: Good, the 400A pickup properly protects 400A Panel HEQ2.

Coordination:

Coordination has been achieved between devices (B3) and (C4) for faults less than the instantaneous setting of device (B3). Faults occurring on the load side of any feeder breaker in Panel HDEQ in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

(D4) 480V feeder breaker to RTU-5

Cable Insulation: Good, as detailed by withstand curve (C029).

Cable Protection: Good, the 150A pickup properly protects the #3/0 AWG (AL) feeder cables.

Coordination:

Coordination has been achieved between devices (C3) and (D4) for faults less than the instantaneous setting of device (C3). Faults occurring on the load side of any feeder breaker in Panel HEQ2 in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

(E4) 480V RTU-5 fused disconnect

Motor Starting/Protection: Devices (D4) and (E4) provides proper motor short-circuit protection while permitting the motor to start without a nuisance operation.

3.5.4 COORDINATION CURVE SHEET No. 4 (continued)

Cable Insulation: Good, as detailed by withstand curve (C030).

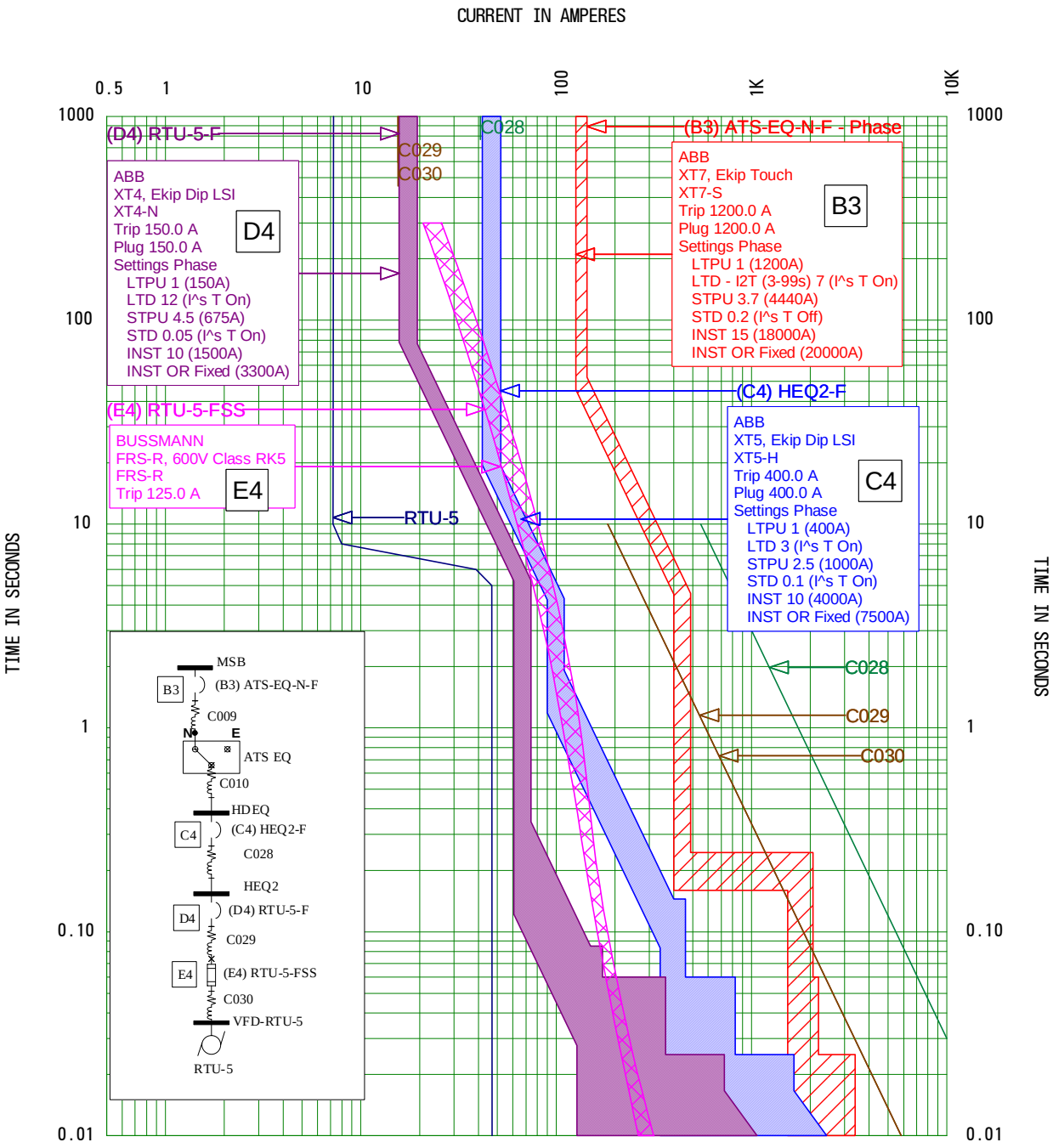
Cable Protection: Good, the 125A fuse properly protects the #3/0 AWG (AL) feeder cables.

Coordination:

A lack of coordination exists between devices (D4) and (E4) in the area of overlap of the time-current characteristics. This is not considered to be a serious lack of coordination since the same outage results regardless of which device operates.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder devices in Panel HEQ2.



TCC Name: 04 - MSB TO RTU-5	Current Scale x 10	Reference Voltage: 480
Oneline: TCC4		
July 30, 2021 4:24 PM		Coordinated Power Engineering, Inc.

3.5.5 COORDINATION CURVE SHEET No. 5

This curve sheet represents coordination of the following devices:

(B3) 480V feeder breaker to ATS-EQ (Normal)
(C5) 480V feeder breaker to Transformer TX-LEQK
(D5) 208V feeder breaker to LEQK
(E5) 208V largest feeder breaker in Panel LEQK

Device (B3), as discussed on Curve Sheet No. 3, has been maintained as the upper limit of coordination for this curve sheet.

(C5) 480V feeder breaker to Transformer TX-LEQK

Cable Insulation: Good, as detailed by withstand curve (C025).

Cable Protection: Good, the 90A pickup properly protects the #4 AWG (CU) feeder cables.

Transformer Protection: ANSI – Good, in conjunction with the secondary breaker.
NEC – Good, the 90A pickup is 166% of the transformer capacity.

Transformer Inrush: Nuisance operation of device (C5) will not occur.

Coordination:

Coordination has been achieved between devices (B3) and (C5) for faults less than the instantaneous setting of device (B3). Faults occurring on the load side of any feeder breaker in Panel HDEQ in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

(D5) 208V feeder breaker to LEQK

Transformer Protection: ANSI – Good, in conjunction with the primary breaker.
NEC – Good, the 150A pickup is 120% of the transformer capacity.

Cable Insulation: Good, as detailed by withstand curves (C026) and (C027).

Cable Protection: Good, the 150A pickup properly protects the #3/0 AWG (AL) feeder cables.

Panel Protection: Good, the 150A pickup properly protects 225A Panel LEQK.

Coordination:

A lack of coordination exists between devices (C5) and (D5) in the area of overlap of the time-current characteristics. This is not considered to be a serious lack of coordination since the same outage results regardless of which device operates.

3.5.5 COORDINATION CURVE SHEET No. 5 (continued)

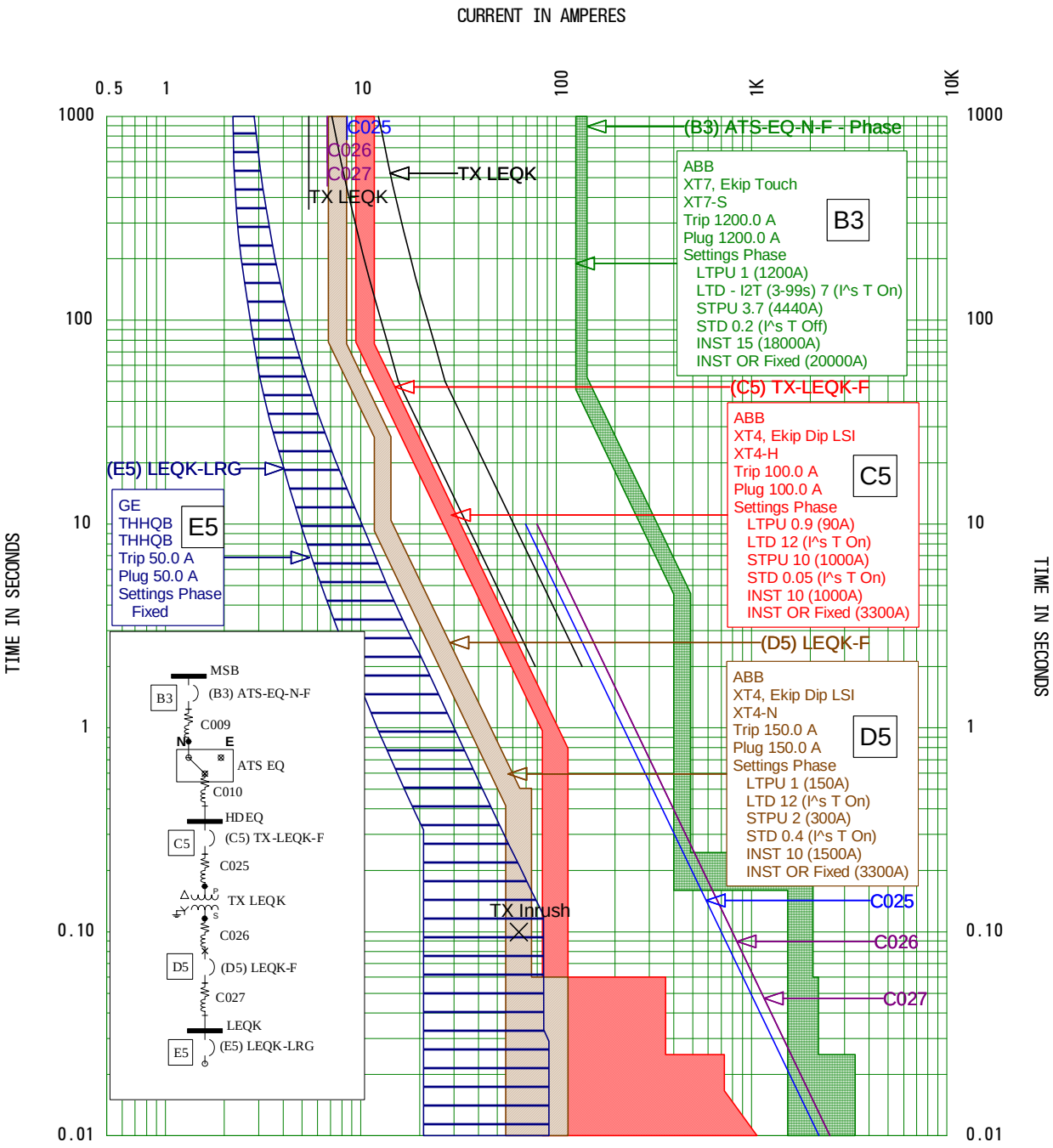
(E5) 208V largest feeder breaker in Panel LEQK

Coordination:

Coordination has been achieved between device (E5) and upstream devices (C5) and (D5) for faults less than the instantaneous settings of devices (C5) and (D5). Faults occurring on the load side of any feeder breaker in Panel LEQK in excess of these levels may cause all three devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder devices in Panel LEQK.



TCC Name: 05 - MSB TO LEQK
Oneline: TCC5
July 20, 2021 1:10 PM

Current Scale x 10

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.6 COORDINATION CURVE SHEET No. 6

This curve sheet represents coordination of the following devices:

(A1) 480V SWBD MSB main breaker
(B6) 480V feeder breaker to ATS-CR (Normal)
(C6) 480V feeder breaker to Panel HCR2
(D6) 480V largest feeder breaker in Panel HCR2

Device (A1), as discussed on Curve Sheet No. 1, has been maintained as the upper limit of coordination for this curve sheet.

(B6) 480V feeder breaker to ATS-CR (Normal)

Cable Insulation: Good, as detailed by withstand curves (C002) and (C003).

Cable Protection: Good, the 400A pickup properly protects the 2 sets of 250kcmil (AL) feeder cables.

ATS Protection: Good, the 400A pickup properly protects 400A ATS-CR.

Panel Protection: Good, the 400A pickup properly protects 400A Panel HCR1.

Coordination:

Coordination has been achieved between devices (A1) and (B6) for faults less than the instantaneous setting of device (A1). Faults occurring on the load side of any feeder breaker in SWBD MSB in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

(C6) 480V feeder breaker to Panel HCR2

Cable Insulation: Good, as detailed by withstand curve (C062).

Cable Protection: Good, the 250A pickup properly protects the 1 set of 500kcmil (AL) feeder cables.

Panel Protection: Good, the 250A pickup properly protects 250A Panel HCR2.

Coordination:

Coordination has been achieved between devices (B6) and (C6) for faults less than the instantaneous setting of device (B6). Faults occurring on the load side of any feeder breaker in Panel HCR1 in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

3.5.6 COORDINATION CURVE SHEET No. 6 (continued)

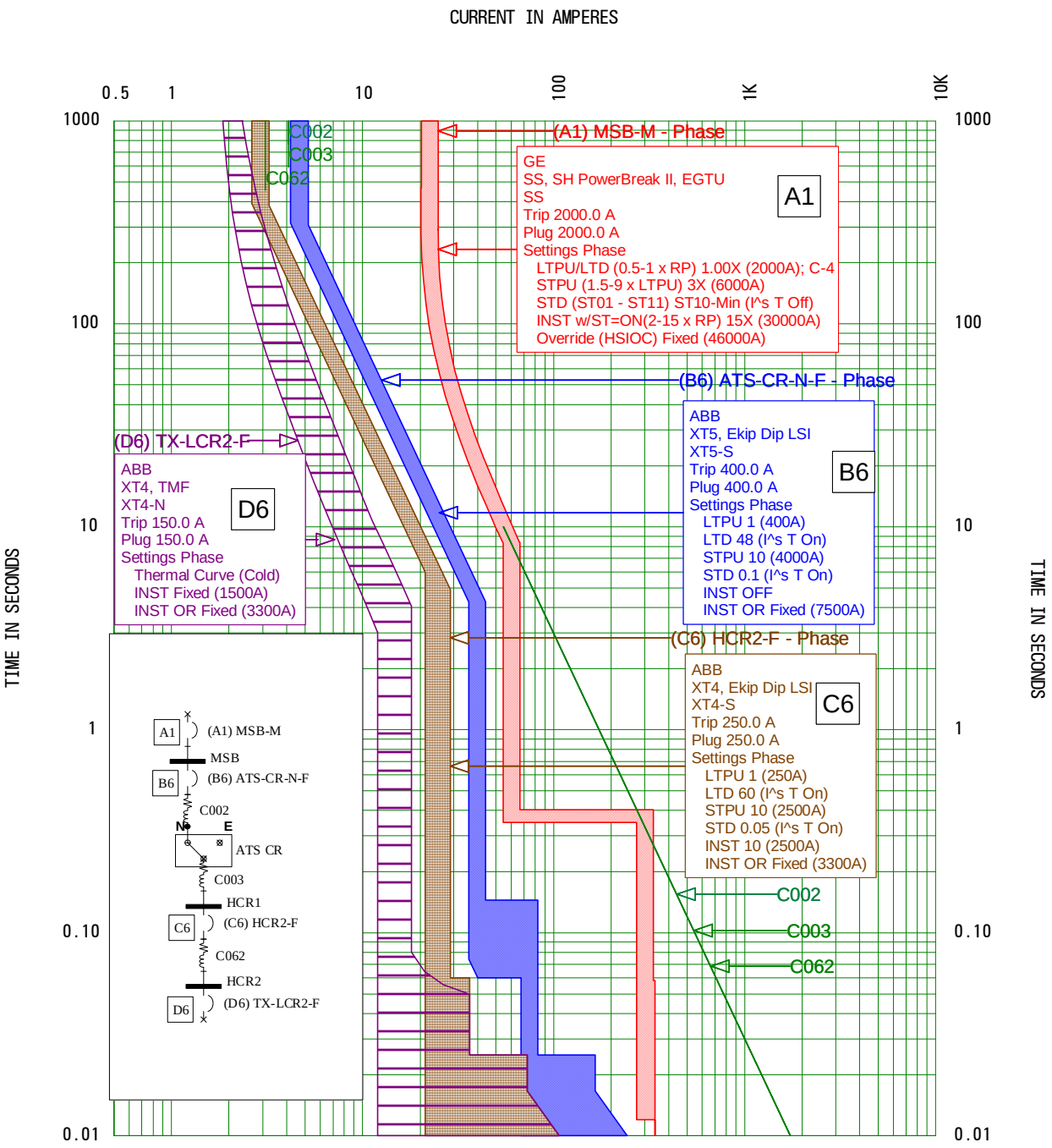
(D6) 480V largest feeder breaker in Panel HCR2

Coordination:

Coordination has been achieved between devices (C6) and (D6) for faults less than the instantaneous pickup of device (C6). Faults occurring on the load side of any feeder breaker in Panel HCR2 in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder devices in Panels HCR1 and HCR2.



TCC Name: 06 - MSB TO HCR1
Oneline: TCC6
September 2, 2021 3:05 PM

Current Scale x 100

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.7 COORDINATION CURVE SHEET No. 7

This curve sheet represents coordination of the following devices:

(A1) 480V SWBD MSB main breaker
(B7) 480V feeder breaker to ATS-LS (Normal)
(C7) 480V feeder breaker to Transformer TX-LLS1
(D7) 208V Panel LLS1 main breaker
(E7) 208V largest feeder breaker in Panel LLS1

Device (A1), as discussed on Curve Sheet No. 1, has been maintained as the upper limit of coordination for this curve sheet.

(B7) 480V feeder breaker to ATS-LS (Normal)

Cable Insulation: Good, as detailed by withstand curves (C031) and (C032).

Cable Protection: Good, the 225A pickup properly protects the 1 set of 300kcmil (AL) feeder cables.

ATS Protection: Good, the 225A pickup properly protects 260A ATS-LS.

Panel Protection: Good, the 225A pickup properly protects 225A Panel HLS1.

Coordination:

Coordination has been achieved between devices (A1) and (B7) for faults less than the instantaneous setting of device (A1). Faults occurring on the load side of any feeder breaker in SWBD MSB in excess of this level may cause both devices to operate. This lack of coordination is typical for series combinations of devices with instantaneous characteristics at high fault levels. Coordination has been maximized.

(C7) 480V feeder breaker to Transformer TX-LLS1

Cable Insulation: Good, as detailed by withstand curve (C033).

Cable Protection: Good, the 30A breaker properly protects the #10 AWG (CU) feeder cables.

Transformer Protection: ANSI – Good, in conjunction with the secondary main breaker.
NEC – Good, the 30A breaker is 167% of the transformer capacity.

Transformer Inrush: Nuisance operation of device (C7) will not occur.

3.5.7 COORDINATION CURVE SHEET No. 7 (continued)

Coordination:

Proper selective coordination has been achieved between devices (B7) and (C7). According to ABB selective coordination tables, these breakers selectively coordinate up to 65kA at 480V. Faults or overloads occurring on the load side of any feeder breaker in Panel HLS1 would be interrupted and cleared by the involved device without disturbing any upstream device.

(D7) 208V Panel LLS1 main breaker

Transformer Protection: ANSI – Good, in conjunction with the primary breaker.
NEC – Good, the 60A pickup is 144% of the transformer capacity.

Cable Insulation: Good, as detailed by withstand curve (C034).

Cable Protection: Good, the 60A pickup properly protects the #6 AWG feeder cables.

Panel Protection: Good, the 60A pickup properly protects 225A Panel LLS1.

Coordination:

Proper coordination has been achieved between devices (C7) and (D7). Faults or overloads occurring on the load side of device (D7) would be interrupted and cleared by the involved device without disturbing any upstream device.

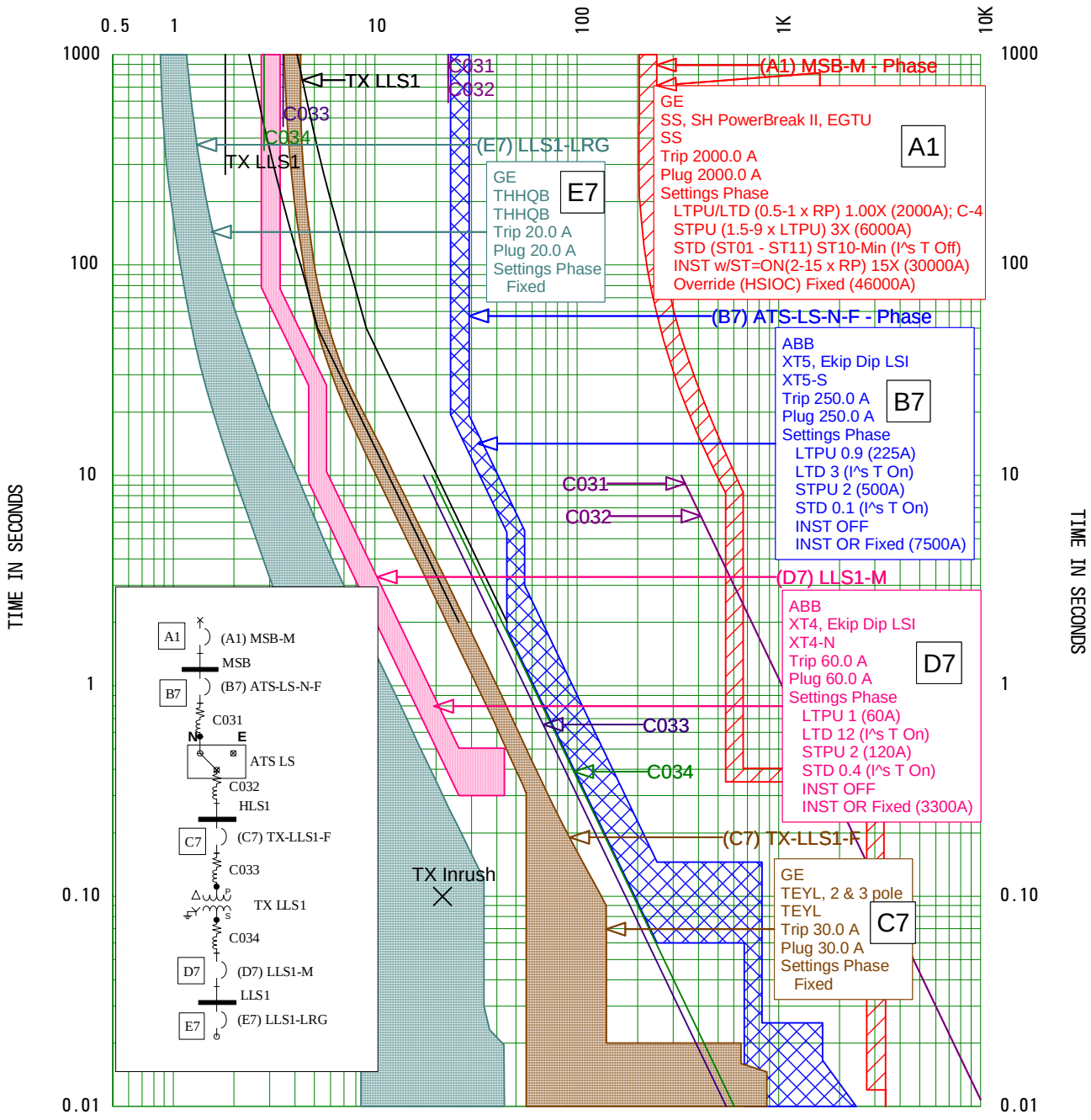
(F7) 208V largest feeder breaker in Panel LLS1

Coordination:

Proper coordination has been achieved between devices (E7) and (F7). Faults or overloads occurring on the load side of any feeder breaker in Panel LLS1 would be interrupted and cleared by the involved device without disturbing any upstream device.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder devices in Panels HLS1 and LLS1.



TCC Name: 07 - MSB TO LLS1
Oneline: TCC7
July 20, 2021 3:53 PM

Current Scale x 10

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.8 COORDINATION CURVE SHEET No. 8

This curve sheet represents coordination of the following devices:

(G8) 480V Generator main breaker
(A8) 480V feeder breaker to ATS-OPT (Standby)
(C1) 480V feeder breaker to Panel H2

Device (C1), as discussed on Coordination Curve Sheet No. 1, has been maintained as the lower limit of coordination for this curve sheet.

This evaluation has been based on an optional standby system, as defined by the NEC, for the ATS-OPT circuit when powered by the generator.

(G8) 480V Generator main breaker

This device, as sized/set to properly protect the generator and the associated downstream equipment, has been maintained as the upper limit of coordination for this curve sheet.

Generator Protection: Good, the 1600A pickup is 106% of generator rated capacity.

Cable Insulation: Good, as detailed by withstand curves (C056) and (C057).

Cable Protection: Good, the 1600A pickup properly protects the 7 sets of 750kcmil (AL) feeder cables.

Switchboard Protection: Good, the 1600A pickup properly protects 1600A SWBD HEM.

(A8) 480V feeder breaker to ATS-OPT (Standby)

Cable Insulation: Good, as detailed by withstand curves (C061) and (C036).

Cable Protection: Good, the 1280A pickup properly protects the 5 sets of 600kcmil (AL) feeder cables.

ATS Protection: Good, the 1280A pickup properly protects 1600A ATS-OPT.

Switchboard Protection: Good, the 1280A pickup properly protects 1600A SWBD HDN.

3.5.8 COORDINATION CURVE SHEET No. 8 (continued)

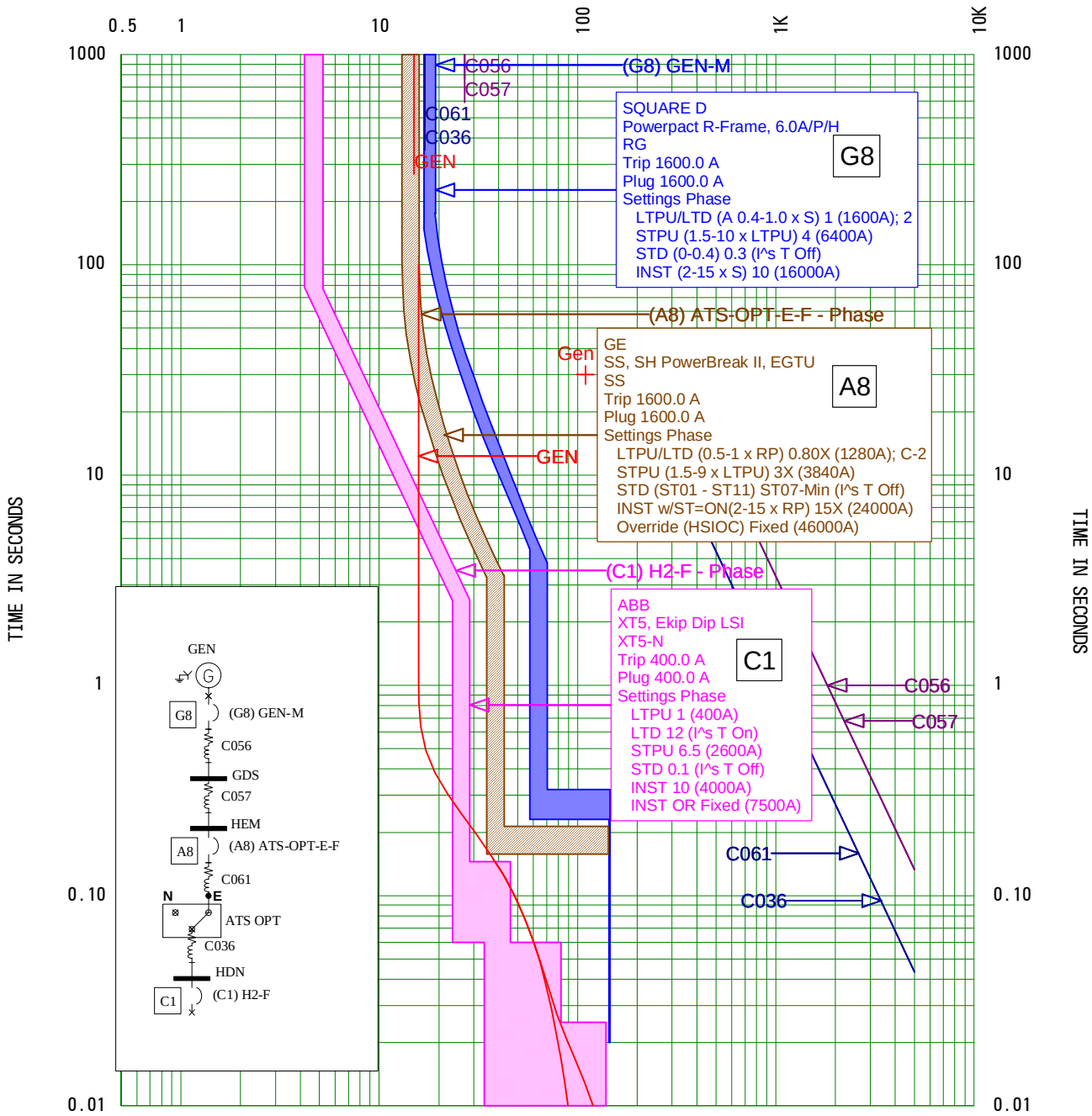
Coordination:

Proper coordination has been achieved between devices (G8) and (A8). Faults or overloads occurring on the load side of any feeder breaker in SWBD HEM would be interrupted and cleared by the involved device without disturbing the upstream generator main breaker.

Proper coordination has been achieved between devices (A8) and (C1). Faults or overloads occurring on the load side of any feeder breaker in SWBD HDN would be interrupted and cleared by the involved device without disturbing any upstream emergency device.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder breakers in Switchboards HEM and HDN when supplied by the generator.



TCC Name: 08 - GEN TO HDN
Oneline: TCC8
August 3, 2021 3:30 PM

Current Scale x 100

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.9 COORDINATION CURVE SHEET No. 9

This curve sheet represents coordination of the following devices:

(G8) 480V Generator main breaker
(A9) 480V feeder breaker to ATS-EQ (Standby)
(C3) 480V feeder breaker to Panel HEQ1

Device (G8), as discussed on Coordination Curve Sheet No. 8, has been maintained as the upper limit of coordination for this curve sheet.

Device (C3), as discussed on Curve Sheet No. 3, has been maintained as the lower limit of coordination for this curve sheet.

This evaluation has been based on an optional standby system, as defined by the NEC, for the ATS-EQ circuit when powered by the generator.

(A9) 480V feeder breaker to ATS-EQ (Standby)

Cable Insulation: Good, as detailed by withstand curves (C059) and (C010).

Cable Protection: Good, the 1200A pickup properly protects the 4 sets of 500kcmil (AL) feeder cables.

ATS Protection: Good, the 1200A pickup properly protects 1200A ATS-EQ.

Panel Protection: Good, the 1200A pickup properly protects 1200A Panel HDEQ.

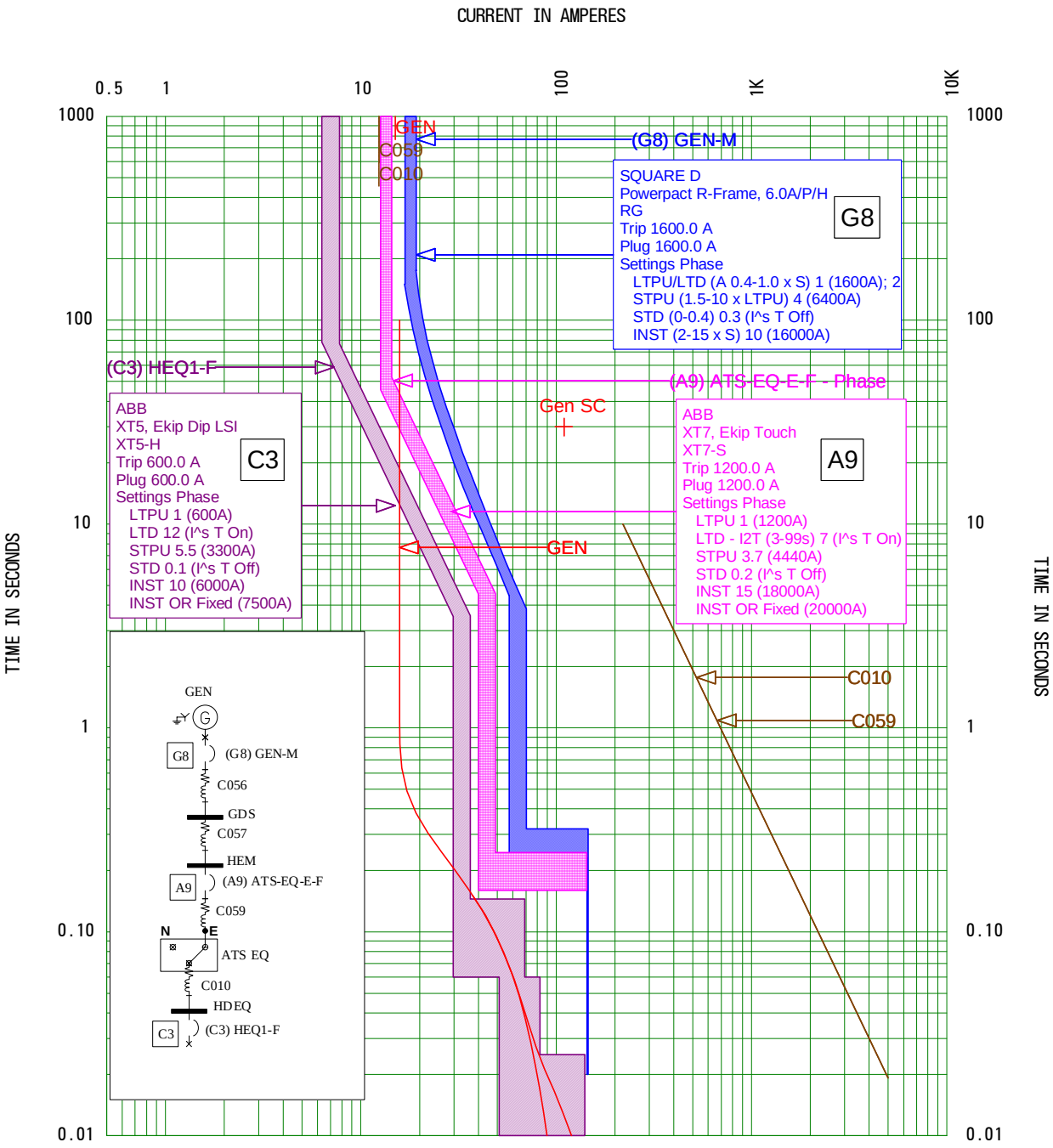
Coordination:

Proper coordination has been achieved between devices (G8) and (A9). Faults or overloads occurring on the load side of any feeder breaker in SWBD HEM would be interrupted and cleared by the involved device without disturbing the upstream generator main breaker.

Proper coordination has been achieved between devices (A9) and (C3). Faults or overloads occurring on the load side of any feeder breaker in Panel HDEQ would be interrupted and cleared by the involved device without disturbing any upstream emergency device.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder breakers in Panel HDEQ when supplied by the generator.



TCC Name: 09 - GEN TO HDEQ
Oneline: TCC9
July 20, 2021 10:13 AM

Current Scale x 100

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.10 COORDINATION CURVE SHEET No. 10

This curve sheet represents coordination of the following devices:

(G8) 480V Generator main breaker
(A10) 480V feeder breaker to ATS-CR (Standby)
(C6) 480V feeder breaker to Panel HCR2

Device (G8), as discussed on Coordination Curve Sheet No. 8, has been maintained as the upper limit of coordination for this curve sheet.

Device (C6), as discussed on Curve Sheet No. 6, has been maintained as the lower limit of coordination for this curve sheet.

This evaluation has been based on a legally-required standby system, as defined by the NEC, for the ATS-CR circuit when powered by the generator.

(A10) 480V feeder breaker to ATS-CR (Standby)

Cable Insulation: Good, as detailed by withstand curves (C058) and (C003).

Cable Protection: Good, the 400A pickup properly protects the 2 sets of 250kcmil (AL) feeder cables.

ATS Protection: Good, the 400A pickup properly protects 400A ATS-CR.

Panel Protection: Good, the 400A pickup properly protects 400A Panel HCR1.

Coordination:

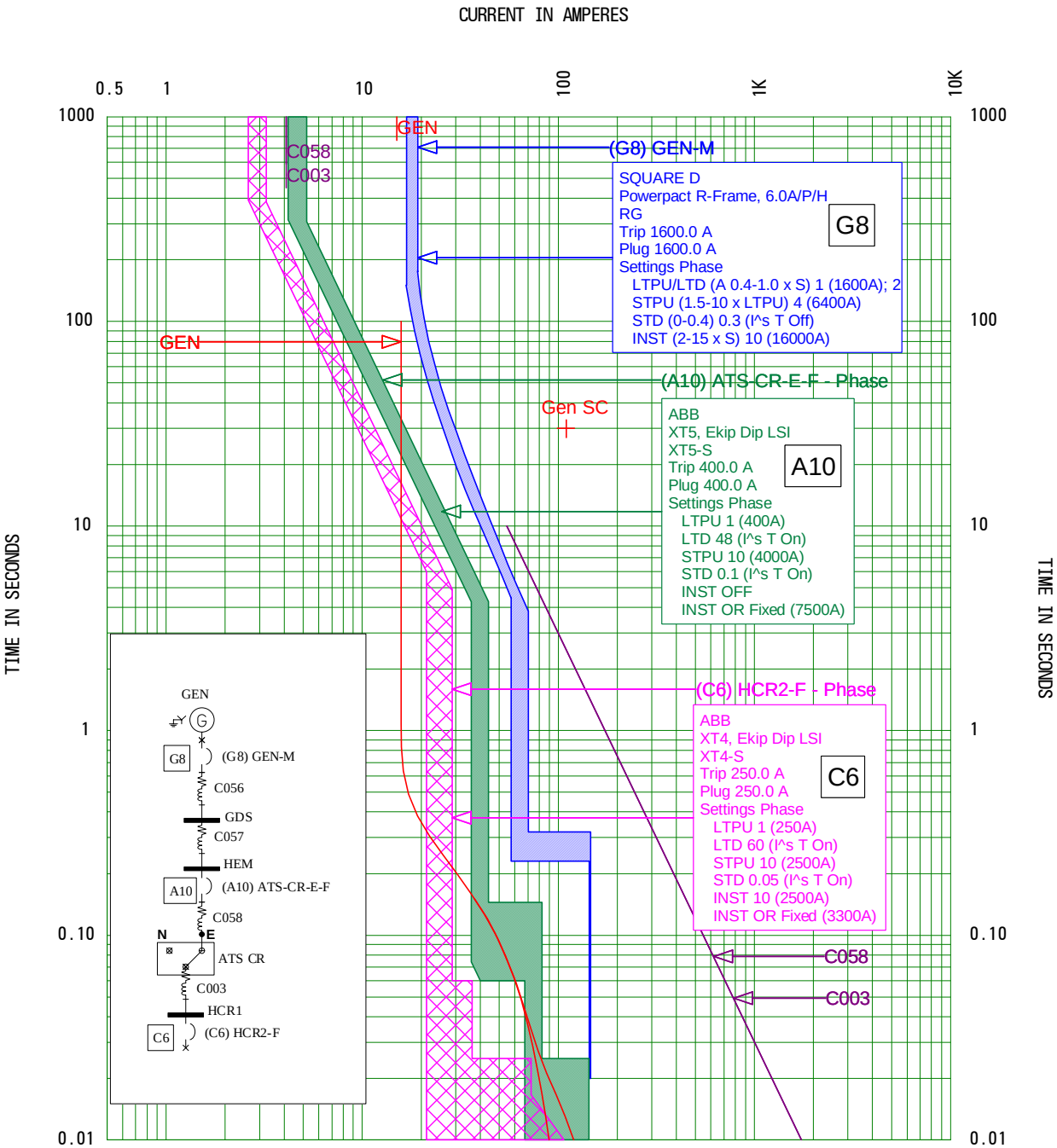
Proper coordination has been achieved between devices (G8) and (A10). Faults or overloads occurring on the load side of any feeder breaker in SWBD HEM would be interrupted and cleared by the involved device without disturbing the upstream generator main breaker.

Proper selective coordination has been achieved between devices (A10) and (C6). According to ABB selective coordination tables, these breakers selectively coordinate up to 100kA at 480V. Faults or overloads occurring on the load side of device (C6) would be interrupted and cleared by the involved device without disturbing any upstream device when fed by the generator. Furthermore, as required by NEC Article 517.31(G), all feeder breakers in Panel HCR1 coordinate with the upstream breaker for fault durations extending beyond 0.1 seconds.

3.5.10 COORDINATION CURVE SHEET No. 10 (continued)

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder breakers in Panel HCR1 when supplied by the generator. Proper selective coordination has been achieved as required by the NEC.



TCC Name: 10 - GEN TO HCR1
Oneline: TCC10
September 2, 2021 3:03 PM

Current Scale x 100

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.11 COORDINATION CURVE SHEET No. 11

This curve sheet represents coordination of the following devices:

(G8) 480V Generator main breaker
(A11) 480V feeder breaker to ATS-LS (Standby)
(C7) 480V feeder breaker to Transformer TX-LLS1

Device (G8), as discussed on Coordination Curve Sheet No. 8, has been maintained as the upper limit of coordination for this curve sheet.

Device (C7), as discussed on Curve Sheet No. 7, has been maintained as the lower limit of coordination for this curve sheet.

This evaluation has been based on an emergency system, as defined by the NEC, for the ATS-LS circuit when powered by the generator.

(A11) 480V feeder breaker to ATS-LS (Standby)

Cable Insulation: Good, as detailed by withstand curves (C060) and (C032).

Cable Protection: Good, the 225A pickup properly protects the 1 set of 300kcmil (AL) feeder cables.

ATS Protection: Good, the 225A pickup properly protects 260A ATS-LS.

Panel Protection: Good, the 225A pickup properly protects 225A Panel HLS1.

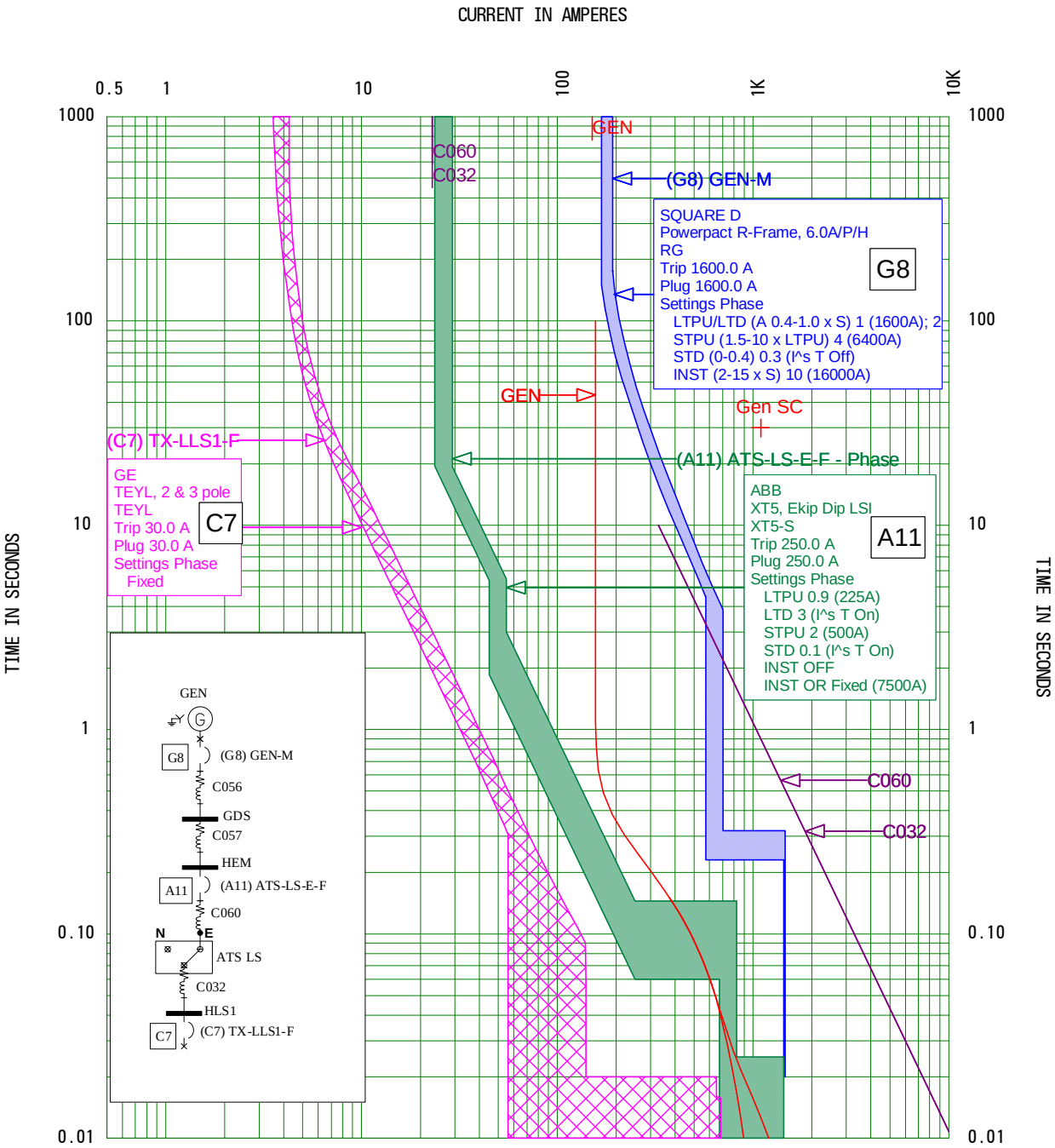
Coordination:

Proper coordination has been achieved between devices (G8) and (A11). Faults or overloads occurring on the load side of any feeder breaker in SWBD HEM would be interrupted and cleared by the involved device without disturbing the upstream generator main breaker.

Proper selective coordination has been achieved between devices (A11) and (C3). Faults or overloads occurring on the load side of any feeder breaker in Panel HLS1 would be interrupted and cleared by the involved device without disturbing any upstream emergency device.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The protection and coordination afforded by the devices depicted on this curve sheet is representative of the other feeder breakers in Panel HLS1 when supplied by the generator. Proper selective coordination has been achieved as required by the NEC.



TCC Name: 11 - GEN TO HLS1
Oneline: TCC11
July 20, 2021 10:16 AM

Current Scale x 10

Reference Voltage: 480

Coordinated Power Engineering, Inc.

3.5.12 COORDINATION CURVE SHEET No. 12

This curve sheet represents coordination of the following devices:

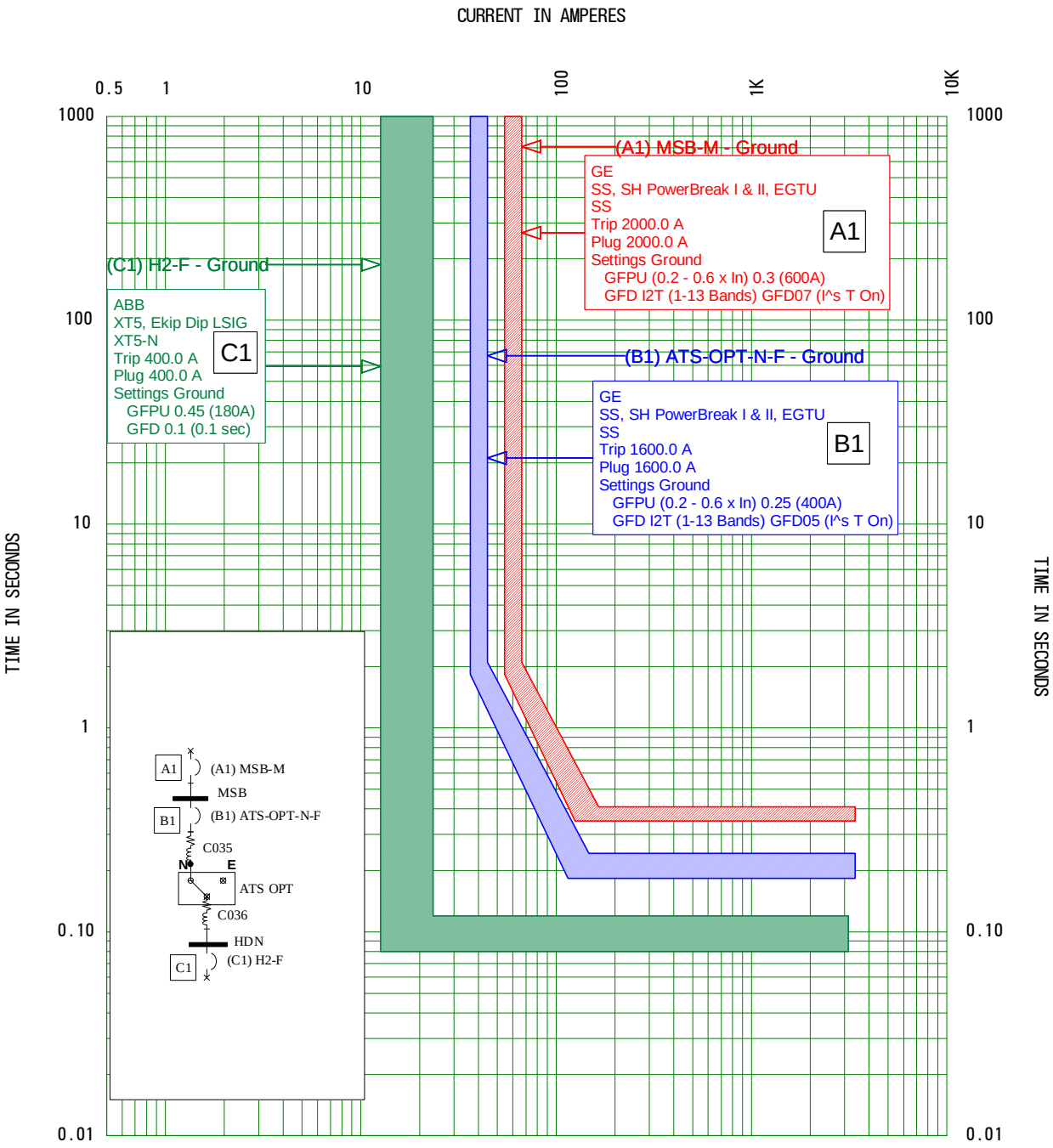
(A1) 480V SWBD MSB main breaker ground trip
(B1) 480V feeder breaker to ATS-OPT (Normal) ground trip
(C1) 480V feeder breaker to Panel H2 ground trip

All devices shown on this curve sheet are properly coordinated.

The values of ground-fault currents shown on this curve sheet represent maximum values which have been determined by phase-ground fault calculations. Values of phase-ground fault currents can be much less than shown. They can even be less than low load currents, depending on the zero sequence current path. For this reason, we have attempted to provide as low as possible pickup values and still allow clearing time between devices.

Summary of Curve Sheet

The coordination illustrated on this curve sheet has been maximized based on the devices within the scope of the project. All devices shown on this curve have been set or sized to provide proper protection of the electrical equipment, in accordance with the NEC and ANSI/IEEE standards. The ground-fault coordination afforded by the devices depicted on this curve sheet is representative of the other feeder device ground trips in Switchboards MSB and HDN.



TCC Name: 12 - GND
Oneline: TCC12
July 20, 2021 9:33 AM

Current Scale x 10

Reference Voltage: 480

Coordinated Power Engineering, Inc.

4. ARC FLASH HAZARD STUDY

General

Arc Flash Hazard studies are performed to determine the safe working distances, arc flash energy and level of Personal Protective Equipment (PPE) to be used when working on and around the electrical distribution equipment. The energy in an arc is a function of the maximum available fault level at a location and the time in which it would take to clear the maximum fault.

Conclusion

The following pages contain the tabulation of the results of the Arc Flash Hazard calculations for the low-voltage systems within the scope of this project, as shown on the one-line diagrams that accompany the tabulation of Arc Flash Hazard values. These tabulations contain the pertinent fault levels, devices opening times, approach distances, flash boundaries, incident energy and Personal Protective Equipment (PPE) level to be used when working on and around each piece of electrical equipment.

Depending on the arcing fault current levels, by reducing the protective device pickup rating or size, the PPE level typically will be reduced due to the fast acting time-current characteristics of the device to clear the fault. However, reducing the pickup also will reduce the load circuit capacity. Also, reducing pickup levels will decrease the level of system coordination with downstream protective devices and nuisance operation may result. Therefore, the recommendations provided in the Short-Circuit and Coordination Study form a balance between the system coordination and the PPE levels.

The protective device settings have been reviewed and adjusted to reduce the arc flash hazard levels while maintaining the optimal system coordination. Two scenarios (Utility Power and Generator Power) have been evaluated. The following table lists the worst-case arc flash incident energies.

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing 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)	PPE Level / Notes (*N)
1	ATS-CR	(B6) ATS-CR-N-F	0.48	28.85	18.70	28.85	18.70	0.0141	PNL	25	12	18	0.64	Level 1 (*N3) (*S0)
2	ATS-EQ	(B3) ATS-EQ-N-F	0.48	32.29	20.50	29.38	18.66	0.245	PNL	25	74	18	11.4	Level 3 (*N3) (*S0)
3	ATS-LS	(B7) ATS-LS-N-F	0.48	23.98	15.91	23.98	15.91	0.025	PNL	25	16	18	0.95	Level 1 (*N3) (*S0)
4	ATS-OPT	(B1) ATS-OPT-N-F	0.48	32.68	23.61	31.76	22.94	0.213	PNL	25	74	18	11.5	Level 3 (*S0)
5	CB-GEN	MaxTripTime @2.0s	0.48	14.58	11.24	10.82	8.29	2	PNL	25	156	18	38.0	Level 4 (*N2) (*N9) (*S1)
6	CB-GLC	TX-GLC-F	0.24	1.06	0.45	1.06	0.45	2	PNL	25	23	18	1.82	Level 1 (*N9) (*S0)
7	CB-LEQK	(C5) TX-LEQK-F	0.208	2.65	1.08	2.65	1.08	2	PNL	25	42	18	4.57	Level 2 (*N9) (*S0)
8	CB-LK1	TX-LK1-F	0.208	6.59	2.91	6.59	2.91	2	PNL	25	79	18	12.9	Level 3 (*N9) (*S0)
9	DS-DSWH1	DSWH1-F	0.48	11.07	7.44	10.50	7.06	0.025	PNL	25	9	18	0.42	Level 1 (*N3) (*S1)
10	DS-DSWH2	DSWH2-F	0.48	20.60	15.76	20.07	15.35	0.0086	PNL	25	8	18	0.32	Level 1 (*S0)
11	DS-OAU-1	OAU-1-F	0.48	8.86	6.74	8.59	6.53	0.025	PNL	25	9	18	0.38	Level 1 (*S0)
12	DS-RTU-1	RTU-1-F	0.48	8.68	6.60	8.26	6.28	0.025	PNL	25	9	18	0.37	Level 1 (*S1)
13	DS-RTU-2	RTU-2-F	0.48	9.41	7.17	9.05	6.90	0.025	PNL	25	9	18	0.40	Level 1 (*S0)
14	DS-RTU-3	(D3) RTU-3-F	0.48	8.72	6.63	8.29	6.30	0.025	PNL	25	9	18	0.37	Level 1 (*S1)
15	DS-RTU-4	RTU-4-F	0.48	8.49	6.45	8.15	6.19	0.025	PNL	25	8	18	0.36	Level 1 (*S0)
16	DS-RTU-5	(D4) RTU-5-F	0.48	8.76	6.66	8.42	6.40	0.025	PNL	25	9	18	0.37	Level 1 (*S0)
17	DS-TXLEQ2	TX-LEQ2-F	0.48	6.92	5.20	6.92	5.20	0.025	PNL	25	7	18	0.29	Level 1 (*S0)
18	ECB-RTU-3	(C3) HEQ1-F	0.48	18.41	14.15	17.53	13.47	0.025	PNL	25	14	18	0.83	Level 1 (*S0)
19	ECB-RTU-4	(C3) HEQ1-F	0.48	18.41	14.15	17.53	13.47	0.025	PNL	25	14	18	0.83	Level 1 (*S0)
20	GDS	(G8) GEN-M	0.48	14.47	11.16	10.69	8.24	0.32	PNL	25	52	18	6.51	Level 2 (*S1)
21	GEN-LC	GEN-LC-F	0.24	0.95	0.40	0.95	0.40	2	PNL	25	22	18	1.61	Level 1 (*N9) (*S0)
22	GEN-LC (GEN-LC-M LineSide)	GEN-LC-F	0.24	0.95	0.40	0.95	0.40	2	PNL	25	22	18	1.61	Level 1 (*N9) (*S0)
23	H1	H1-F	0.48	27.79	18.11	27.79	18.11	0.0147	PNL	25	12	18	0.64	Level 1 (*N3) (*S0)
24	H2	(C1) H2-F	0.48	9.55	7.29	9.55	7.29	0.06	PNL	25	16	18	0.98	Level 1 (*S1)
25	H3	(D2) H3-F	0.48	7.64	5.77	7.64	5.77	0.025	PNL	25	8	18	0.32	Level 1 (*S0)
26	HCR1	(B6) ATS-CR-N-F	0.48	25.94	17.06	25.94	17.06	0.0159	PNL	25	12	18	0.65	Level 1 (*N3) (*S0)
27	HCR2	(C6) HCR2-F	0.48	7.95	6.02	7.95	6.02	0.025	PNL	25	8	18	0.33	Level 1 (*S1)
28	HDEQ	(B3) ATS-EQ-N-F	0.48	31.05	22.66	28.14	20.53	0.245	PNL	25	78	18	12.5	Level 3 (*S0)

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing 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)	PPE Level / Notes (*N)
29	HDN	(B1) ATS-OPT-N-F	0.48	31.40	22.86	30.48	22.19	0.213	PNL	25	72	18	11.1	Level 3 (*S0)
30	HEM	(G8) GEN-M	0.48	14.35	11.06	10.55	8.13	0.32	PNL	25	51	18	6.43	Level 2 (*S1)
31	HEQ1	(C3) HEQ1-F	0.48	11.07	7.45	10.16	6.83	0.145	PNL	25	26	18	2.18	Level 1 (*N3) (*S1)
32	HEQ2	(C4) HEQ2-F	0.48	10.71	8.21	10.35	7.93	0.06	PNL	25	17	18	1.11	Level 1 (*S0)
33	HLS1	(B7) ATS-LS-N-F	0.48	8.71	6.62	8.71	6.62	0.145	PNL	25	26	18	2.11	Level 1 (*S0)
34	L1	TX-L1-F	0.208	5.92	2.23	5.92	2.23	0.57	PNL	25	30	18	2.68	Level 1 (*N3) (*N5) (*S1)
35	L1 (L1-M LineSide)	TX-L1-F	0.208	5.92	2.23	5.92	2.23	0.57	PNL	25	30	18	2.68	Level 1 (*N3) (*S1)
36	L2	(D1) TX-L2-F	0.208	6.10	2.67	6.10	2.67	0.265	PNL	25	21	18	1.57	Level 1 (*N5) (*S0)
37	L2 ((E1) L2-M LineSide)	(D1) TX-L2-F	0.208	6.10	2.67	6.10	2.67	0.265	PNL	25	21	18	1.57	Level 1 (*S0)
38	L3	(E2) TX-L3-F	0.208	3.11	1.10	3.11	1.10	1.159	PNL	25	30	18	2.67	Level 1 (*N3) (*N5) (*S1)
39	L3 ((F2) L3-M LineSide)	(E2) TX-L3-F	0.208	3.11	1.10	3.11	1.10	1.159	PNL	25	30	18	2.67	Level 1 (*N3) (*S1)
40	LCR1	LCR1-M	0.208	1.69	0.66	1.69	0.66	2	PNL	25	30	18	2.74	Level 1 (*N9) (*S0)
41	LCR1 (LCR1-M LineSide)	TX-LCR1-F	0.208	1.69	0.66	1.69	0.66	2	PNL	25	30	18	2.74	Level 1 (*N9) (*S0)
42	LCR2	LCR2-M	0.208	3.75	1.57	3.75	1.57	2	PNL	25	53	18	6.79	Level 2 (*N9) (*S0)
43	LCR2 (LCR2-M LineSide)	(D6) TX-LCR2-F	0.208	3.75	1.57	3.75	1.57	2	PNL	25	53	18	6.79	Level 2 (*N9) (*S0)
44	LCR3	LCR3-M	0.208	2.23	0.89	2.23	0.89	2	PNL	25	37	18	3.76	Level 1 (*N9) (*S0)
45	LCR3 (LCR3-M LineSide)	LCR3-F	0.208	2.23	0.89	2.23	0.89	2	PNL	25	37	18	3.76	Level 1 (*N9) (*S0)
46	LEQ1	TX-LEQ1-F	0.208	3.84	1.39	3.84	1.39	2	PNL	25	48	18	5.80	Level 2 (*N3) (*N5) (*N9) (*S1)
47	LEQ1 (LEQ1-M LineSide)	TX-LEQ1-F	0.208	3.84	1.39	3.84	1.39	2	PNL	25	48	18	5.80	Level 2 (*N3) (*N9) (*S1)
48	LEQ2	TX-LEQ2-F	0.208	3.58	1.49	3.58	1.49	2	PNL	25	51	18	6.43	Level 2 (*N5) (*N9) (*S0)
49	LEQ2 (LEQ2-M LineSide)	TX-LEQ2-F	0.208	3.58	1.49	3.58	1.49	2	PNL	25	51	18	6.43	Level 2 (*N9) (*S0)
50	LEQ3	LEQ3-M	0.208	2.15	0.86	2.15	0.86	2	PNL	25	36	18	3.59	Level 1 (*N9) (*S0)

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing 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)	PPE Level / Notes (*N)
51	LEQ3 (LEQ3-M LineSide)	LEQ3-F	0.208	2.15	0.86	2.15	0.86	2	PNL	25	36	18	3.59	Level 1 (*N9) (*S0)
52	LEQK	(D5) LEQK-F	0.208	2.12	0.73	2.12	0.73	2	PNL	25	32	18	3.07	Level 1 (*N3) (*N9) (*S0)
53	LK1	TX-LK1-F	0.208	5.26	2.27	5.26	2.27	2	PNL	25	68	18	9.96	Level 3 (*N5) (*N9) (*S0)
54	LLS1	(D7) LLS1-M	0.208	0.99	0.32	0.99	0.32	1.77	PNL	25	17	18	1.14	Level 1 (*N3) (*S1)
55	LLS1 ((D7) LLS1-M LineSide)	(C7) TX-LLS1-F	0.208	1.01	0.38	1.01	0.38	2	PNL	25	21	18	1.53	Level 1 (*N9) (*S0)
56	MSB	(A1) MSB-M	0.48	33.85	24.26	30.05	21.54	0.405	PNL	25	111	18	22.1	Level 3 (*S0)
57	MSB ((A1) MSB-M LineSide)	MaxTripTime @2.0s	0.48	33.85	24.26	30.05	22.06	2	PNL	25	299	18	107.2	Dangerous! (*N2) (*N9) (*S0)
58	TX-GLC	TX-GLC-F	0.48	11.24	8.62	11.24	8.62	0.012	PNL	25	6	18	0.23	Level 1 (*S0)
59	TX-L1	TX-L1-F	0.48	26.10	19.57	26.10	19.57	0.0086	PNL	25	9	18	0.40	Level 1 (*S0)
60	TX-L2	(D1) TX-L2-F	0.48	9.20	7.01	9.20	7.01	0.025	PNL	25	9	18	0.39	Level 1 (*S1)
61	TX-L3	(E2) TX-L3-F	0.48	6.80	5.11	6.80	5.11	0.025	PNL	25	7	18	0.28	Level 1 (*S0)
62	TX-LCR1	TX-LCR1-F	0.48	16.94	13.05	16.94	13.05	0.025	PNL	25	14	18	0.76	Level 1 (*S0)
63	TX-LCR2	(D6) TX-LCR2-F	0.48	10.36	6.95	10.36	6.95	0.025	PNL	25	9	18	0.39	Level 1 (*N3) (*S0)
64	TX-LEQ1	TX-LEQ1-F	0.48	27.28	20.33	27.28	20.33	0.0086	PNL	25	9	18	0.42	Level 1 (*S0)
65	TX-LEQ2	TX-LEQ2-F	0.48	6.58	4.94	6.58	4.94	0.025	PNL	25	7	18	0.27	Level 1 (*S0)
66	TX-LEQK	(C5) TX-LEQK-F	0.48	10.91	7.33	10.91	7.33	0.0164	PNL	25	7	18	0.27	Level 1 (*N3) (*S1)
67	TX-LK1	TX-LK1-F	0.48	26.10	19.57	26.10	19.57	0.0086	PNL	25	9	18	0.40	Level 1 (*S0)
68	TX-LLS1	(C7) TX-LLS1-F	0.48	4.72	3.48	4.72	3.48	0.02	PNL	25	5	18	0.15	Level 1 (*S0)
69	VFD-RTU-1	RTU-1-FSS	0.48	8.25	6.26	7.83	5.94	0.0083	PNL	25	4	18	0.12	Level 1 (*N4b) (*S1)
70	VFD-RTU-2	RTU-2-FSS	0.48	8.84	5.90	8.49	5.66	0.0083	PNL	25	4	18	0.11	Level 1 (*N3) (*N4b) (*S0)
71	VFD-RTU-3	(E3) RTU-3-FSS	0.48	8.32	6.31	7.90	5.99	0.0083	PNL	25	4	18	0.12	Level 1 (*N4b) (*S1)
72	VFD-RTU-4	RTU-4-FSS	0.48	8.04	6.09	7.70	5.83	0.0083	PNL	25	4	18	0.11	Level 1 (*N4b) (*S0)
73	VFD-RTU-5	(E4) RTU-5-FSS	0.48	8.28	6.28	7.94	6.02	0.0083	PNL	25	4	18	0.12	Level 1 (*N4b) (*S0)

	Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault (kA)	Bus Arcing 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)	PPE Level / Notes (*N)
74	Level 1: Arc-rated FR Shirt & Pants	0.0 - 1.2 cal/cm^2											#Level 1 = 55	(*N2) < 80% Cleared Fault Threshold
75	Level 1: Arc-rated FR Shirt & Pants	1.2 - 4.0 cal/cm^2											#Level 2 = 9	(*N3) - Arcing Current Low Tolerances Used
76	Level 2: Arc-rated FR Shirt & Pants	4.0 - 8.0 cal/cm^2											#Level 3 = 7	(*N4b) - Current Limiting Fuse
77	Level 3: Arc-rated FR Shirt & Pants & Arc Flash Suit	8.0 - 25.0 cal/cm^2											#Level 4 = 1	(*N5) - Miscoordinated, Upstream Device Tripped
78	Level 4: Arc-rated FR Shirt & Pants & Arc Flash Suit	25.0 - 40.0 cal/cm^2											#Danger = 1	(*N9) - Max Arcing Duration Reached
79	Level Dangerous!: No AF Clothing Category Found, Energized Work Prohibited!	40.0 - 999.0 cal/cm^2												IEEE 1584 2018 Bus + Line Side - Comprehensive Fault80% Cleared Fault Threshold, mis-coordination checked
80														Worst Case:
81	For additional information refer to NFPA 70 E, Standard for Electrical Safety in the Workplace.													(*S0) - NORMAL
82														(*S1) - GENERATOR

5. RECOMMENDATIONS & COMMENTS

The following are the recommendations and comments for the electrical distribution system. Implementation of these recommendations is imperative to ensure maximized system safety, performance, and reliability.

1) According to the manufacturer's published interrupting ratings, all devices within the scope of this study have sufficient interrupting capacity to safely interrupt the calculated maximum fault current at each location. See the Short-Circuit Analysis in Section 2 of this report for further details.

2) The recommended low-voltage circuit breaker settings are tabulated on Pages 5-2 to 5-4. In addition, CPE recommends setting all other new low-voltage adjustable breakers to "HI/MAX".

3) Section 4 shows the results of Arc Flash Hazard calculations. Incident energy and arc flash boundaries are calculated based on the bus 3-phase fault current and arcing duration. Clothing requirements are specified from the NFPA 70E personal protective equipment table. The personal protective equipment category requirements shown on the table are based on the Coordination Study. Therefore, protective devices must be set as recommended by the study.

4) The Appendix shows the single-line representation of the electrical distribution system within the scope of this project. All device sizes/ratings shown on the diagram are the **recommended** values.

TABULATION OF LOW-VOLTAGE CIRCUIT BREAKER SETTINGS

LOCATION	MFR/TRIP DEVICE	SENSOR /PLUG	LTPU	LTD BAND	STPU	STD BAND	INST PU	GROUND PU	GROUND TIME
480V Switchboard MSB									
Main Bkr	GE SS PBII w/ EGTU	2000A	1x (2000A)	C-4	3x (6000A)	ST10-Min (I^2t-Off)	15x (30kA)	0.3x (600A)	GFD07 (I^2t-On)
Fdr Bkr to ATS-CR	ABB XT5-S w/ Ekip Dip	400A	1x (400A)	48 Sec (I^2t)	10x (4000A)	0.1 Sec (I^2t-On)	OFF	0.45x (180A)	0.2 Sec
Fdr Bkr to ATS-EQ	ABB XT7-S w/ Ekip Touch	1200A	1x (1200A)	7 Sec (I^2t)	3.7x (4440A)	0.2 Sec (I^2t-On)	15x (18kA)	0.35x (420A)	0.2 Sec (I^2t-Off)
Fdr Bkr to ATS-LS	ABB XT5-S w/ Ekip Dip	250A	0.9x (225A)	3 Sec (I^2t)	2x (450A)	0.1 Sec (I^2t-On)	OFF	0.45x (112.5A)	0.2 Sec
Fdr Bkr to ATS-OPT	GE SS PBII w/ EGTU	1600A	1x (1600A)	C-2	2.5x (4000A)	ST07-Min (I^2t-Off)	15x (24kA)	0.25x (400A)	GFD05 (I^2t-On)
Set the RELT function for all applicable breakers in this switchboard to default minimum.									
480V Switchboard HDN									
Fdr Bkr to H1	ABB XT5-N w/ Ekip Dip	400A	1x (400A)	3 Sec (I^2t)	1x (400A)	0.05 Sec (I^2t-On)	10x (4000A)	0.45x (180A)	0.1 Sec
Fdr Bkr to TX-GLC	GE FBV	50A	50A	--	--	--	FIXED	--	--
Fdr Bkr to TX-L1	ABB XT4-S w/ Ekip Dip	250A	0.9x (225A)	3 Sec (I^2t)	1x (250A)	0.05 Sec (I^2t-On)	10x (2500A)	0.45x (112.5A)	0.1 Sec
Fdr Bkr to TX-LK1	ABB XT4-S w/ Ekip Dip	250A	0.9x (225A)	12 Sec (I^2t)	10x (2250A)	0.05 Sec (I^2t-On)	10x (3000A)	0.45x (112.5A)	0.1 Sec
Fdr Bkr to H2	ABB XT5-N w/ Ekip Dip	400A	1x (400A)	12 Sec (I^2t)	6.5x (2600A)	0.1 Sec (I^2t-On)	10x (4000A)	0.45x (180A)	0.1 Sec
Fdr Bkr to RTU-1	ABB XT4-S w/ Ekip Dip	150A	1x (150A)	12 Sec (I^2t)	4.5x (675A)	0.05 Sec (I^2t-On)	10x (1500A)	0.55x (82.5A)	0.1 Sec
Fdr Bkr to RTU-2	ABB XT4-S w/ Ekip Dip	150A	1x (150A)	12 Sec (I^2t)	4.5x (675A)	0.05 Sec (I^2t-On)	10x (1500A)	0.55x (82.5A)	0.1 Sec
Fdr Bkr to Kitchen Dryer*	ABB XT4-H w/ Ekip Dip	40A	0.88x (35.2A)	60 Sec (I^2t)	10x (352A)	0.2 Sec (I^2t-On)	10x (400A)	0.75x (30A)	0.1 Sec
* Circuit not shown on System Diagram. Long-time pickup set as indicated in ABB submittals.									
208V Breaker CB-LEQK									
Main Bkr	ABB XT4-S w/ Ekip Dip	150A	1x (150A)	12 Sec (I^2t)	2x (300A)	0.4 Sec (I^2t-On)	10x (1500A)	--	--
208V Breaker CB-LK1									
Fdr Bkr to LK1	ABB XT5-N w/ TMA	400A	MAX (400A)	--	--	--	MAX	--	--

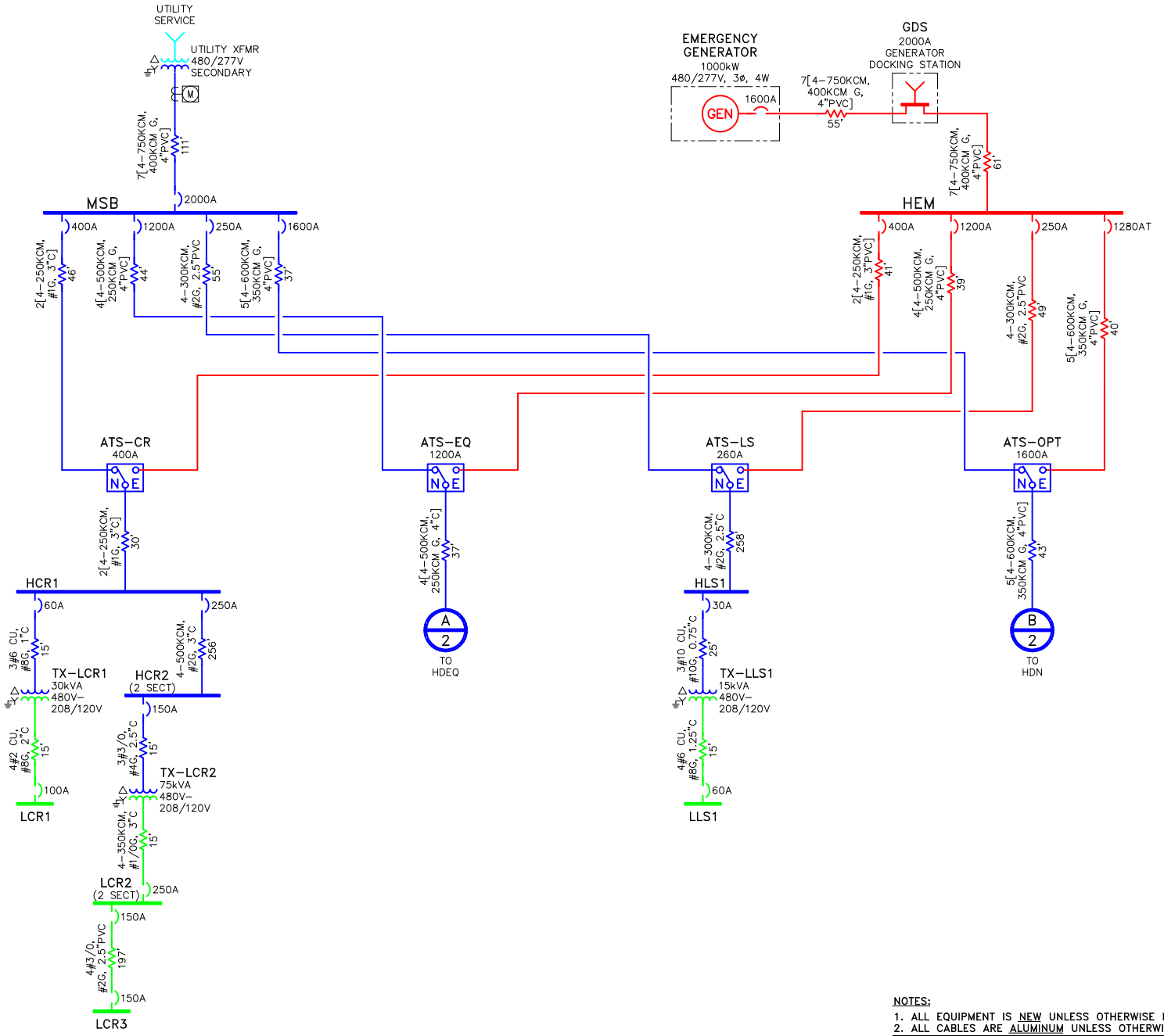
TABULATION OF LOW-VOLTAGE CIRCUIT BREAKER SETTINGS

LOCATION	MFR/TRIP DEVICE	SENSOR /PLUG	LTPU	LTD BAND	STPU	STD BAND	INST PU	GROUND PU	GROUND TIME
480V Panel HDEQ									
Fdr Bkr to OAU-1	ABB XT4-H w/ Ekip Dip	100A	1x (100A)	12 Sec (I^2t)	6.5x (650A)	0.05 Sec (I^2t-On)	10x (1000A)	--	--
Fdr Bkr to DSWH1	ABB XT4-H w/ Ekip Dip	150A	1x (150A)	36 Sec (I^2t)	5.5x (825A)	0.05 Sec (I^2t-On)	10x (1000A)	--	--
Fdr Bkr to DSWH2	ABB XT4-H w/ Ekip Dip	150A	1x (150A)	36 Sec (I^2t)	5.5x (825A)	0.05 Sec (I^2t-On)	10x (1500A)	--	--
Fdr Bkr to TX-LEQ1	ABB XT4-H w/ Ekip Dip	150A	1x (150A)	3 Sec (I^2t)	9x (1350A)	0.05 Sec (I^2t-On)	10x (1500A)	--	--
Fdr Bkr to TX-LEQ2	ABB XT4-H w/ Ekip Dip	150A	1x (150A)	36 Sec (I^2t)	10x (1500A)	0.05 Sec (I^2t-On)	10x (1500A)	--	--
Fdr Bkr to HEQ1	ABB XT5-H w/ Ekip Dip	600A	1x (600A)	12 Sec (I^2t)	5.5x (3300A)	0.1 Sec (I^2t-Off)	10x (6000A)	--	--
Fdr Bkr to TX-LEQK	ABB XT4-H w/ Ekip Dip	100A	0.9x (90A)	12 Sec (I^2t)	10x (1000A)	0.05 Sec (I^2t-On)	10x (1000A)	--	--
Fdr Bkr to HEQ2	ABB XT5-H w/ Ekip Dip	400A	1x (400A)	3 Sec (I^2t)	2.5x (1000A)	0.1 Sec (I^2t-On)	10x (4000A)	--	--
208V Panel LLS1									
Main Bkr	ABB XT4-N w/ Ekip Dip	60A	1x (60A)	12 Sec (I^2t)	2x (120A)	0.4 Sec (I^2t-On)	OFF	--	--
480V Panel H2									
Fdr Bkr to TX-L2	ABB XT4-N w/ Ekip Dip	250A	0.9x (225A)	3 Sec (I^2t)	2x (500A)	0.2 Sec (I^2t-Off)	8x (2000A)	--	--
Fdr Bkr to Panel H3	ABB XT4-N w/ Ekip Dip	250A	0.9x (225A)	12 Sec (I^2t)	7.5x (1875A)	0.05 Sec (I^2t-Off)	10x (2500A)	--	--
480V Panel H3									
Fdr Bkr to TX-L3	ABB XT4-N w/ Ekip Dip	100A	0.9x (90A)	3 Sec (I^2t)	5.5x (500A)	0.2 Sec (I^2t-Off)	10x (1000A)	--	--
208V Panel L2									
Main Bkr	ABB XT5-N w/ TMA	400A	MAX (400A)	--	--	--	MAX	--	--

TABULATION OF LOW-VOLTAGE CIRCUIT BREAKER SETTINGS

LOCATION	MFR/TRIP DEVICE	SENSOR /PLUG	LTPU	LTD BAND	STPU	STD BAND	INST PU	GROUND PU	GROUND TIME
480V Switchboard HEM									
Fdr Bkr to ATS-CR	ABB XT5-S w/ Ekip Dip	400A	1x (400A)	48 Sec (I^2t)	10x (4000A)	0.1 Sec (I^2t-On)	OFF	0.45x (180A)	0.2 Sec
Fdr Bkr to ATS-EQ	ABB XT7-S w/ Ekip Touch	1200A	1x (1200A)	7 Sec (I^2t)	3.7x (4440A)	0.2 Sec (I^2t-On)	15x (18kA)	0.35x (420A)	0.2 Sec (I^2t-Off)
Fdr Bkr to ATS-LS	ABB XT5-S w/ Ekip Dip	250A	0.9x (225A)	3 Sec (I^2t)	2x (500A)	0.1 Sec (I^2t-On)	OFF	0.45x (112.5A)	0.2 Sec
Fdr Bkr to ATS-OPT	GE SS PBII w/ EGTU	1600A	0.8x (1280A)	C-2	3x (3840A)	ST07-Min (I^2t-Off)	15x (24kA)	0.25x (400A)	GFD05 (I^2t-On)
480V Panel HEQ2									
Fdr Bkr to RTU-5	ABB XT4-N w/ Ekip Dip	150A	1x (150A)	12 Sec (I^2t)	4.5x (675A)	0.05 Sec (I^2t-On)	10x (1500A)	--	--
480V Panel HEQ1									
Fdr Bkr to RTU-3	ABB XT4-N w/ Ekip Dip	150A	1x (150A)	12 Sec (I^2t)	4.5x (675A)	0.05 Sec (I^2t-On)	10x (1500A)	--	--
Fdr Bkr to RTU-4	ABB XT4-N w/ Ekip Dip	150A	1x (150A)	12 Sec (I^2t)	4.5x (675A)	0.05 Sec (I^2t-On)	10x (1500A)	--	--
480V Generator Breaker									
Main Bkr	SQD RG w/ ML5.0	1600A	1x (1600A)	2 Sec	4x (6400A)	0.3 Sec (I^2t-Off)	10x (16kA)	--	--
480V Panel HCR1									
Fdr Bkr to HCR2	ABB XT4-S w/ Ekip Dip	250A	1x (250A)	60 Sec (I^2t)	10x (2500A)	0.05 Sec (I^2t-On)	10x (2500A)	--	--

NOTE: Set all other new low-voltage adjustable breakers to “HI/MAX”.



NOTES:

1. ALL EQUIPMENT IS NEW UNLESS OTHERWISE NOTED AS EXISTING (EX.).
2. ALL CABLES ARE ALUMINUM UNLESS OTHERWISE NOTED AS COPPER (CU).

SYMBOL LEGEND

- CABLE
- MOLDED CASE BREAKER
- SWITCH & FUSE
- AUTOMATIC TRANSFER SWITCH
- SWITCH
- UTILITY METER & CT
- MOTOR CONTROLLER
- MOTOR
- GENERATOR
- POWER TRANSFORMER
- VFD — VARIABLE FREQUENCY DRIVE
- MATCH LETTER
- CONT'D. SHEET NUMBER

COLOR LEGEND

- UTILITY SERVICE
- 480/277V DIST.
- 208/120V & 240/120V DIST.
- EMERGENCY DIST.

APPROVALS		DATE
DRAWN	CKG	11/22
CHECKED	MG	11/22
DESIGN		

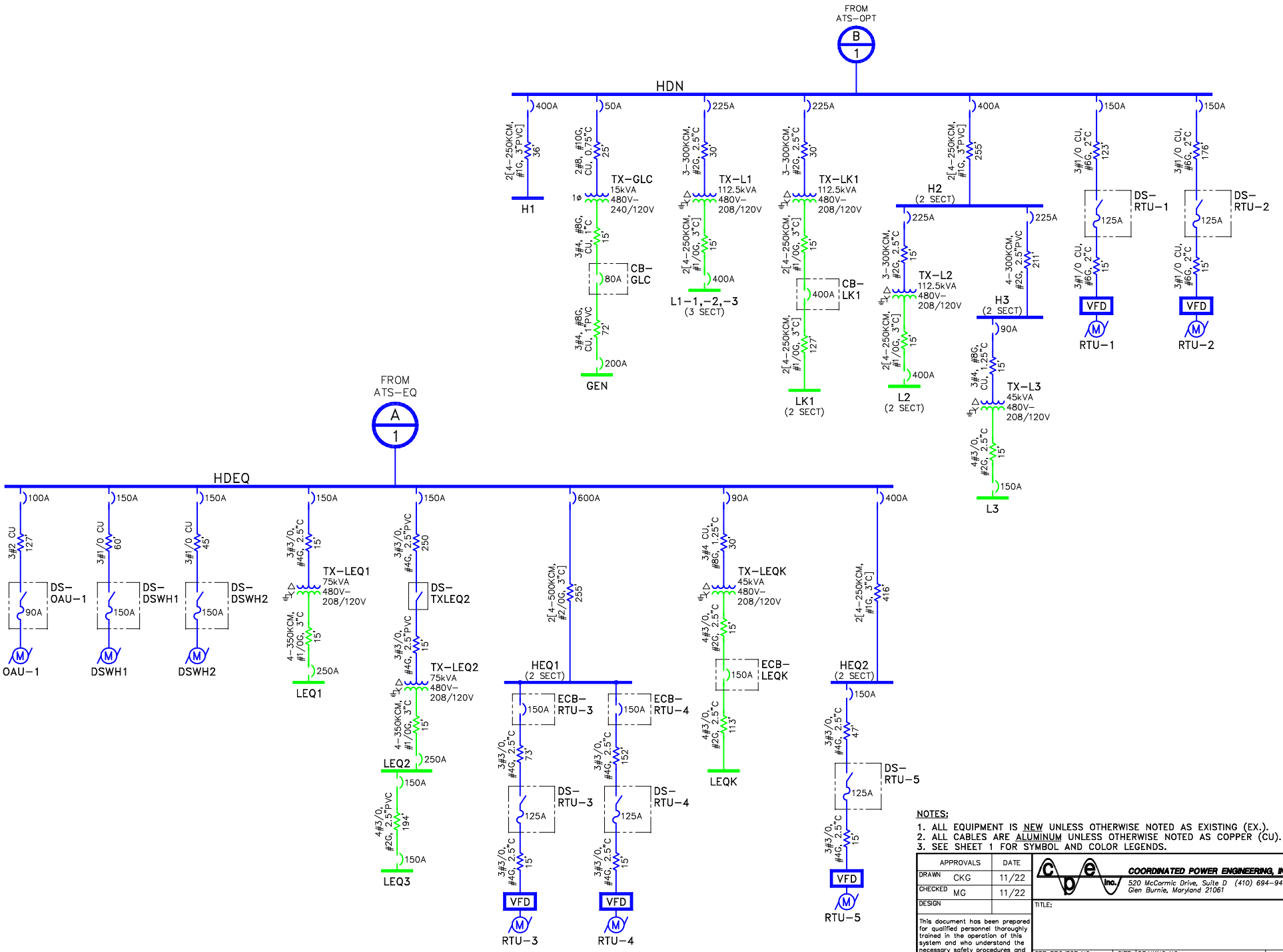
This document has been prepared for qualified personnel thoroughly trained in the operation of this system and who understand the necessary safety procedures and hazards associated with this type of system.

COORDINATED POWER ENGINEERING, INC.
520 McCormic Drive, Suite D (410) 694-9494
Glen Burnie, Maryland 21061

TITLE:

CPE PROJECT NO.:	SIZE	DRAWING NO.:	REV
21870	C	21870A	0

SCALE: NONE | CONTRACT NO. | SHEET 1 OF 2



NOTES:

1. ALL EQUIPMENT IS NEW UNLESS OTHERWISE NOTED AS EXISTING (EX.).
2. ALL CABLES ARE ALUMINUM UNLESS OTHERWISE NOTED AS COPPER (CU).
3. SEE SHEET 1 FOR SYMBOL AND COLOR LEGENDS.

APPROVALS		DATE
DRAWN	CKG	11/22
CHECKED	MG	11/22
DESIGN		

This document has been prepared for qualified personnel thoroughly trained in the operation of this system and who understand the necessary safety procedures and hazards associated with this type of system.

COORDINATED POWER ENGINEERING, INC.
520 McCormic Drive, Suite D (410) 694–9494
Glen Burnie, Maryland 21061

TITLE:

CPE PROJECT NO.:	SIZE	DRAWING NO.:	REV
21870	C	21870B	0

SCALE: NONE | CONTRACT NO. | SHEET 2 OF 2

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.64 cal/cm^2 @18 in

12 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 28.85 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **ATS-CR**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

11.4 cal/cm^2 @18 in

74 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 32.29 kA

Required PPE: **Level 3**

Arc-rated FR Shirt & Pants & Arc Flash Suit

EQPT ID: **ATS-EQ**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.95 cal/cm^2 @18 in

16 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 23.98 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **ATS-LS**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

11.5 cal/cm^2 @18 in

74 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 32.68 kA

Required PPE: **Level 3**

Arc-rated FR Shirt & Pants & Arc Flash Suit

EQPT ID: **ATS-OPT**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

38.0 cal/cm^2 @18 in

156 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 14.58 kA

Required PPE: **Level 4**

Arc-rated FR Shirt & Pants & Arc Flash Suit

EQPT ID: **CB-GEN**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

1.82 cal/cm^2 @18 in

23 in	Flash Hazard Boundary
240 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 1.06 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **CB-GLC**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

4.57 cal/cm^2 @18 in

42 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 2.65 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **CB-LEQK**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

12.9 cal/cm^2 @18 in

79 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 6.59 kA

Required PPE: **Level 3**

Arc-rated FR Shirt & Pants & Arc Flash Suit

EQPT ID: **CB-LK1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.42 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 11.07 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-DSWH1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.32 cal/cm^2 @18 in

8 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 20.60 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-DSWH2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.38 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.86 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-OAU-1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.37 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.68 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-RTU-1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.40 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 9.41 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-RTU-2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.37 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.72 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-RTU-3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.36 cal/cm^2 @18 in

8 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.49 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-RTU-4**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.37 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.76 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-RTU-5**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.29 cal/cm^2 @18 in

7 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 6.92 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **DS-TXLEQ2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.83 cal/cm^2 @18 in

14 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 18.41 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **ECB-RTU-3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.83 cal/cm^2 @18 in

14 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 18.41 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **ECB-RTU-4**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

6.51 cal/cm^2 @18 in

52 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 14.47 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **GDS**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

1.61 cal/cm^2 @18 in

22 in	Flash Hazard Boundary
240 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 0.95 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **GEN-LC**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

1.61 cal/cm^2 @18 in

22 in	Flash Hazard Boundary
240 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 0.95 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **GEN-LC**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.64 cal/cm^2 @18 in

12 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 27.79 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **H1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.98 cal/cm^2 @18 in

16 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 9.55 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **H2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.32 cal/cm^2 @18 in

8 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 7.64 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **H3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.65 cal/cm^2 @18 in

12 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 25.94 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **HCR1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.33 cal/cm^2 @18 in

8 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 7.95 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **HCR2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

12.5 cal/cm^2 @18 in

78 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 31.05 kA

Required PPE: **Level 3**

Arc-rated FR Shirt & Pants & Arc Flash Suit

EQPT ID: **HDEQ**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

11.1 cal/cm^2 @18 in

72 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 31.40 kA

Required PPE: **Level 3**

Arc-rated FR Shirt & Pants & Arc Flash Suit

EQPT ID: **HDN**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

6.43 cal/cm^2 @18 in

51 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 14.35 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **HEM**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

2.18 cal/cm^2 @18 in

26 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 11.07 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **HEQ1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

1.11 cal/cm^2 @18 in

17 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 10.71 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **HEQ2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

2.11 cal/cm^2 @18 in

26 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.71 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **HLS1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

2.68 cal/cm^2 @18 in

30 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 5.92 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **L1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

2.68 cal/cm^2 @18 in

30 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 5.92 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **L1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

1.57 cal/cm^2 @18 in

21 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 6.10 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **L2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

1.57 cal/cm^2 @18 in

21 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 6.10 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **L2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

2.67 cal/cm^2 @18 in

30 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 3.11 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **L3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

2.67 cal/cm^2 @18 in

30 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 3.11 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **L3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

2.74 cal/cm^2 @18 in

30 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 1.69 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LCR1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

2.74 cal/cm^2 @18 in

30 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 1.69 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LCR1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

6.79 cal/cm^2 @18 in

53 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 3.75 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **LCR2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

6.79 cal/cm^2 @18 in

53 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 3.75 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **LCR2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

3.76 cal/cm^2 @18 in

37 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 2.23 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LCR3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

3.76 cal/cm^2 @18 in

37 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 2.23 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LCR3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

5.80 cal/cm^2 @18 in

48 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 3.84 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **LEQ1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

5.80 cal/cm^2 @18 in

48 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 3.84 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **LEQ1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

6.43 cal/cm^2 @18 in

51 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 3.58 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **LEQ2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

6.43 cal/cm^2 @18 in

51 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 3.58 kA

Required PPE: **Level 2**

Arc-rated FR Shirt & Pants

EQPT ID: **LEQ2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

3.59 cal/cm^2 @18 in

36 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 2.15 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LEQ3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

3.59 cal/cm^2 @18 in

36 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 2.15 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LEQ3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

3.07 cal/cm^2 @18 in

32 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 2.12 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LEQK**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

9.96 cal/cm^2 @18 in

68 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 5.26 kA

Required PPE: **Level 3**

Arc-rated FR Shirt & Pants & Arc Flash Suit

EQPT ID: **LK1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

1.14 cal/cm^2 @18 in

17 in Flash Hazard Boundary

208 VAC Shock Hazard

42 in Limited Approach

12 in Restricted Approach

Glove Class: 00

Fault Current: 0.99 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LLS1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

1.53 cal/cm^2 @18 in

21 in	Flash Hazard Boundary
208 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 1.01 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **LLS1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

22.1 cal/cm^2 @18 in

111 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 33.85 kA

Required PPE: **Level 3**

Arc-rated FR Shirt & Pants & Arc Flash Suit

EQPT ID: **MSB**

DANGER

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

107.2 cal/cm^2 @18 in

299 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 33.85 kA

Required PPE: **Dangerous!**

No AF Clothing Category Found, Energized Work Prohibited!

EQPT ID: **MSB**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.23 cal/cm^2 @18 in

6 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 11.24 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-GLC**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.40 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 26.10 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-L1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.39 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 9.20 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-L2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.28 cal/cm^2 @18 in

7 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 6.80 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-L3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.76 cal/cm^2 @18 in

14 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 16.94 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-LCR1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.39 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 10.36 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-LCR2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.42 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 27.28 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-LEQ1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.27 cal/cm^2 @18 in

7 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 6.58 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-LEQ2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.27 cal/cm^2 @18 in

7 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 10.91 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-LEQK**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.40 cal/cm^2 @18 in

9 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 26.10 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-LK1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.15 cal/cm^2 @18 in

5 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 4.72 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **TX-LLS1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.12 cal/cm^2 @18 in

4 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.25 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **VFD-RTU-1**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.11 cal/cm^2 @18 in

4 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.84 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **VFD-RTU-2**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.12 cal/cm^2 @18 in

4 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.32 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **VFD-RTU-3**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.11 cal/cm^2 @18 in

4 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.04 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **VFD-RTU-4**

WARNING

Arc Flash and Shock Hazards
Appropriate PPE Required

CPE#21870 Date 11-08-2022

0.12 cal/cm^2 @18 in

4 in	Flash Hazard Boundary
480 VAC	Shock Hazard
42 in	Limited Approach
12 in	Restricted Approach

Glove Class: 00

Fault Current: 8.28 kA

Required PPE: **Level 1**

Arc-rated FR Shirt & Pants

EQPT ID: **VFD-RTU-5**