Solicitation
Solicitation Amendment

UNITED STATES POSTAL SERVICE

1. Amendment Number A01	to Solicitation Number 089495-22-A-0023	Date 03/15/2022

2a. Facility HARTFORD, CT - P&DC 141 Weston Street Hartford, CT 06101-9612	2b. Project B43529 Switchgear Replacement
3a. Offeror Name and Address	3b. Issued By REPAIR AND ALTERATION EAST 6 GRIFFIN RD N WINDSOR, CT 06095-1666 3c. Contact JOHN E FLYNN III 860-752-9427

4. The above numbered solicitation is amended as set forth in Block 5.

Note: Offerors must acknowledge receipt of this amendment prior to the date and time specified in the solicitation by one of the following methods:

a. By signing and returning one copy of the amendment;
b. By acknowledging receipt of this amendment on each copy of the offer submitted; or
c. By submitting a separate letter or telegram which includes a reference to the solicitation and amendment numbers.

FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE SPECIFIED IN THE SOLICITATION PRIOR TO THE DATE AND TIME SPECIFIED FOR RECEIPT OF OFFERS MAY RESULT IN REJECTION OF YOUR OFFER.
If by virtue of this amendment, you desire to change an offer already submitted, such change may be made by telegram or letter provided such telegram or letter makes reference to the solicitation and amendment numbers, and is received prior to the date and time specified.
The date and time specified for receipt of offers is:

5. Description of Amendment:

This amendment is being issued to incorporate the changes as described in the attached document titled Addendum No. 1.

6. Contractor Signature	Date Signed	U. S. Postal Service Signature	Date Signed

Name of person authorized to sign	Contracting Officer HELEN L HYNES

eDCCSAmend, March 2004, Version 1.00

McKINNELL & McKINNELL & TAYLOR Inc.
ARCHITECTS
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United States Postal Service
Switchgear Replacement
Hartford, CT - P&DC
USPS Project No. B43529
A/E Project No. 18034.00

Addendum No. 1

March 14, 2022

SPECIFICATIONS

Section 260500 – Common Work Results For Electrical

1. Add the attached Power System Study report to the end of this Section as Attachment A.

DRAWINGS

Drawing E0.01 – Electrical Abbreviations, Legends, and Notes

1. Under "Electrical General Notes", replace note no. 21 with the following:

   "21. THE EXISTING FIRE ALARM SYSTEM WAS RECENTLY INSTALLED AND IS UNDER A ONE-YEAR WARRANTY BY WESFIELD CONSTRUCTION. THE CONTRACTOR SHALL COORDINATE DIRECTLY WITH WESFIELD CONSTRUCTION (603) 256-3003 AND PAY ALL CHARGES ASSOCIATED WITH DISCONNECTING, REMOVING, AND TEMPORARY CONNECTION TO THE EXISTING FIRE ALARM SYSTEM, INCLUDING BUT NOT LIMITED TO, TEMPORARY CONNECTIONS, TEMPORARY MONITORING, AND RE-PROGRAMMING."

Drawing E3.01 – First Floor Plan – Area A

1. Under "Key Notes", delete note no. 8 and all references to the same.

Drawing E3.03 – First Floor Plan – Area C

1. Under "Key Notes", delete note no. 8 and all references to the same.

Drawing E3.04 – First Floor Plan – Area D

1. Under "Key Notes", delete note no. 8 and all references to the same.

McKINNELL
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January 11, 2021

United States Postal Service
955 Goffs Fall Road
Manchester, NH 03103-9991

Attn: John Flynn

Re: Switchgear Replacement
Hartford, CT - P&DC
A/E Project No. 18034.00

Dear John:

Enclosed please find the Power System Study Report for the above referenced project.

This report includes the Short Circuit Study, Coordination Study and Arc Flash Risk Assessment.

The recommended interrupting ratings and device settings will be incorporated into the 100% contract documents.

After your review should you have any questions, please give me a call.

Sincerely,

Brian M. Morley
Associate/Electrical Engineer

BMM/tac

Enclosure(s)

cc: Peter Jarzynski

Power Engineers, LLC
Electric Power Engineering

David J. Colombo, P.E.
(508) 612-0382
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USPS Hartford Processing & Distribution Center (P&DC)
141 Weston Street, Hartford, CT

New Electrical Equipment

Power System Study

January 2021

USPS Hartford Processing & Distribution Center (P&DC) -
141 Weston Street, Hartford, CT

New Electrical Equipment
Drawing E7.03 & E7.04

Power System Study

Table of Contents

USPS Hartford Processing & Distribution Center (P&DC) -
141 Weston Street, Hartford, CT

New Electrical Equipment
Drawing E7.03 & E7.04

Power System Study

Summary of Findings

1.0 INTRODUCTION

This report contains the results of the Power System Study performed for proposed electrical equipment located in the above-named facility. This report contains a description of the facility, the methodology used to complete the study, the results of the study and recommendations made to improve the reliability and performance of the equipment considered in the study.

The Short Circuit Study was completed, including a calculation of the three-phase and single-phase fault currents available at the new proposed (low-voltage) switchboards, panelboards, transformers, circuit breakers and motors. A computer model was created for the normal operating configuration of the equipment, with maximum available utility fault current level.

Maximum short circuit currents were calculated for the proposed equipment. These short circuit currents were compared to the nameplate interrupting ratings of the devices considered, and recommendations have been provided for those devices that do not have a sufficient interrupting rating.

The Protective Device Coordination Study was completed to determine the appropriate interrupting device settings to maximize the protection of electrical equipment from faults. Device settings have been provided to minimize nuisance interruptions, by selectively having the interrupting device closest to the fault operate in the shortest amount of time. Proper coordination of protective devices increases safety of operations, and minimizes nuisance trips and interruptions. The scope of the device coordination includes the new equipment shown on the attached one-line diagram(s).

This report details issues with the coordination of the proposed devices and recommendations have been made for changes to device settings, fuse sizes, etc. These recommendations have been made to improve the selectivity of devices, whose coordination with upstream and downstream devices could be increased while minimizing the potential of nuisance tripping.

The Arc Flash Hazard Calculations have been completed for the proposed three-phase electrical equipment in order to determine the maximum available incident energy that could result from a failure of, or contact with electrical equipment. The calculated available incident energy of an electrical arc has been used to determine the required class of Personal Protective Equipment (PPE) that must be worn, in accordance with the latest editions of the National Electrical Code (NEC 2020) §110, NFPA 70E-2018 and IEEE Std. 1584-2018. The available incident energy has been calculated at each three-phase piece of proposed electrical equipment based on bolted short circuit current values and clearing times of upstream protective devices. Note that single-phase equipment is not included, in accordance with IEEE 1584.

Enclosed in the back of this report are the tabular results of the Short Circuit Study, the proposed protective device settings, the time current characteristic (TCC) curves, Arc Flash Hazard labels and copies of one-lines and other facility/equipment documentation.

2.0 DESCRIPTION OF FACILITY

The electrical equipment that has been evaluated is located at the USPS Hartford Processing & Distribution Center (P&DC), Hartford, CT. Specifically the scope of this study focuses on the new electrical distribution equipment installed in the facility as part of this project. The computer model for this study was developed based on the information listed below.

- One Line Diagram E7.03 & E7.04, dated 12/8/2020.
- Electrical equipment submittal (switchboards, circuit breakers, etc.), by MMT
- Available short circuit current information, provided by local utility (Eversource).
- Cable information, provided by electrical contractor (attached)

In conjunction with the information provided to us by the client, the computer model, short circuit requirements and TCC curves were developed based on manufacturer's published equipment data, industry standards and information from standard reference materials. The studies were performed using PowerTools software package by SKM Systems Analysis Inc.

The new electrical equipment for the project is fed from utility 23kV feeders to 4 utility 2000kVA transformers with 480/277V secondaries. The load side of each transformer feeds to a padmount MDP with metering, designated MDP #1 - #4. These are rated 4000A with 3600A trip circuit breakers. The load side of the MDP's feed to a respective Main Switchboard, designated HMDP #1 - #4. Each of the four HMDP are rated 3000A at 480/277V. The HMDP Switchboards have branch breakers to supply downstream loads.

The computer models for this study were developed based on available information (one-line diagrams, input data spreadsheets, etc.) provided by others. See the attached Riser Diagram E7.03 & E7.04 for additional information on the new equipment being added as part of this project. Attached computer model Drawing OL-1 illustrates the new equipment which is shown on the riser diagram.

3.0 SHORT CIRCUIT STUDY

A Short Circuit Study was completed, based on equipment information and drawings provided by the client and manufacturers, as listed in the previous section. The study objective was to calculate the available three-phase and line-to-ground fault currents under worst case (bolted fault) conditions and compare these values to the published device interrupting and panelboard bus bracing ratings. The maximum symmetrical fault currents occur during the first 1/2 cycle after a fault. The Short Circuit Study has been performed based on the intent of the following applicable industry standards:

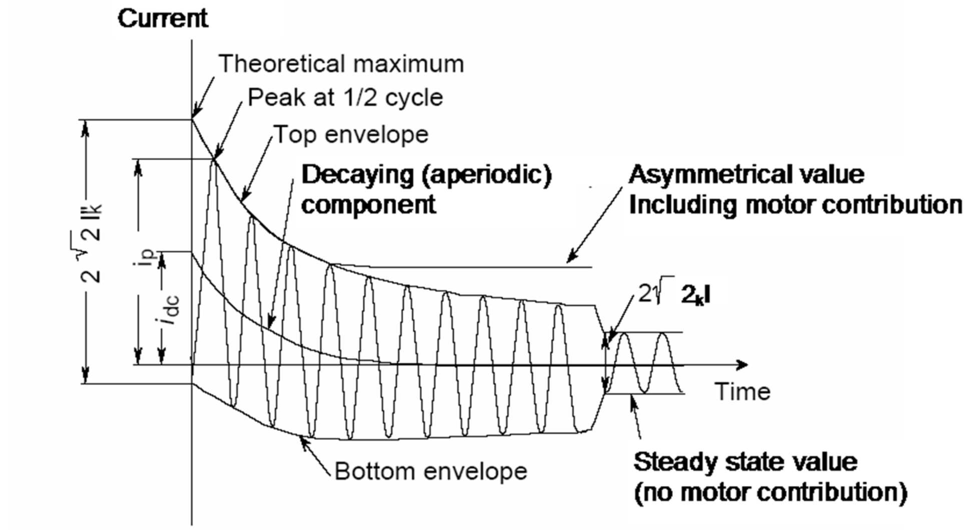
- ANSI/IEEE Std C37.010 - *Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis*
- ANSI/IEEE Std C37.13 - *Low-Voltage AC Power Circuit Breakers Used in Enclosures*
- IEEE Std 141 – *Recommended Practice for Electric Power Distribution in Industrial Facilities.*
- IEEE Std 399 - *Recommended Practice for Industrial and Commercial Power Systems Analysis*

The short circuit computer model includes the incoming supply to the facility and new downstream equipment as shown on the attached one-line riser diagrams.

A single short circuit case has been examined as part of this Study:

Case No. 1 Normal Utility Supply

For each case, the initial symmetrical and asymmetrical short circuit currents during the first one-half cycle after a bus fault occurs were calculated. This provides a worst case calculation to be used for comparison with equipment ratings. See Figure 1 below.



i_p – peak fault current, first 1/2 cycle
i_{dc} – dc decaying component of fault current
I_k" – ratio of pre-fault voltage to Thevenin equivalent impedance

Figure 1 – Short Circuit Current Versus Time After Fault Occurs.

The following faults were simulated and calculated for each (3-phase) equipment bus:

- Three-phase fault,
- Single line-to-ground fault,
- Double line-to-ground fault and
- Line-to-line fault.

3.1 Case No. 1 – Normal Utility Supply – Maximum Short Circuit

The short circuit case was developed for the normal operating configuration of the facility, with the local utility supplying power, and a maximum short circuit contribution.

The short circuit study was performed by modeling the worst case of the supply feeders. Information provided from the local utility (Eversource) indicates the following:

> *Transformer Size: Pad# 2144, 2145, 2391, 2392: 2000 kVA, 22860 – 480 / 277 volts.*
> *Transformer Connections: Primary: Grounded Wye / Grounded Wye Secondary*
> *Transformer Impedance: Nameplate: 5.75%, (R is assumed to be 10% of X)*
> *Impedance at "A": Z1=Z2= 1.368+ j3.774, Z0 = 5.780+ j7.522 in Ω.*
> *Z1=Z2= + j , Z0 = + j in per unit (pu). Use ZΩ *100/ (kVLL)2*
> *(PowerBase = 100 MVA; Voltage Base = Primary Voltage in kV)*
> *Fault Current: I3ϕFault = 3308 Amps, I1ϕFault = 2301 Amps (at 23kV)*

This has been used as the starting point for the Study.

For Case No. 1, the maximum available three phase fault current at the major switchboards and panelboards (for load side bolted faults) are as listed in the table contained in Appendix B (in the back of this report). These values are for normal operating conditions, without any emergency generators running. The interrupting rating listed for each switchboard and panelboard is the lowest interrupting rating of any of the devices present, or of the panel or switchboard itself.

The available fault currents for each of the 480V major equipment are listed on the attached Short Circuit Study Summary sheets (included in the back of this report – Appendix B). In general, the maximum available fault currents are below the interrupting or bus bracing rating of the panelboards and switchboards, with the following exceptions.

A. The equipment listed below is considered under-rated as the available short circuit current at this equipment exceeds the interrupting rating of the lowest rated device. For this equipment it is recommended that the interrupting rating be increased to be above the available short circuit current:

   - None

B. The equipment listed below is considered "marginal", as the available short circuit current at the equipment is within 10% of the interrupting rating of the lowest rated device. No immediate correction action is recommended.

   - None

The following notes that are included in the attached Device Evaluation (Appendix B) are explained below:

(*N1) System X/R higher than Test X/R, Calc INT kA modified based on low voltage factor.
Each circuit breaker in the study has a manufacturer's listed X/R ratio for the device. If the study calculated that the point in the system has a higher X/R than the manufacturer's listing for that protective device, the study will adjust the calculated available short circuit current, to compensate for the slower decay of the asymmetrical portion of the fault current after the time of the fault. Interrupting devices should be rated to meet this modified value to insure withstand for bolted faults at that location in the system.

In high X/R ratio situations, the symmetrical rating may not be exceeded by the calculated short circuit symmetrical duty; however, there is a possibility that the protective device's tested asymmetrical withstand value could be exceeded.

(*N2) Dev Isc kA modified based on Max Rating Voltage and K Factor.
This note applied typically to medium-voltage equipment, which manufacturers list a nominal voltage (say 13.8kV) and a maximum voltage rating (say 15.5kV) for certain types of equipment, along with K factors and other ratings. The device AIC is adjustable based on study conditions and then compared to the available fault current at that point in the system.

4.0 PROTECTIVE DEVICE COORDINATION STUDY

A Protective Device Coordination Study was performed in order to achieve the most effective and reliable coordination for the new equipment. The Coordination Study was performed using the PowerTools TCC software, by SKM Systems Analysis, Inc. and manufacturers published equipment data, time current curves, and electrical characteristics.

The intent of the study was to determine the best device settings to achieve selective coordination, such that the device nearest the fault on the power source side will attempt to operate first, and interrupt the fault current and clear the downstream fault. Furthermore, these protective devices should operate in the minimum possible time to avoid and minimize damage to equipment, cable, other protective devices, and interruption of service due to loss of power.

Settings have been provided for the new circuit breakers being installed that have adjustability. For equipment with main circuit breakers, we have coordinated the main circuit breaker and the largest branch feeder circuit breaker to the upstream feeder breaker in the upstream switchgear, etc. For equipment without main circuit breakers, (i.e. Main Lugs Only) we have coordinated the largest branch feeder breakers to the upstream feeder breakers in the upstream switchgear, etc.

The Protective Device Coordination Study has been performed based on the intent of the following applicable industry standards:

- IEEE Std 242 **-** *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems*
- IEEE Std 1015 - *Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.*
- IEEE Std 399 - *Recommended Practice for Industrial and Commercial Power Systems Analysis*
- National Electric Code (NEC) – 110-9 & 110-10

The coordination study reveals that in general, proper coordination can be achieved between the various circuit breakers, with a few exceptions that will be discussed below (Section 4.2) and in the Results & Recommendation section of this report (Section 6.0).

The proposed protective device settings contained herein have been made to properly coordinate, with emphasis placed on critical, emergency, elevator and legally required standby equipment, to be as selective as possible given the range of settings allowed by the various devices, in accordance with the National Electrical Code. Miscoordinations that are deemed to be more than minor or that should be corrected are detailed in Section 4.2 below.

4.1 LIST OF TIME CURRENT CHARACTERISTIC CURVES:

The following is a list of the Time Current Characteristic (TCC) curves for this Study. Each curve typically shows the upstream circuit breaker, and the panelboard main and largest feeder circuit breakers.

Drawing E7.03 & E7.04

- HMDP #3 (phase & ground)
- HMDP #4 (phase & ground)
- HMDP #2 (phase & ground)
- HMDP #1 (phase & ground)

Note that the TCC curves listed above are typical of similar panels in the equipment considered.

4.2 PROTECTIVE DEVICE COORDINATION ISSUES

The following is a list of concerns/issues with the circuit breaker coordination and recommendations:

1. The recommended device settings are provided in Appendix C and should be programmed into the trip units for the circuit breakers listed.
2. For those downstream panelboards not listed on the settings sheets, or for new or reconfigured equipment in the future, the following table of basic setting criteria is proposed for panelboard with thermal-magnetic circuit breakers with adjustable instantaneous trip units.

TABLE 4-1
Proposed Instantaneous Settings for Thermal-Magnetic Circuit Breakers

Breaker Type	Breaker Size	Proposed Inst. Setting
Main Lugs Only Panels Up to 400A		
Branch Feeder Breakers with Inst.	Up to 200A	Max (typically 10X rating)
Branch Feeder Breakers with Inst.	225A – 400A	Int (typically 7.5X rating) On 5-10X range
Main CB Panels Up to 400A		
Main Circuit Breaker	Up to 400A	Int (typically 7.5X rating) On 5-10X range
Branch Feeder Breakers with Inst.	Up to 150A	Int (typically 7.5X rating) On 5-10X range
Branch Feeder Breakers with Inst.	175A – 400A	Min (typically 5.0X rating) On 5-10X range
Main CB Panels Up to 800A		
Main Circuit Breaker	Up to 800A	Int (typically 7.5X rating) On 5-10X range
Branch Feeder Breakers with Inst.	Less than 200A	Max (typically 10X rating)
Branch Feeder Breakers with Inst.	200 - 400A	Int (typically 7.5X rating) On 5-10X range
Branch Feeder Breakers with Inst.	450A – 800A	Min (typically 5.0X rating) On 5-10X range

4.3 GROUND FAULT COORDINATION

Ground Fault settings are typically made such that low level arcing ground faults can be detected and cleared quickly in order to minimize damage to cables and equipment, yet still maintain full coordination to avoid nuisance trips. Ground fault short time delay pickup levels should be chosen to allow for a minimum of 100 milliseconds of separation between the main circuit breakers and other downstream devices.

The four (4) MDP and HMDP switchboards have LSIG trip units. Ground fault settings have been proposed to coordinate these two layers of ground fault protection.

5.0 ARC FLASH RISK ASSESSMENT

5.1 ARC FLASH THEORY

Arc Flash is the result of a rapid release of energy due to an arcing fault between a phase bus bar and another phase bus bar, neutral or a ground. During a typical arc fault the air is the conductor. Arc faults are generally limited to systems where the bus voltage is in excess of 120 volts. Lower voltage levels normally will not sustain an arc. An arc fault is similar to the arc obtained during electric welding and the fault has to be manually started by something creating the path of conduction or a failure such as a breakdown in insulation.

The cause of the short normally burns away during the initial flash and the arc fault is then sustained by the establishment of highly-conductive plasma. The plasma will conduct as much energy as is available and is only limited by the impedance of the arc. In electrical equipment this massive energy discharge burns the bus bars, vaporizing the copper and thus causing an explosive volumetric increase, known as the arc blast. Temperature greater than 5000°F can be produced at the center of the arc. The Arc Flash will continue to burn until protective devices react.

Electrical short circuits are either bolted faults or arcing faults. A bolted fault is current flowing through bolted bus bars or other electrical conductors. An arcing fault is current flowing through the air. Because air offers impedance to electrical current flow, the arc fault current is always lower than the bolted fault current. Arcing occurs in both types. However, each behaves differently and requires different protection methods.

Arcing faults occur when electrical clearances are reduced or compromised by deteriorating insulation or human error, causing a conductive path among phases or phase-to-ground. Bolted faults occur when phases or phase-to-ground conductors are connected together. Generally, they are caused by mistakes made during installation or maintenance.

The upstream overcurrent protection device for a bolted fault opens quickly to protect the system. Arcing occurs inside the protective device as the contacts open. In circuit breakers, arcing and the resulting gases are vented through the arc chute to the breaker's exterior.

An electrical arc could happen at any time, when no one is around, when someone is walking in proximity, or when someone is working on the equipment. The most hazardous situation is when someone is working on or near energized equipment. The equipment doors may be open, placing workers close to electrical components, conductors, and connections.

An electrical arc can form when an electrical worker makes contact between phases or from phase to ground with a conductive object such as a screwdriver, pliers, or body parts while working inside an energized electrical panel. The temperature of the arc is intense enough to produce radiation burns, which could result in long-term internal bodily damage. The explosive energy released by this electrical arc creates a pressure wave. When this wave comes into contact with a surface, which could be a person, it is called incident energy.

The Arc Flash Risk Assessment was based on the formulas and procedures contained in IEEE Standard 1584-2018, *Guide for Performing Arc Flash Hazard Calculations,* and NFPA-70E (2018). This method is far superior to simply calculating bolted fault current based on an infinite bus. Equipment should be labeled (by others) to meet the requirements of the latest edition of the NEC (2020), Section 110.16.

5.2 ARC HAZARD RECOMMENDATIONS

The following recommendations are being made, based on the results of the Arc Flash Evaluation performed:

1. Label electrical equipment designating the level of PPE a worker must wear when working on energized equipment. Appropriate Arc Flash Labels are provided in the back of this report. Labels should be installed on enclosure doors or removable panels of the equipment, in visible areas.

2. Have qualified employees and contractors wear PPE as recommended herein, based on available levels of incident energy.

3. Train workers and update work practice procedures to comply with the applicable standards. OSHA, 29CFR Part 1910.333(a) requires that "*Safety related work practices shall be employed to prevent electric shock of other injuries resulting from either direct or indirect electrical contacts…*". This should include the use of *Energized Electrical Work Permit* forms (sample copy attached).

4. Conduct an Arc Flash Audit at least every three (3) years, in accordance with industry recommendations and NFPA-70E 110.1(I)(1). This Audit should be part of an Electrical Safety Program and conducted on shorter intervals if numerous electrical system changes have been made.

5. Maintain work place policies, procedures, methods, and products to limit arc flash risks whenever possible. This would include (but not be limited to):

   a. Determine all possible sources of electrical supply

   b. Open disconnecting devices for each source

   c. Where possible, visually verify device is open

   d. Apply lockout/tagout devices

   e. Test voltage on each conductor to verify that it is deenergized

   f. Apply grounding devices where stored energy or induced voltage could exist or where deenergized conductors could contact live parts

Limit Arc Flash Risks by de-energizing electrical equipment prior to working on, whenever possible. OSHA 29 CFR 1910.333(a)(1) states, *"Live parts to which an employee may be exposed shall be deenergized before the employee works on or near them, unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations"*

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PART I: TO BE COMPLETED BY THE REQUESTER: Job/Work Order Number

(1) Description of circuit/equipment/job location:

(2) Description of work to be done:

(3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:

Requester/Title

Date

Check when complete

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS DOING THE WORK:

(1) Detailed job description procedure to be used in performing the above detailed work: ❏

(2) Description of the safe work practices to be employed: ❏

(3) Results of the shock risk assessment: ❏

- (a) Voltage to which personnel will be exposed ❏
- (b) Limited approach boundary ❏
- (c) Restricted approach boundary ❏
- (d) Necessary shock, personal, and other protective equipment to safely perform assigned task ❏

(4) Results of the arc flash risk assessment: ❏

- (a) Available incident energy at the working distance or arc flash PPE category ❏
- (b) Necessary arc flash personal and other protective equipment to safely perform the assigned task ❏
- (c) Arc flash boundary ❏

(5) Means employed to restrict the access of unqualified persons from the work area: ❏

(6) Evidence of completion of a job briefing, including discussion of any job-related hazards: ❏

(7) Do you agree the above-described work can be done safely? ❏ Yes ❏ No (If no, return to requester.)

Electrically Qualified Person(s) Date

Electrically Qualified Person(s) Date

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

Manufacturing Manager Maintenance/Engineering Manager

Safety Manager Electrically Knowledgeable Person

General Manager Date

Note: Once the work is complete, forward this form to the site Safety Department for review and retention.

NFPA 70E

5.3 Personal Protective Equipment (PPE) Requirements

NFPA 70E-2018, Article 130.7 requires that "*Employees exposed to electrical hazards when the risk associated with that hazard is not adequately reduced by the applicable electrical installation requirements shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed*".

Specific to PPE, the same article (130) states "*When an employee is working within the Restricted Approach Boundary the worker shall wear PPE in accordance with NFPA-70E (2018) Article 130.4. When an employee is working within the Arc Flash Boundary, he or she shall wear protective clothing and other PPE in accordance with 130.5 (Arc Flash Risk Assessment).*

The results of this Arc Flash Risk Assessment provide the minimum PPE that must be worn when working on or near each substation, switchboard, panelboard or other equipment, inside of the Arc Flash Boundary. For each major equipment considered herein, the incident energy has been calculated that could occur from an arc. The minimum PPE for these categories are listed in the table (Table 5-1) below, taken from NFPA-70E Table 130.7(C)(15)(c):

Table 5-1 – Required PPE

Arc Flash PPE Category	Incident Energy From (cal/cm^2)	Incident Energy To (cal/cm^2)	Clothing Description	Minimum Arc Rating of PPE Clothing (cal/cm^2)
1	0.0	4.0	Arc Rated Clothing, Minimum Arc Rating of 4 cal/cm2, Per NFPA-70E 2018 Table 130.7(C)(15)(c)	4
2	4.0	8.0	Arc Rated Clothing, Minimum Arc Rating of 8 cal/cm2, Per NFPA-70E 2018 Table 130.7(C)(15)(c)	8
3	8.0	25.0	Arc Rated Clothing, Minimum Arc Rating of 25 cal/cm2, Per NFPA-70E 2018 Table 130.7(C)(15)(c)	25
4	25.0	40.0	Arc Rated Clothing, Minimum Arc Rating of 40 cal/cm2, Per NFPA-70E 2018 Table 130.7(C)(15)(c)	40

5.4 Protective Clothing By Arc Flash PPE Category

The following table (Table 5-2) contains the recommended and example protective clothing arranged by Arc Flash PPE Category, per the latest edition of NFPA 70E, *Standard for Electrical Safety in the Workplace*. 2018 Edition, Table 130.7(C)(15)(c). Note that the protective clothing listed for the corresponding Arc Flash PPE Category shall have an Arc Rating of at least that listed in Table 5-1, on the previous page.

Table 5-2 – Protective Clothing Matrix

Hazard/Risk Category	**Protective Clothing and PPE**
Hazard/Risk Category 1 Arc Rated Clothing, Minimum Arc Rating of 4cal/cm2 (Note a) Protective Equipment	 Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated face shield or arc flash suit hood (Note b) Arc-rated jacket, parka, or rain wear (AN) Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) (Note c) Leather gloves (Note d) Leather footwear (AN)
Hazard/Risk Category 2 Arc Rated Clothing, Minimum Arc Rating of 8cal/cm2 (Note a) Protective Equipment	 Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated face shield or arc flash suit hood (Note b) Arc-rated jacket, parka, or rain wear (AN) Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) (Note c) Leather gloves (Note d) Leather footwear (AN)
Hazard/Risk Category 3 Arc Rated Clothing, Minimum Arc Rating of 25 cal/cm2 (Note a) Protective Equipment	 Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves (Note d) Arc-rated jacket, parka, or rain wear (AN) Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) (Note c) Leather footwear

Table 5-2 (Continued)

Hazard/Risk Category 4 Arc Rated Clothing, Minimum Arc Rating of 40 cal/cm2 (Note a)	Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves (Note d) Arc-rated jacket, parka, or rain wear (AN)
Arc Rated Protective Equipment	Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) (Note c) Leather footwear

AN = As needed (optional)
AR = As required
SR = Selection required

Table 5-2 Notes:

a. Arc Rating is defined in NFPA-70E 2018, Article 100.

b. Face shields are to have wrap-around guarding to protect not only the face but also the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn.

c. Other types of hearing protection are permitted to be used in lieu of or in addition to ear canal inserts provided they are worn under an arc-rated arc flash suit hood

d. If rubber insulated gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulated gloves with leather protectors satisfies the arc protection requirement.

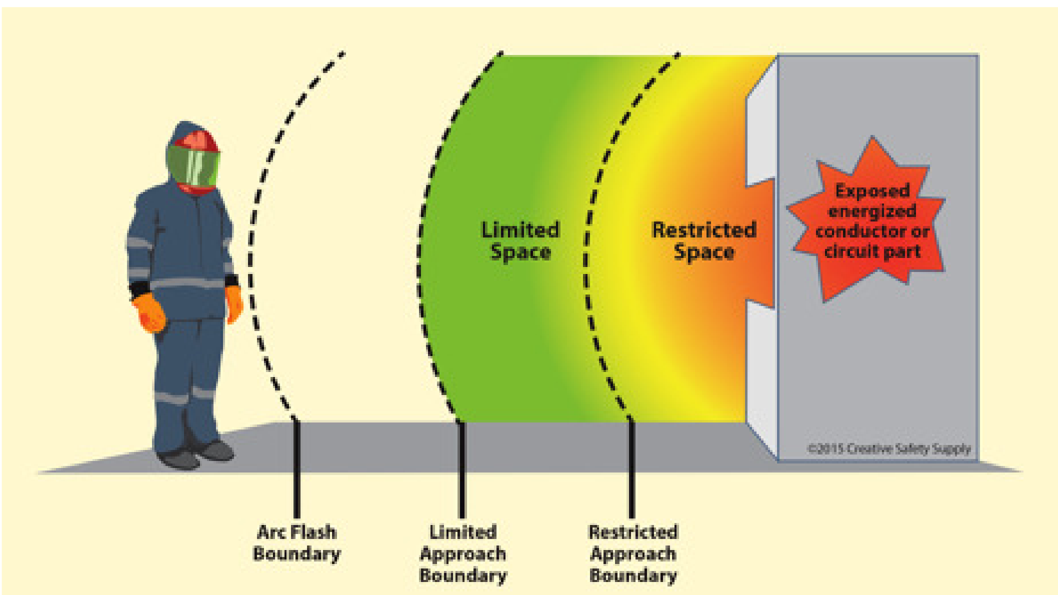
5.5 Arc Flash Risk Assessment Results

The tables contained on the following pages are the results of the Arc Flash Risk Assessment calculations, to determine the safe boundaries for workers and employees, including:

- Arc Flash Boundary
- Limited Approach Boundary
- Restricted Approach Boundary

Figure 5-3 illustrates the boundaries that are calculated, in relation to the equipment (switchboards, panelboard, etc.) as required by NFPA 70E.

Figure 5-3 Protection Boundaries



Note that the Prohibited Approach Boundary was removed in the 2015 NFPA-70E and is shown above for illustration only. Once the Restricted Approach Boundary is crossed there are no additional protective requirements.

5.6 Crossing Arc Flash Boundaries (Per NFPA 70E-2018)

The following boundaries are defined in the NFPA-70E standard and are shown graphically in Figure 5-4 on the following page :

Arc Flash Boundary:
Defined as "*When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within a person could receive a second degree burn if an electrical arc flash were to occur*". The boundary has been increased or decreased based on the actual incident energy calculated as part of this evaluation.

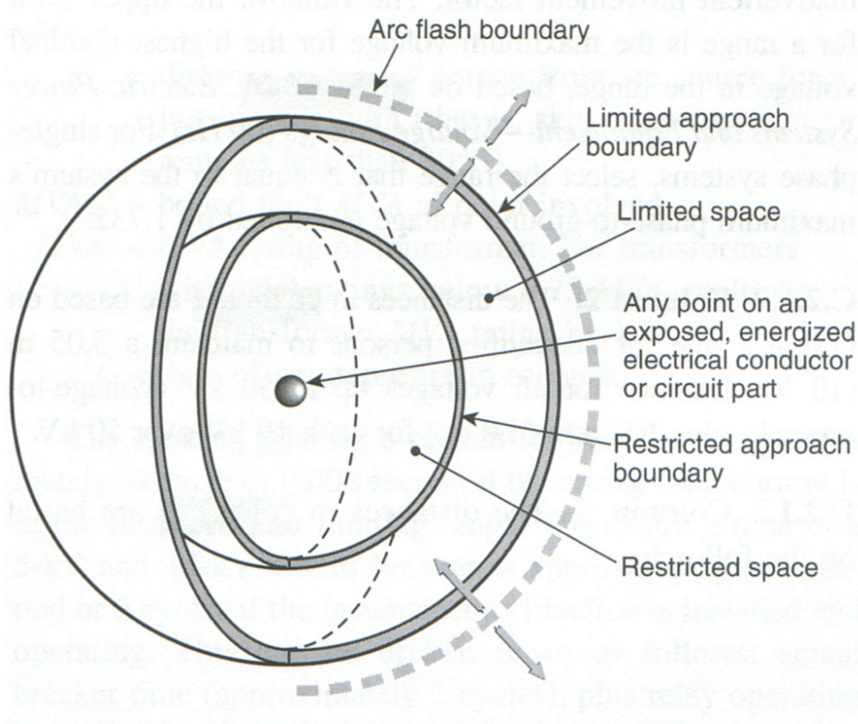
Persons crossing into the Flash Protection Boundary are required to wear the appropriate PPE as determined by this Arc Flash Evaluation. In addition, a qualified person must accompany unqualified persons.

Limited Approach Boundary:
Defined as "*An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists*". A shock protection boundary to be crossed by only qualified persons (at a distance from a live part) which is not to be crossed by unqualified persons unless escorted by a qualified person. Caution should be taken such that tools (including long-handled tools) do not cross the Limited Approach Boundary. For a qualified person to cross the Limited Approach Boundary and enter the "Limited Space", they must use the appropriate PPE and be trained to perform the required work.

Restricted Approach Boundary:
Defined as "*An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of shock, due to electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part*". A shock protection boundary to be crossed by only qualified persons (at a distance from a live part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed." To cross the Restricted Approach Boundary into the "Restricted Space", in addition to the PPE and required training, a qualified person must have a documented plan approved by management, and plan the work to keep all parts of the body out of the "Restricted Space".

It is also worth noting that the electrical safety standards contained in NFPA 70E and OSHA apply to all workers, not just those performing electrical work. For example, cleaning personnel or painters working near exposed energized equipment or conductors must not approach closer than the Limited Approach Boundary. In addition, any tools they may use must not be capable of entering the boundary.

Figure 5-4 – NFPA-70E Arc Flash Boundaries



(taken from Figure C.1.2.3, Annex C to NFPA-70E 2018)

5.7 Arc Flash Labels

Appendix E in the back of this report contains color copies of the Arc Flash Labels, which detail the appropriate minimum Arc Rating of PPE that is required to be worn while working on or near the equipment covered in this Power System Study.

Adhesive Arc Flash Labels in accordance with ANSI Z535.4-2011 shall be installed on the designated electrical equipment (switchboards, panelboard, etc.) as soon as possible. This is necessary to be in compliance with NFPA-70E, the National Electrical Code and the other standards listed within this report.

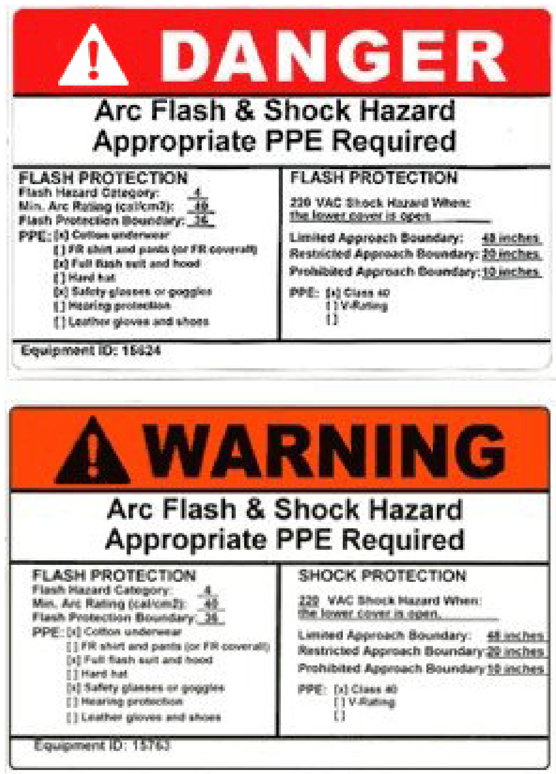
Labels have been provided for the specific panelboards, transformers, etc. that were considered as part of this study, as follows. Labels are provided with the information required per NFPA-70E (2018) and ANSI Z535.4-2011, with the Arc Flash PPE Categories and corresponding PPE as below.

Table 5-5

Arc Flash PPE Category	Incident Energy From (cal/cm^2)	Incident Energy To (cal/cm^2)	Clothing Description	Minimum Arc Rating of PPE Clothing (cal/cm^2)
1	0.0	4.0	Arc Rated Clothing, Minimum Arc Rating of 4 cal/cm2, Per NFPA-70E 2018 Table 130.7(C)(15)(c)	4
2	4.0	8.0	Arc Rated Clothing, Minimum Arc Rating of 8 cal/cm2, Per NFPA-70E 2018 Table 130.7(C)(15)(c)	8
3	8.0	25.0	Arc Rated Clothing, Minimum Arc Rating of 25 cal/cm2, Per NFPA-70E 2018 Table 130.7(C)(15)(c)	25
4	25.0	40.0	Arc Rated Clothing, Minimum Arc Rating of 40 cal/cm2, Per NFPA-70E 2018 Table 130.7(C)(15)(c)	40

The labels are provided per the two color labeling system recommended by ANSI Z535.4-2011 and NFPA-70E-2018, illustrate in Figure 5-6 below. The equipment with incident energy at or below 40 cal/cm2 uses an orange label with the words “Warning” across the top. For equipment above 40 cal/cm2 incident energy, there is no safe level of PPE and the red “Danger” label is provided.

Figure 5-6 – Arc Flash Warning Labels (Typical)



5.8 Unlabeled Electrical Equipment (Per NFPA 70E-2018)

In most facilities it is not possible or practical to have a specific Arc Flash label on each and every piece of equipment. Workers should treat unlabeled equipment downstream from a panelboard, etc. to have the same incident energy and minimum Arc Rating for PPE as the upstream panelboard, or closest equipment that is labeled with a specific Arc Flash label.

For the majority of low-voltage electrical equipment, Table 130.7(C)(15)(a) can be used as a guideline as to what equipment should require the use of Arc Flash PPE and at what category. For un-labeled equipment, Table 130.7(C)(15)(a) can be used as a guideline for the Arc Flash PPE Category of various equipment and the typical Arc Flash Boundary.

A copy of Table 130.7(C)(15)(a) and Table 130.7(C)(15)(b) is on the following two (2) pages.

Medium and high voltage equipment is likely to have the Arc Flash label designation “Dangerous!”. This designation is based on an available incident energy above 40 cal/cm.; which is higher than the Arc Flash PPE Category 4 limit according to NFPA-70E. For most equipment above 4160V it is not practical to safely work on live components; thus the designation of “Dangerous!”. For this equipment it is recommended to de-energize the equipment prior to approaching live components, and follow local lock-out tag-out (LOTO) rules.

Table 130.7(C)(15)(a) Arc-Flash PPE Categories for Alternating Current (ac) Systems

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 volts and below Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	1	485 mm (19 in.)
Panelboards or other equipment rated greater than 240 volts and up to 600 volts Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	900 mm (3 ft)
600-volt class motor control centers (MCCs) Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	1.5 m (5 ft)
600-volt class motor control centers (MCCs) Parameters: Maximum of 42 kA available fault current; maximum of 0.33 sec (20 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	4.3 m (14 ft)
600-volt class switchgear (with power circuit breakers or fused switches) and 600-volt class switchboards Parameters: Maximum of 35 kA available fault current; maximum of up to 0.5 sec (30 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	6 m (20 ft)
Other 600-volt class (277 volts through 600 volts, nominal) equipment Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	1.5 m (5 ft)
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Metal-clad switchgear, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Arc-resistant switchgear 1 kV through 15 kV [for clearing times of less than 0.5 sec (30 cycles) with an available fault current not to exceed the arc-resistant rating of the equipment], and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	N/A (doors closed) 4 (doors open)	N/A (doors closed) 12 m (40 ft)
Other equipment 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)

Note: For equipment rated 600 volts and below and protected by upstream current-limiting fuses or current-limiting circuit breakers sized at 200 amperes or less, the arc flash PPE category can be reduced by one number but not below arc flash PPE category 1.

Informational Note to Table 130.7(C)(15)(a): The following are typical fault clearing times of overcurrent protective devices:

(1) 0.5 cycle fault clearing time is typical for current limiting fuses when the fault current is within the current limiting range.

(2) 1.5 cycle fault clearing time is typical for molded case circuit breakers rated less than 1000 volts with an instantaneous integral trip.

(3) 3.0 cycle fault clearing time is typical for insulated case circuit breakers rated less than 1000 volts with an instantaneous integral trip or relay operated trip.

(4) 5.0 cycle fault clearing time is typical for relay operated circuit breakers rated 1 kV to 35 kV when the relay operates in the instantaneous range (i.e., "no intentional delay").

(5) 20 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay for motor inrush.

(6) 30 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay without instantaneous trip.

Informational Note No. 1: See Table 1 of IEEE 1584TM, *Guide for Performing Arc Flash Hazard Calculations*, for further information regarding Notes b through d.

Informational Note No. 2: An example of a standard that provides information for arc-resistant switchgear referred to in Table 130.7(C)(15)(a) is IEEE C37.20.7, *Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults*.

Table 130.7(C)(15)(b) Arc-Flash PPE Categories for Direct Current (dc) Systems

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Storage batteries, dc switchboards, and other dc supply sources Parameters: Greater than or equal to 100 V and less than or equal to 250 V Maximum arc duration and minimum working distance: 2 sec @ 455 mm (18 in.)		
Available fault current less than 4 kA	2	900 mm (3 ft)
Available fault current greater than or equal to 4 kA and less than 7 kA	2	1.2 m (4 ft)
Available fault current greater than or equal to 7 kA and less than 15 kA	3	1.8 m (6 ft)
Storage batteries, dc switchboards, and other dc supply sources Parameters: Greater than 250 V and less than or equal to 600 V Maximum arc duration and minimum working distance: 2 sec @ 455 mm (18 in.)		
Available fault current less than 1.5 kA	2	900 mm (3 ft)
Available fault current greater than or equal to 1.5 kA and less than 3 kA	2	1.2 m (4 ft)
Available fault current greater than or equal to 3 kA and less than 7 kA	3	1.8 m (6 ft.)
Available fault current greater than or equal to 7 kA and less than 10 kA	4	2.5 m (8 ft)

Notes

(1) Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

(a) Be evaluated for electrolyte protection

Informational Note: ASTM F1296, *Standard Guide for Evaluating Chemical Protective Clothing*, contains information on evaluating apparel for protection from electrolyte.

(b) Be arc-rated

Informational Note: ASTM F1891, *Standard Specifications for Arc Rated and Flame Resistant Rainwear*, contains information on evaluating arc-rated apparel.

(2) A two-second arc duration is assumed if there is no overcurrent protective device (OCPD) or if the fault clearing time is not known. If the fault clearing time is known and is less than 2 seconds, an incident energy analysis could provide a more representative result.

Informational Note No. 1: When determining available fault current, the effects of cables and any other impedances in the circuit should be included. Power system modeling is the best method to determine the available short-circuit current at the point of the arc. Battery cell short-circuit current can be obtained from the battery manufacturer. See Informative Annex D.5 for the basis for table values and alternative methods to determine dc incident energy. Methods should be used with good engineering judgment.

Informational Note No. 2: The methods for estimating the dc arc-flash incident energy that were used to determine the categories for this table are based on open-air incident energy calculations. Open-air calculations were used because many battery systems and other dc process systems are in open areas or rooms. If the specific task is within an enclosure, it would be prudent to consider additional PPE protection beyond the value shown in this table. Research with ac arc flash has shown a multiplier of as much as 3× for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is necessary when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

	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	HMDP#1 (BUS#1)	MCB-HMDP #1	0.48	31.45	20.07	31.45	20.07	0.7148	PNL	25	149	18	35.0	Level 4 (*N3)
2	HMDP#2 (BUS#2)	MCB-HMDP #2	0.48	31.45	20.07	31.45	20.07	0.7148	PNL	25	149	18	35.0	Level 4 (*N3)
3	HMDP#3 (BUS#3)	MCB-HMDP #3	0.48	31.68	20.19	31.68	20.19	0.7065	PNL	25	148	18	34.8	Level 4 (*N3)
4	HMDP#4 (BUS#4)	MCB-HMDP #4	0.48	31.60	20.15	31.60	20.15	0.7092	PNL	25	148	18	34.9	Level 4 (*N3)
5	MDP-1	MaxTripTime @2.0s	0.48	32.87	23.71	32.87	23.71	2	PNL	25	314	18	115.5	Dangerous! (*N2) (*N9)
6	MDP-2	MaxTripTime @2.0s	0.48	32.87	23.71	32.87	23.71	2	PNL	25	314	18	115.5	Dangerous! (*N2) (*N9)
7	MDP-3	MaxTripTime @2.0s	0.48	32.95	23.76	32.95	23.76	2	PNL	25	314	18	115.7	Dangerous! (*N2) (*N9)
8	MDP-4	MaxTripTime @2.0s	0.48	32.87	23.71	32.87	23.71	2	PNL	25	314	18	115.5	Dangerous! (*N2) (*N9)
9	Level 1: PPE Category: Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm2	0.0 - 4.0 cal/cm^2											#Level 4 = 4	(*N2) < 80% Cleared Fault Threshold
10	Level 2: PPE Category: Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm2	4.0 - 8.0 cal/cm^2											#Danger = 4	(*N3) - Arcing Current Low Tolerances Used
11	Level 3: PPE Category: Arc-Rated Clothing, Minimum Arc Rating of 25 cal/cm2	8.0 - 25.0 cal/cm^2											#Equip Eval Failed = 0	(*N9) - Max Arcing Duration Reached
12	Level 4: PPE Category: Arc-Rated Clothing, Minimum Arc Rating of 40 cal/cm2	25.0 - 40.0 cal/cm^2											#Bus Equip Eval Failed = 0	

	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)
13	Level Dangerous!: DO NOT WORK ON LIVE!	40.0 - 999.0 cal/cm^2												IEEE 1584 2018 Bus Report - Comprehensive Fault (80% Cleared Fault Threshold, include Ind. Motors for 5.0 Cycles, mis-coordination not checked
14														
15	For additional information refer to NFPA 70 E, Standard for Electrical Safety in the Workplace.													

6.0 RESULTS & RECOMMENDATIONS

The Short Circuit Study indicates that for maximum fault currents from three-phase and line-to-ground faults, the interrupting ratings of the New Electrical Equipment are sufficient, with no deficiencies noted in Section 3.1 of this report.

The results of the Protective Device Coordination Study indicate that satisfactory coordination exists between the circuit breakers considered in this study, with the exceptions noted in the Sections 4.2 and 4.3 (if any). The recommended circuit breaker settings are included in the back of this report (Appendix C).

Included in the back of this report are the results of the Short Circuit Study, the recommended circuit breaker and relay settings and copies of the Time Current Characteristic (TCC) curves.

If there are any questions related to this study, or if additional information is requested, please do not hesitate to call.

USPS Hartford Processing & Distribution Center (P&DC) -
141 Weston Street, Hartford, CT

<u>New Electrical Equipment</u>

Short Circuit Study Results
(Appendix B)

Power Engineers, LLC
Duxbury, MA 02332
(508) 612-0382

Bus	Manufacturer	Status	Type	Bus Voltage	VD%	LF Current	Design Amps	Ampacity	LF Rating%	Design%	Calc Isc kA	Dev Isc kA	Series Rating kA	Isc Rating%
HMDP#1 (BUS#1)	UL 891	Passed	LV Switchboard	480				3000.0			32.45	100.00		32.45
HMDP#2 (BUS#2)	UL 891	Passed	LV Switchboard	480				3000.0			32.45	100.00		32.45
HMDP#3 (BUS#3)	UL 891	Passed	LV Switchboard	480				3000.0			32.87	100.00		32.87
HMDP#4 (BUS#4)	UL 891	Passed	LV Switchboard	480				3000.0			32.79	100.00		32.79
MDP-1	UL 891	Passed	LV Switchboard	480				4000.0			34.67 (*N1)	65.00		53.33
MDP-2	UL 891	Passed	LV Switchboard	480				4000.0			34.67 (*N1)	65.00		53.33
MDP-3	UL 891	Passed	LV Switchboard	480				3000.0			34.78 (*N1)	65.00		53.50
MDP-4	UL 891	Passed	LV Switchboard	480				3000.0			34.67 (*N1)	65.00		53.33
(*N1) System X/R higher than Test X/R, Calc INT kA modified based on low voltage factor.														

Project: USPS Hartford PDC
Base Project

DAPPER Fault Contribution Brief Report

Comprehensive Short Circuit Study Settings

Three Phase Fault	Yes	**Faulted Bus**	All Buses
Single Line to Ground	Yes	**Bus Voltages**	First Bus From Fault
Line to Line Fault	Yes	**Branch Currents**	First Branch From Fault
Line to Line to Ground	Yes	**Phase or Sequence**	Report phase quantities
Motor Contribution	Yes	**Fault Current Calculation**	Initial Symmetrical RMS (with 1/2 Cycle Asym)
Transformer Tap	Yes	**Asym Fault Current at Time**	0.50 **Cycles**
Xformer Phase Shift	Yes		

				---------------Initial Symmetrical Amps---------------				------------------------Asymmetrical Amps------------------------			
Bus Name	----------Contributions----------			**3 Phase**	**SLG**	**LLG**	**LL**	**3 Phase**	**SLG**	**LLG**	**LL**
HMDP#1 (BUS#1)				**31,447**	**28,832**	**32,447**	**27,234**	**40,524**	**33,266**	**39,777**	**35,095**
	BUSTIE1-2	CABLE	In	0	0	0	0	0	0	0	0
	CBL-0009	CABLE	In	31,447	28,832	32,447	27,234	40,524	33,266	39,777	35,095
HMDP#2 (BUS#2)				**31,447**	**28,832**	**32,447**	**27,234**	**40,524**	**33,266**	**39,777**	**35,095**
	BUSTIE1-2	CABLE	In	0	0	0	0	0	0	0	0
	CBL-0010	CABLE	In	31,447	28,832	32,447	27,234	40,524	33,266	39,777	35,095
HMDP#3 (BUS#3)				**31,678**	**27,837**	**32,874**	**27,434**	**39,430**	**30,421**	**38,642**	**34,147**
	BUSTIE3-4	CABLE	In	0	0	0	0	0	0	0	0
	BUS HMDP#3	CABLE	In	31,678	27,837	32,874	27,434	39,430	30,421	38,642	34,147
HMDP#4 (BUS#4)				**31,601**	**27,755**	**32,795**	**27,367**	**39,318**	**30,315**	**38,532**	**34,051**
	BUSTIE3-4	CABLE	In	0	0	0	0	0	0	0	0
	BUS HMDP#4	CABLE	In	31,601	27,755	32,795	27,367	39,318	30,315	38,532	34,051

Bus Name	----------Contributions----------			----------------Initial Symmetrical Amps----------------				-------------------------Asymmetrical Amps-------------------------			
				3 Phase	SLG	LLG	LL	3 Phase	SLG	LLG	LL
MDP-1				**32,868**	**30,756**	**34,132**	**28,464**	**43,415**	**36,272**	**42,762**	**37,598**
	CBL-0009	CABLE	In	0	0	0	0	0	0	0	0
	CBL-0003	CABLE	In	32,868	30,756	34,132	28,464	43,415	36,272	42,762	37,598
MDP-2				**32,868**	**30,756**	**34,132**	**28,464**	**43,415**	**36,272**	**42,762**	**37,598**
	CBL-0010	CABLE	In	0	0	0	0	0	0	0	0
	CBL-0006	CABLE	In	32,868	30,756	34,132	28,464	43,415	36,272	42,762	37,598
MDP-3				**32,950**	**30,853**	**34,211**	**28,536**	**43,553**	**36,433**	**42,901**	**37,718**
	BUS HMDP#3	CABLE	In	0	0	0	0	0	0	0	0
	CBL-0002	CABLE	In	32,950	30,853	34,211	28,536	43,553	36,433	42,901	37,718
MDP-4				**32,868**	**30,756**	**34,132**	**28,464**	**43,415**	**36,272**	**42,762**	**37,598**
	BUS HMDP#4	CABLE	In	0	0	0	0	0	0	0	0
	CBL-0001	CABLE	In	32,868	30,756	34,132	28,464	43,415	36,272	42,762	37,598

USPS Hartford Processing & Distribution Center (P&DC) -
141 Weston Street, Hartford, CT

<u>New Electrical Equipment</u>

Circuit Breaker and
Relay Settings
(Appendix C)

Power Engineers, LLC
Duxbury, MA 02332
(508) 612-0382

Project: USPS Hartford PDC
Scenario: Base Project
USPS HARTFORD PDC
ADJUSTABLE LOW VOLTAGE CIRCUIT BREAKER SETTINGS

HMDP#1 (BUS#1)

DESIGNATION	FRAME								TRIP UNIT								
									SETTINGS								
NAME	Frame Amps	AIC kA	MFR	TYPE MODEL	Amps Sensor/Plug		Description	TYPE/MODEL	L.T. P.U.	L.D. TIME	S.D. P.U.	S.D. TIME	S.D. I2T	INST P.U.	GF PU	GFD	I2T
MCB-HMDP#1	3,000	100	SCHNEIDER	MTZ2-H	3,000	3,000	LSI, 800-3000A	MTZ2, 5.0X/6.0X	1 (3000A)	20	4.5 (13500A)	0.3 (I^s T On)		8 (24000A)	0.25 (750A)	0.3 (I^s T Off)	
CB-HMDP1-VFS	400	100	SQUARE D	LL	400	400	LSI, 400AS	PowerPact L-Frame, 3.3S	400 (400A)	Fixed	4 (1600A)	Fixed		6 (2400A)			
CB-HMDP1-BR	150	125	SQUARE D	HL	100	100	LSI, 100AS	PowerPact H-Frame, 3.2S	100 (100A)	Fixed	4 (400A)	Fixed		6 (600A)			
CB-HMDP1-COMPR.2	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed		6 (1500A)			
CB-HMDP1-TC19	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed		6 (1500A)			
CB-HMDP1-COMPR.3	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed		6 (1500A)			

CB-HMDP1-COMPR.1	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed	6 (1500A)		
CB-HMDP1-WORKROOM	2,500	100	SQUARE D	RL	1,000	1,000	LSI, 600-2500A, UL	Powerpact R-Frame, 6.0A/P/H	1 (1000A)	12	4 (4000A)	0.2 (I^s T Off)	8 (8000A)		
CB-HMDP1-MDP	400	100	SQUARE D	LL	400	400	LSI, 400AS	PowerPact L-Frame, 3.3S	400 (400A)	Fixed	4 (1600A)	Fixed	6 (2400A)		
CB-HMDP1-PANEL B	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed	6 (1500A)		
CB-HMDP1-TC12	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed	6 (1500A)		
CB-HMDP1-LP4E	600	100	SQUARE D	LL	600	600	LSI, 600AS	Powerpact L-Frame, 5.3A/E & 6.3A/E	250 (250A)	8	4 (1000A)	0.2 (I^s T Off)	6 (3600A)		
CB-HMDP1-LP4K	600	100	SQUARE D	LL	600	600	LSI, 600AS	Powerpact L-Frame, 5.3A/E & 6.3A/E	450 (450A)	8	4 (1800A)	0.2 (I^s T Off)	6 (3600A)		
MCC-11	600	100	SQUARE D	LL	600	600	LSI, 600AS	Powerpact L-Frame, 5.3A/E & 6.3A/E	600 (600A)	8	4 (2400A)	0.2 (I^s T Off)	6 (3600A)		
CB-HMDP1-LP4H	600	100	SQUARE D	LL	600	600	LSI, 600AS	Powerpact L-Frame, 5.3A/E & 6.3A/E	225 (225A)	8	4 (900A)	0.2 (I^s T Off)	6 (3600A)		
CB-HMDP1-TC7	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed	6 (1500A)		
CB-HMDP1-TC9	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed	6 (1500A)		
CB-HMDP1-TD12	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed	6 (1500A)		
CB-HMDP1-HPME	2,500	100	SQUARE D	RL	1,600	1,600	LSI, 600-2500A, UL	Powerpact R-Frame, 6.0A/P/H	1 (1600A)	12	4 (6400A)	0.2 (I^s T Off)	8 (12800A)		
CB-TIE-HMDP1-2	3,000	100	SCHNEIDER	MTZ2-H	3,000	3,000	LSI, 800-3000A	MTZ2, 5.0X/6.0X	1 (3000A)	20	4.5 (13500A)	0.3 (I^s T On)	8 (24000A)	0.3 (900A)	0.3 (I^s T Off)

HMDP#2 (BUS#2)

DESIGNATION	FRAME								TRIP UNIT								
NAME	Frame Amps	AIC kA	MFR	TYPE MODEL	Amps Sensor/Plug		Description	TYPE/MODEL	SETTINGS								
									L.T. P.U.	L.D. TIME	S.D. P.U.	S.D. TIME	S.D. I2T	INST P.U.	GF PU	GFD	I2T
MCB-HMDP#2	3,000	100	SCHNEIDER	MTZ2-H	3,000	3,000	LSI, 800-3000A	MTZ2, 5.0X/6.0X	1 (3000A)	20	4.5 (13500A)	0.3 (I^s T On)		8 (24000A)	0.25 (750A)	0.3 (I^s T Off)	
CB-HMDP1-DPLP	2,500	100	SQUARE D	RL	1,600	1,600	LSI, 600-2500A, UL	Powerpact R-Frame, 6.0A/P/H	1 (1600A)	4	4 (6400A)	0.2 (I^s T Off)		8 (12800A)			
CB-HMDP1-TC8	250	100	SQUARE D	JL	250	250	LSI, 250AS	PowerPact J-Frame, 3.2S	200 (200A)	Fixed	4 (800A)	Fixed		6 (1500A)			
CB-HMDP1-LP12H	400	100	SQUARE D	LL	400	400	LSI, 400AS	PowerPact L-Frame, 3.3S	225 (225A)	Fixed	4 (900A)	Fixed		6 (2400A)			
CB-HMDP1-MCC-13	600	100	SQUARE D	LL	600	600	LSI, 600AS	Powerpact L-Frame, 5.3A/E & 6.3A/E	600 (600A)	8	4 (2400A)	0.2 (I^s T Off)		6 (3600A)			
CB-HMDP1-LP12E	600	100	SQUARE D	LL	600	600	LSI, 600AS	Powerpact L-Frame, 5.3A/E & 6.3A/E	500 (500A)	8	4 (2000A)	0.2 (I^s T Off)		6 (3600A)			
CB-HMDP1-LP12K	600	100	SQUARE D	LL	600	600	LSI, 600AS	Powerpact L-Frame, 5.3A/E & 6.3A/E	250 (250A)	8	4 (1000A)	0.2 (I^s T Off)		6 (3600A)			

HMDP#3 (BUS#3)

DESIGNATION	FRAME								TRIP UNIT								
NAME	Frame Amps	AIC kA	MFR	TYPE MODEL	Amps Sensor/Plug		Description	TYPE/MODEL	SETTINGS								
									L.T. P.U.	L.D. TIME	S.D. P.U.	S.D. TIME	S.D. I2T	INST P.U.	GF PU	GFD	I2T
MCB-HMDP#3	3,000	100	SCHNEIDER	MTZ2-H	3,000	3,000	LSI, 800-3000A	MTZ2, 5.0X/6.0X	1 (3000A)	20	4.5 (13500A)	0.3 (I^s T On)		8 (24000A)	0.3 (900A)	0.3 (I^s T Off)	
CB-HMDP3-CHILLER#1	1,200	100	SQUARE D	PL	800	800	LSI, 100-1200A, UL	Powerpact P-Frame, 6.0A/P/H	1 (800A)	12	4 (3200A)	0.2 (I^s T Off)		8 (6400A)			

CB-HMDP3-CHILLER#2	1,200	100	SQUARE D	PL	600	600	LSI, 100-1200A, UL	Powerpact P-Frame, 6.0A/P/H	1 (600A)	12	4 (2400A)	0.2 (I^s T Off)		8 (4800A)			
CB-HMDP3-PENT HOUSE BUS	2,500	100	SCHNEIDER	MTZ2-H	2,500	2,500	LSI, 800-3000A	MTZ2, 5.0X/6.0X	1 (2500A)	8	3 (7500A)	0.1 (I^s T On)		6 (15000A)			

HMDP#4 (BUS#4)

DESIGNATION	FRAME								TRIP UNIT								
NAME	Frame Amps	AIC kA	MFR	TYPE MODEL	Amps Sensor	Amps Plug	Description	TYPE/MODEL	SETTINGS								
									L.T. P.U.	L.D. TIME	S.D. P.U.	S.D. TIME	S.D. I2T	INST P.U.	GF PU	GFD	I2T
MCB-HMDP#4	3,000	100	SCHNEIDER	MTZ2-H	3,000	3,000	LSI, 800-3000A	MTZ2, 5.0X/6.0X	1 (3000A)	20	4.5 (13500A)	0.3 (I^s T On)		8 (24000A)	0.3 (900A)	0.3 (I^s T Off)	
CB-HMDP4-800A BUS	1,200	100	SQUARE D	PL	800	800	LSI, 100-1200A, UL	Powerpact P-Frame, 6.0A/P/H	1 (800A)	12	4 (3200A)	0.2 (I^s T Off)		8 (6400A)			
CB-HMDP4-PENT HOUSE BUS	2,500	100	SCHNEIDER	MTZ2-H	2,000	2,000	LSI, 800-3000A	MTZ2, 5.0X/6.0X	1 (2000A)	8	3 (6000A)	0.1 (I^s T On)		6 (12000A)			
CB-TIE-HMDP3-4	3,000	100	SCHNEIDER	MTZ2-H	3,000	3,000	LSI, 800-3000A	MTZ2, 5.0X/6.0X	1 (3000A)	20	4.5 (13500A)	0.3 (I^s T On)		8 (24000A)	0.3 (900A)	0.3 (I^s T On)	

MDP-1

DESIGNATION	FRAME								TRIP UNIT								
NAME	Frame Amps	AIC kA	MFR	TYPE MODEL	Amps Sensor	Amps Plug	Description	TYPE/MODEL	SETTINGS								
									L.T. P.U.	L.D. TIME	S.D. P.U.	S.D. TIME	S.D. I2T	INST P.U.	GF PU	GFD	I2T
CB-3600A-MDP-1	4,000	100	SQUARE D	SE	4,000	4,000	LS, 4000AP	SE & SEH, Micrologic	0.9 (3600A)	16	5 (20000A)	0.32 (I^s T On)		30000A (30000A)	1200 (940A)	0.5 (I^s T Off)	

MDP-2

DESIGNATION	FRAME								TRIP UNIT								
									SETTINGS								
NAME	Frame Amps	AIC kA	MFR	TYPE MODEL	Amps Sensor	Amps Plug	Description	TYPE/MODEL	L.T. P.U.	L.D. TIME	S.D. P.U.	S.D. TIME	S.D. I2T	INST P.U.	GF PU	GFD	I2T
CB-3600A-MDP-2	4,000	100	SQUARE D	SE	4,000	4,000	LS, 4000AP	SE & SEH, Micrologic	0.9 (3600A)	16	5 (20000A)	0.32 (I^s T On)		30000A (30000A)	1200 (940A)	0.5 (I^s T Off)	

MDP-3

DESIGNATION	FRAME								TRIP UNIT								
									SETTINGS								
NAME	Frame Amps	AIC kA	MFR	TYPE MODEL	Amps Sensor	Amps Plug	Description	TYPE/MODEL	L.T. P.U.	L.D. TIME	S.D. P.U.	S.D. TIME	S.D. I2T	INST P.U.	GF PU	GFD	I2T
CB-3000A-MDP-3	3,000	100	SQUARE D	NW30H	3,000	3,000	LSI, 400-6000AS, UL	Masterpact NW, 5.0 & 6.0 A/P/H	1 (3000A)	24	10 (30000A)	0.3 (I^s T On)		10 (30000A)	J (1200A)	0.4 (I^s T Off)	

MDP-4

DESIGNATION	FRAME								TRIP UNIT								
									SETTINGS								
NAME	Frame Amps	AIC kA	MFR	TYPE MODEL	Amps Sensor	Amps Plug	Description	TYPE/MODEL	L.T. P.U.	L.D. TIME	S.D. P.U.	S.D. TIME	S.D. I2T	INST P.U.	GF PU	GFD	I2T
CB-3000A-MDP-4	3,000	100	SQUARE D	NW30H	3,000	3,000	LSI, 400-6000AS, UL	Masterpact NW, 5.0 & 6.0 A/P/H	1 (3000A)	24	10 (30000A)	0.3 (I^s T On)		10 (30000A)	J (1200A)	0.4 (I^s T Off)	

Thermal Magnetic Circuit Breaker Settings

BUS NAME: **HMDP#4 (BUS#4)**

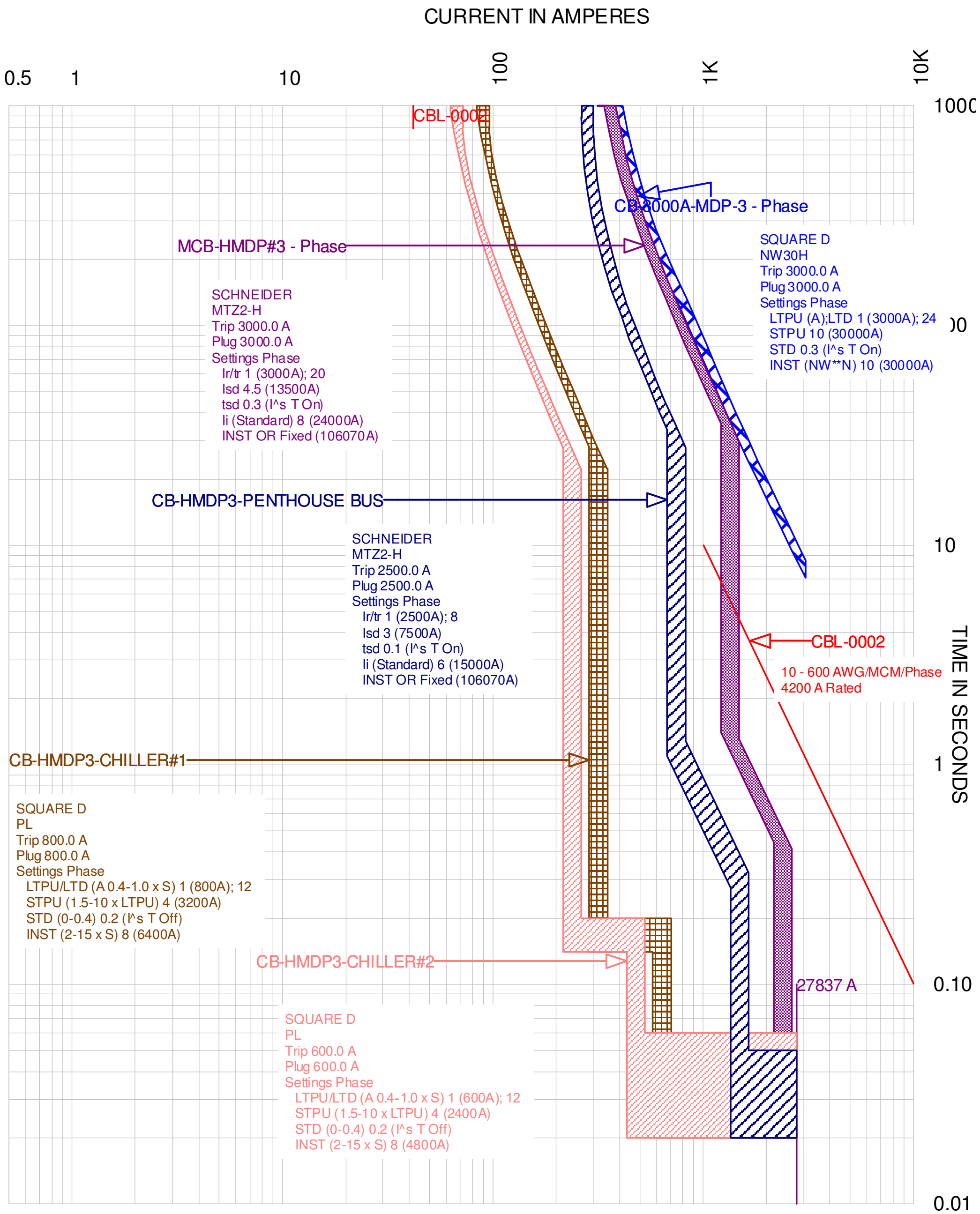
DESIGNATION		FRAME		TRIP UNIT				
Location/Name	Amps Frame	MFR	TYPE MODEL	Amps Sensor	Description	TYPE/MODEL	LT SETTING	INST SETTING
HMDP#4 (BUS#4), CB-HMDP4-PR17J1	30	SQUARE D	HL	30	15-150A	Powerpact HL	FIXED	FIXED

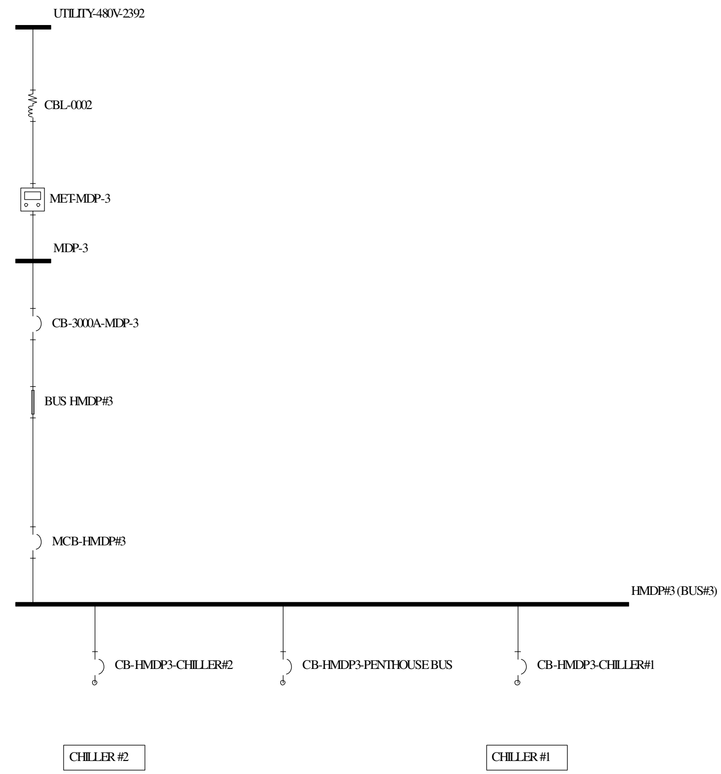
USPS Hartford Processing & Distribution Center (P&DC) -
141 Weston Street, Hartford, CT

New Electrical Equipment

TCC Curves
(Appendix D)

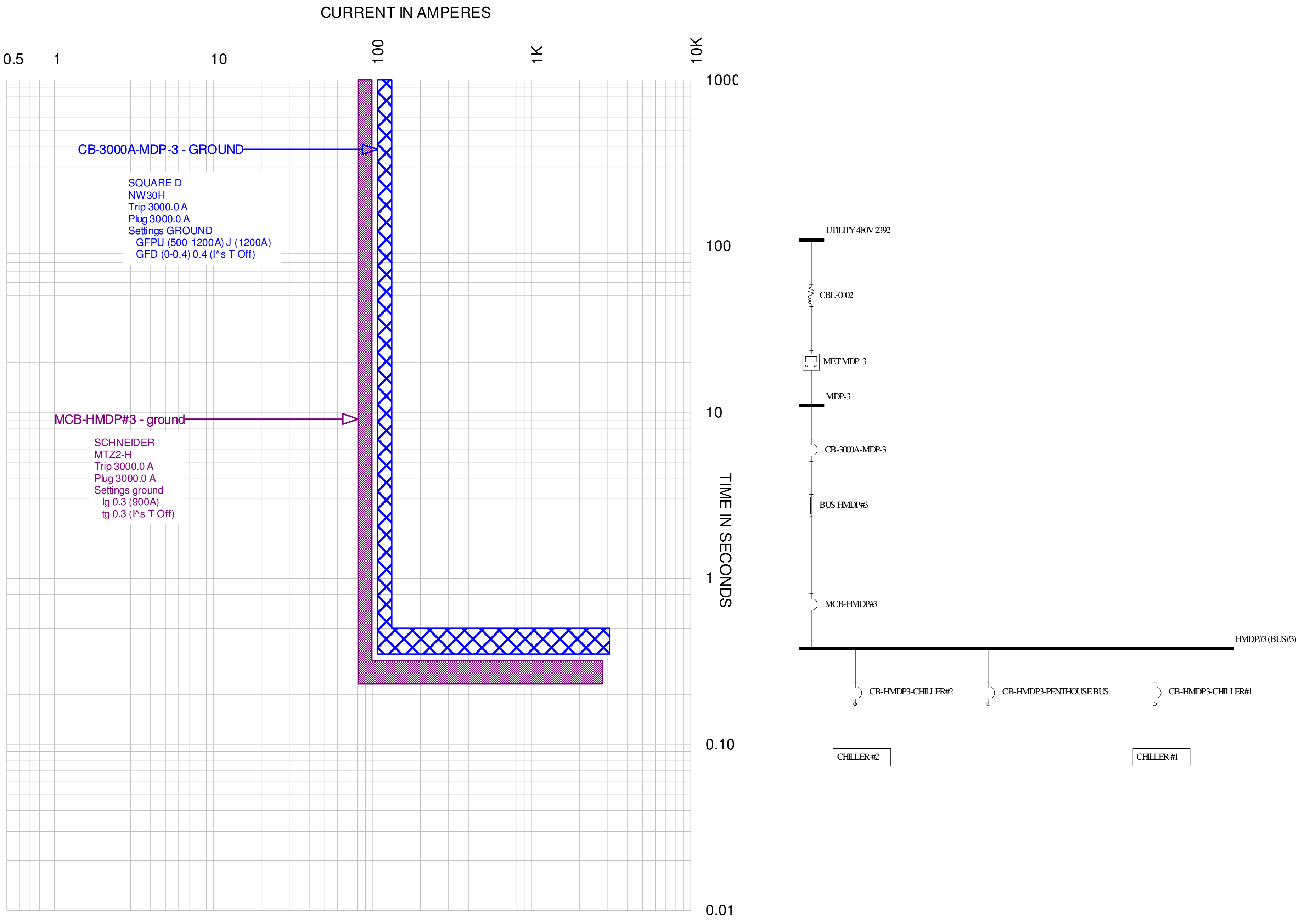
Power Engineers, LLC
Duxbury, MA 02332
(508) 612-0382





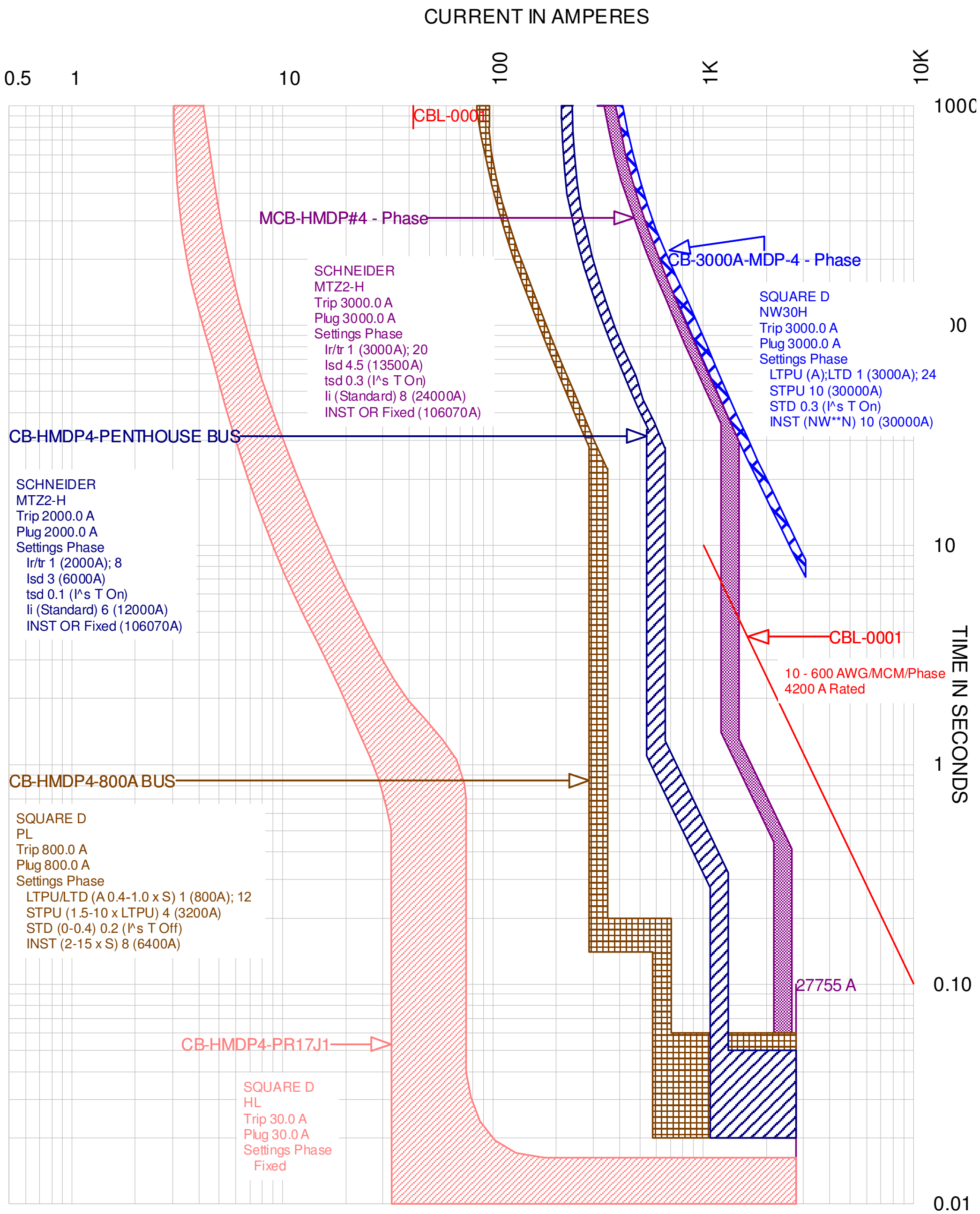
TCC Name:HMDP#3 PHASE | Current Scale x 10 | Reference Voltage: 480 | January 7, 2021

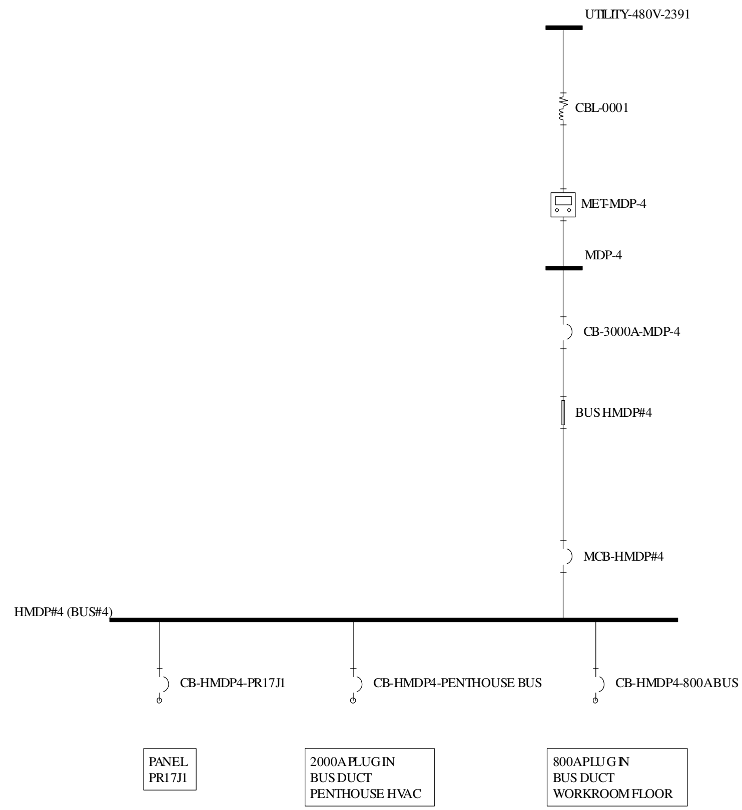
Project: USPS HARTFORD PDC | Power Engineers, LLC



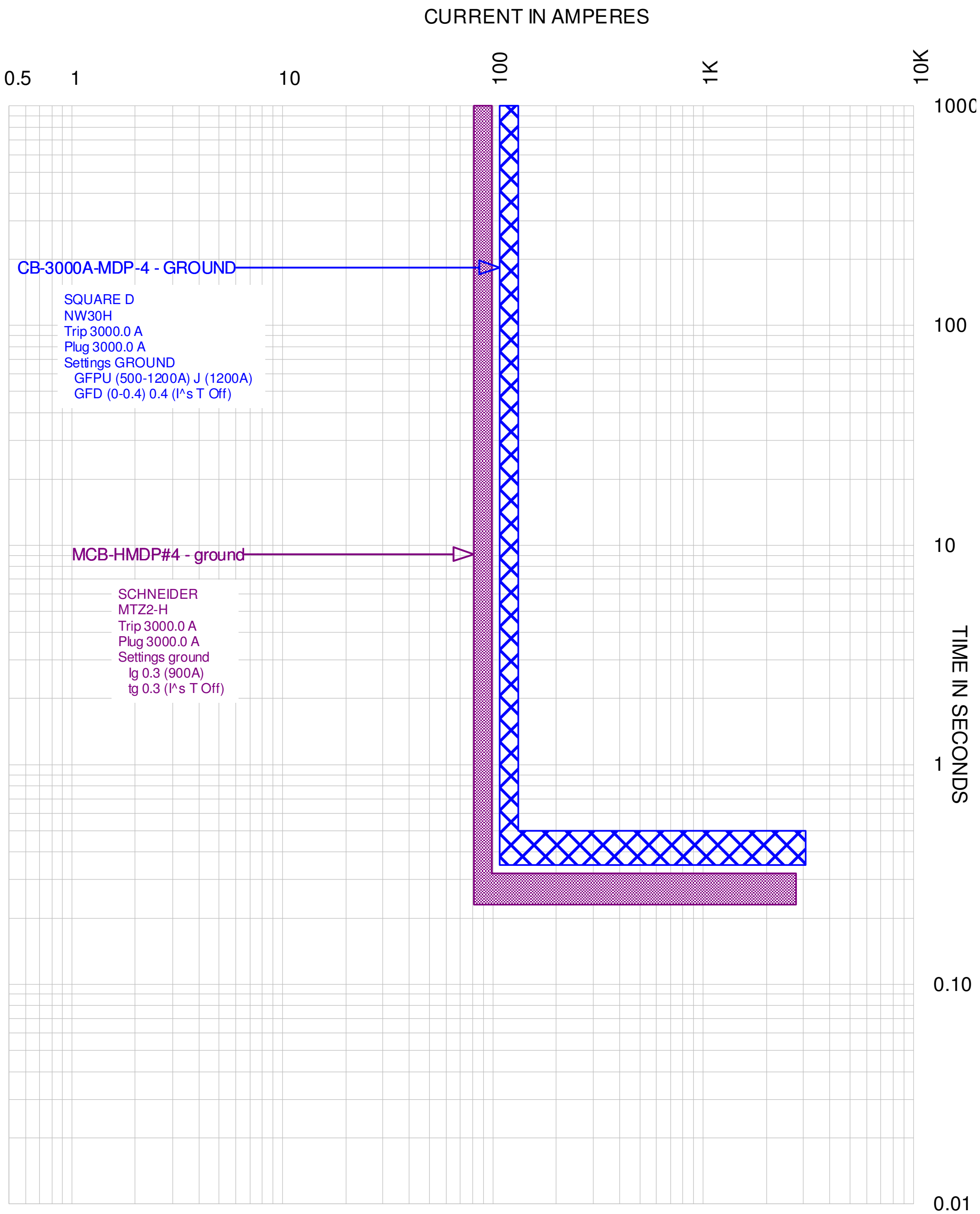
TCC Name:HMDP#3 GROUND | Current Scale x 10 | Reference Voltage: 480 | January 7, 2021

Project: USPS HARTFORD PDC | Power Engineers, LLC

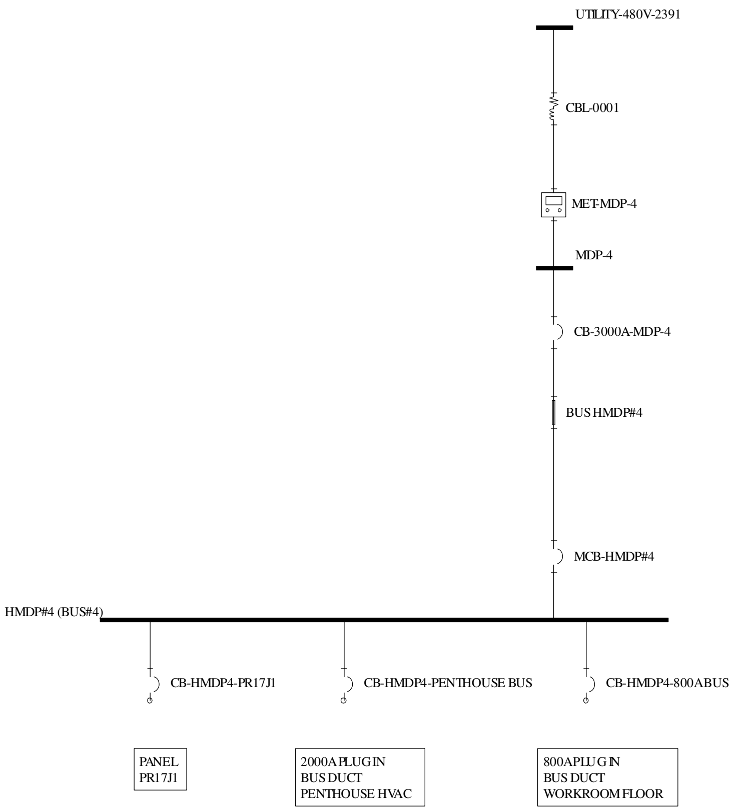




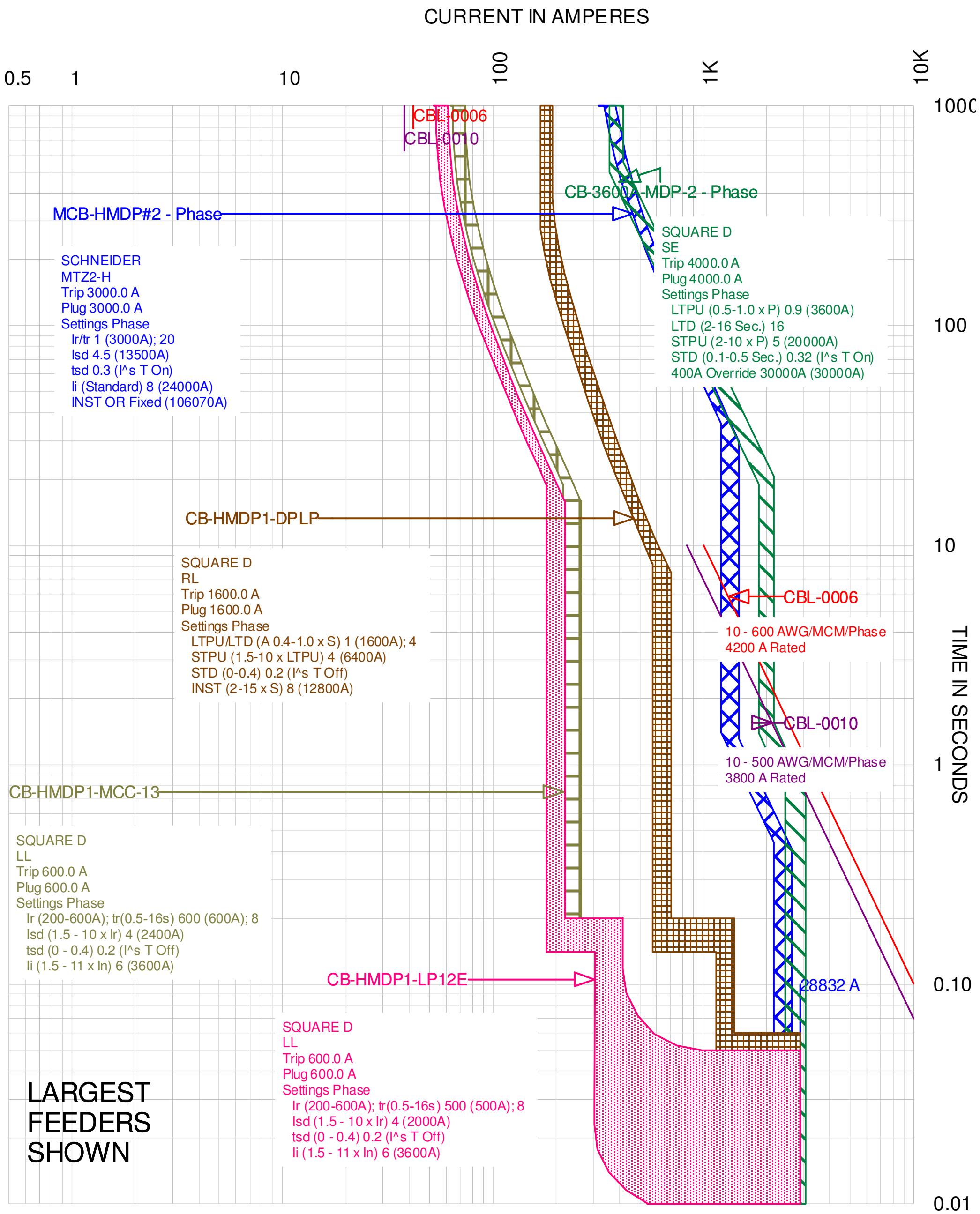
TCC Name:HMDP#4 PHASE	Current Scale x 10	Reference Voltage: 480	January 7, 2021
Project: USPS HARTFORD PDC	Power Engineers, LLC		Page 3

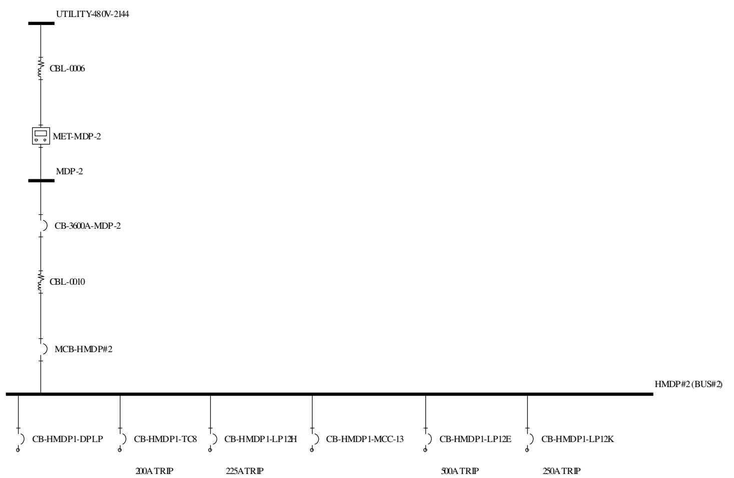


CURRENT IN AMPERES
0.5
1
10
100
1K
10K
1000
100
10
1
0.10
0.01
TIME IN SECONDS
CB-3000A-MDP-4 - GROUND
SQUARE D
NW30H
Trip 3000.0 A
Plug 3000.0 A
Settings GROUND
GFPU (500-1200A) J (1200A)
GFD (0-0.4) 0.4 (I^s T Off)
MCB-HMDP#4 - ground
SCHNEIDER
MTZ2-H
Trip 3000.0 A
Plug 3000.0 A
Settings ground
Ig 0.3 (900A)
tg 0.3 (I^s T Off)



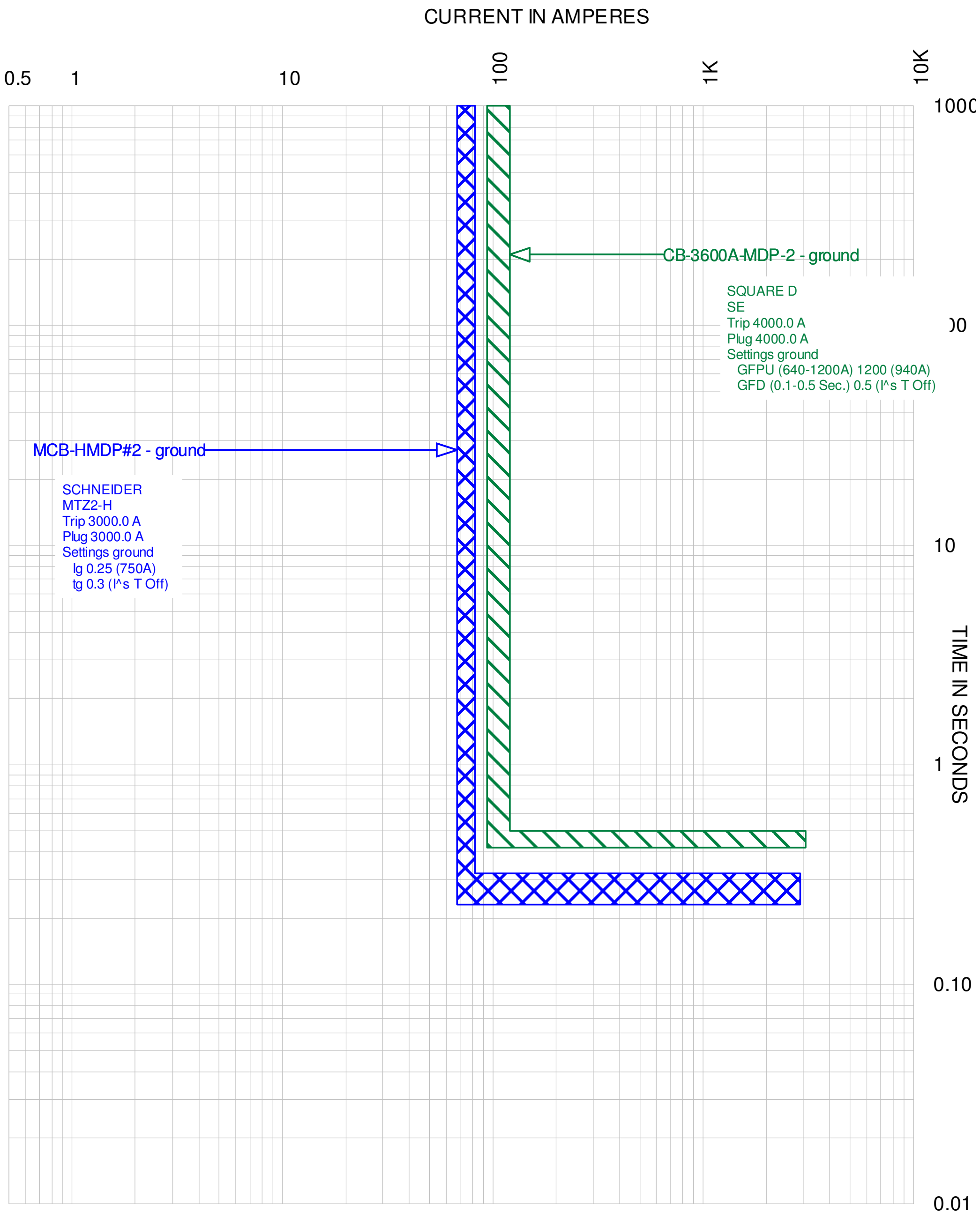
UTILITY-480V-2391
CBL-0001
MET-MDP-4
MDP-4
CB-3000A-MDP-4
BUS HMDP#4
MCB-HMDP#4
HMDP#4 (BUS#4)
CB-HMDP4-PR17J1
CB-HMDP4-PENTHOUSE BUS
CB-HMDP4-800ABUS
PANEL
PR17J1
2000A PLUG IN
BUS DUCT
PENTHOUSE HVAC
800APLUG IN
BUS DUCT
WORKROOM FLOOR

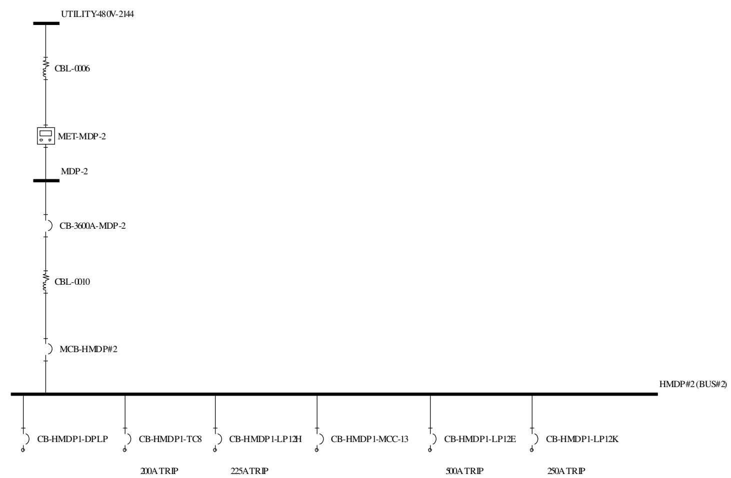




TCC Name:HMDP#2 PHASE | Current Scale x 10 | Reference Voltage: 480 | January 7, 2021

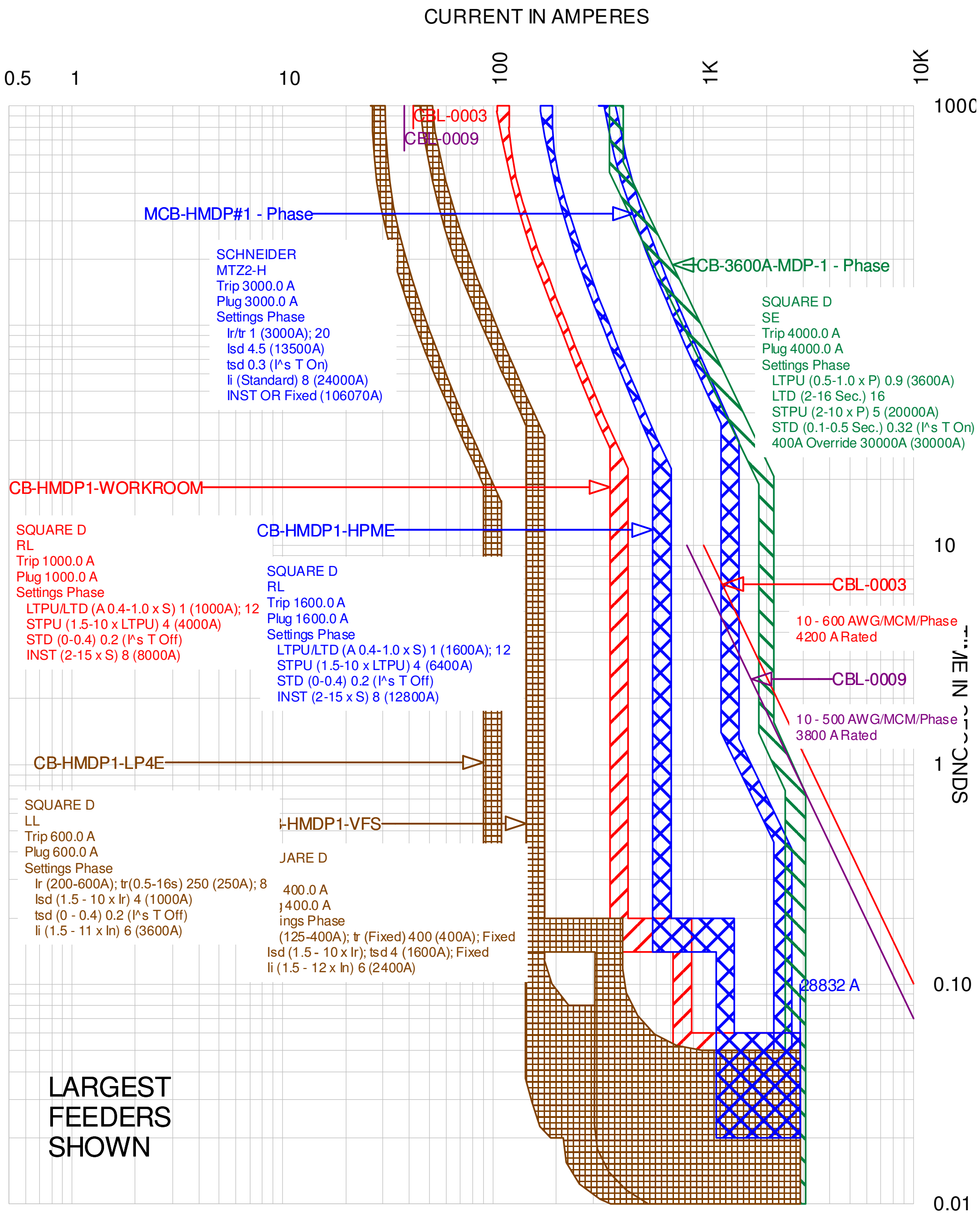
Project: USPS HARTFORD PDC | Power Engineers, LLC

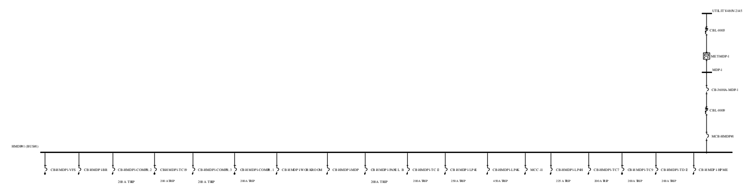




TCC Name:HMDP#2 GROUND | Current Scale x 10 | Reference Voltage: 480 | January 7, 2021

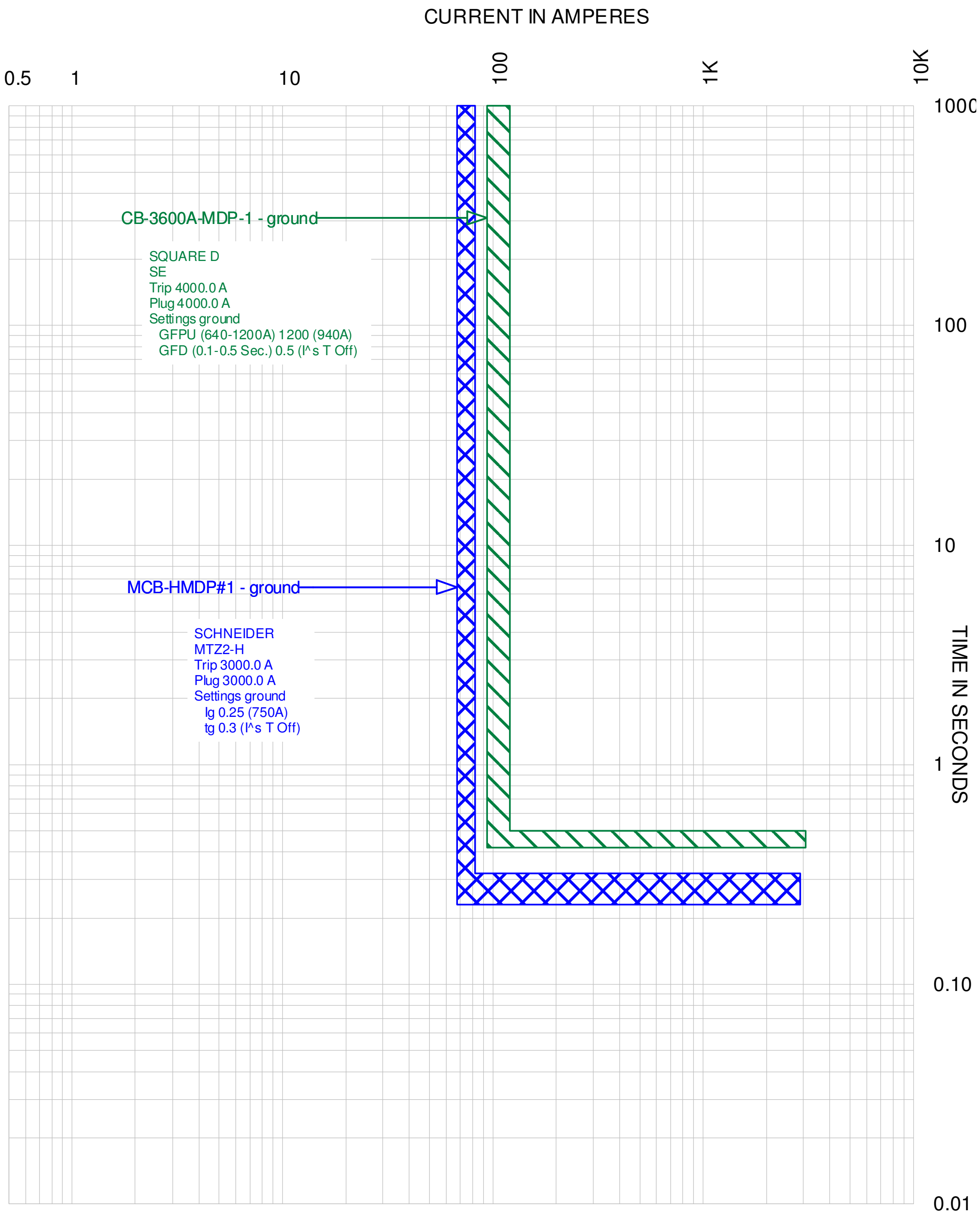
Project: USPS HARTFORD PDC | Power Engineers, LLC

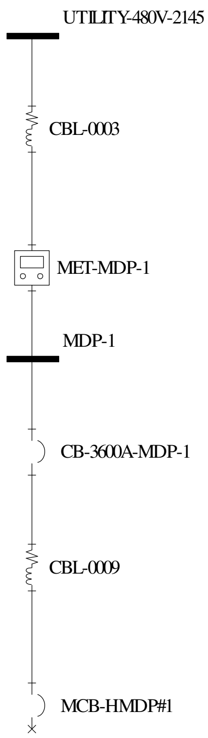




TCC Name:HMDP#1 PHASE | Current Scale x 10 | Reference Voltage: 480 | January 7, 2021

Project: USPS HARTFORD PDC | Power Engineers, LLC





TCC Name:HMDP#1 GROUND	Current Scale x 10	Reference Voltage: 480	January 7, 2021	
Project: USPS HARTFORD PDC	Power Engineers, LLC			Page 8

USPS Hartford Processing & Distribution Center (P&DC) -
141 Weston Street, Hartford, CT

New Electrical Equipment

Copies of Arc Flash Hazard Labels
(Appendix E)

WARNING

Arc Flash and Shock Risk
Appropriate PPE Required

FLASH PROTECTION

Flash Risk at **18 in**
Incident Energy: **35.0 cal/cm^2**
Flash Protection Boundary:**149 in**
Glove Class: **00**
Clothing Category:40 cal/cm^2
Per NFPA Table
130.7(C)(15)(c)

SHOCK PROTECTION

Shock Risk when cover is removed **480 VAC**
Limited Approach **42 in**
Restricted Approach **12 in**

01/04/2021

Bus: HMDP#1 (BUS#1) Prot: MCB-HMDP#1

WARNING

Arc Flash and Shock Risk
Appropriate PPE Required

FLASH PROTECTION

Flash Risk at **18 in**
Incident Energy: **35.0 cal/cm^2**
Flash Protection Boundary:**149 in**
Glove Class: **00**
Clothing Category:40 cal/cm^2
Per NFPA Table
130.7(C)(15)(c)

SHOCK PROTECTION

Shock Risk when cover is removed **480 VAC**
Limited Approach **42 in**
Restricted Approach **12 in**

01/04/2021

Bus: HMDP#2 (BUS#2) Prot: MCB-HMDP#2

WARNING

Arc Flash and Shock Risk
Appropriate PPE Required

FLASH PROTECTION

Flash Risk at **18 in**
Incident Energy: **34.8 cal/cm^2**
Flash Protection Boundary:**148 in**
Glove Class: **00**
Clothing Category:40 cal/cm^2
Per NFPA Table
130.7(C)(15)(c)

SHOCK PROTECTION

Shock Risk when cover is removed **480 VAC**
Limited Approach **42 in**
Restricted Approach **12 in**

01/04/2021

Bus: HMDP#3 (BUS#3) Prot: MCB-HMDP#3

WARNING

Arc Flash and Shock Risk
Appropriate PPE Required

FLASH PROTECTION

Flash Risk at **18 in**
Incident Energy: **34.9 cal/cm^2**
Flash Protection Boundary:**148 in**
Glove Class: **00**
Clothing Category:40 cal/cm^2
Per NFPA Table
130.7(C)(15)(c)

SHOCK PROTECTION

Shock Risk when cover is removed **480 VAC**
Limited Approach **42 in**
Restricted Approach **12 in**

01/04/2021

Bus: HMDP#4 (BUS#4) Prot: MCB-HMDP#4

DANGER

NO SAFE PPE EXISTS
ENERGIZED WORK PROHIBITED

FLASH PROTECTION

Flash Risk at **18 in**
Incident Energy: **115.5 cal/cm^2**
Flash Protection Boundary:**314 in**
Glove Class: **00**
Clothing Category:N/A
Per NFPA Table
130.7(C)(15)(c)

SHOCK PROTECTION

Shock Risk when cover is removed **480 VAC**
Limited Approach **42 in**
Restricted Approach **12 in**

01/04/2021

Bus: MDP-1 Prot: MaxTripTime @2.0s

DANGER

NO SAFE PPE EXISTS
ENERGIZED WORK PROHIBITED

FLASH PROTECTION

Flash Risk at **18 in**
Incident Energy: **115.5 cal/cm^2**
Flash Protection Boundary:**314 in**
Glove Class: **00**
Clothing Category:N/A
Per NFPA Table
130.7(C)(15)(c)

SHOCK PROTECTION

Shock Risk when cover is removed **480 VAC**
Limited Approach **42 in**
Restricted Approach **12 in**

01/04/2021

Bus: MDP-2 Prot: MaxTripTime @2.0s

DANGER

NO SAFE PPE EXISTS
ENERGIZED WORK PROHIBITED

FLASH PROTECTION

Flash Risk at **18 in**
Incident Energy: **115.7 cal/cm^2**
Flash Protection Boundary:**314 in**
Glove Class: **00**
Clothing Category:N/A
Per NFPA Table
130.7(C)(15)(c)

SHOCK PROTECTION

Shock Risk when cover is removed **480 VAC**
Limited Approach **42 in**
Restricted Approach **12 in**

01/04/2021

Bus: MDP-3 Prot: MaxTripTime @2.0s

DANGER

NO SAFE PPE EXISTS
ENERGIZED WORK PROHIBITED

FLASH PROTECTION

Flash Risk at **18 in**
Incident Energy: **115.5 cal/cm^2**
Flash Protection Boundary:**314 in**
Glove Class: **00**
Clothing Category:N/A
Per NFPA Table
130.7(C)(15)(c)

SHOCK PROTECTION

Shock Risk when cover is removed **480 VAC**
Limited Approach **42 in**
Restricted Approach **12 in**

01/04/2021

Bus: MDP-4 Prot: MaxTripTime @2.0s

USPS Hartford Processing & Distribution Center (P&DC) -
141 Weston Street, Hartford, CT

New Electrical Equipment

System Information
(Appendix F)

Power Engineers, LLC
Duxbury, MA 02332
(508) 612-0382

USPS HARTFORD PDC
POWER STUDY
COMPUTER MODEL INPUT DATA

SKM POWER*TOOLS FOR WINDOWS
INPUT DATA REPORT

ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE.

FEEDER INPUT DATA

```
====================================================================================================================
CABLE          FEEDER FROM     FEEDER TO        QTY  VOLTS   LENGTH           FEEDER
NAME           NAME            NAME             /PH  L-L                   SIZE       TYPE
====================================================================================================================
BUS HMDP#3     MDP-3           HMDP#3 (BUS#3)    1    480  100.0  FEET    3000     Copper
               Duct Material:       Busway     Insulation Type:      Epoxy    Insulation Class:    Class B
               +/-  Impedance: 0.0046 + J  0.0026  Ohms/1000 ft      0.1997 + J  0.1128  PU
               Z0   Impedance: 0.0273 + J  0.0139  Ohms/1000 ft        1.18 + J  0.6033  PU

BUS HMDP#4     MDP-4           HMDP#4 (BUS#4)    1    480  100.0  FEET    3000     Copper
               Duct Material:       Busway     Insulation Type:      Epoxy    Insulation Class:    Class B
               +/-  Impedance: 0.0046 + J  0.0026  Ohms/1000 ft      0.1997 + J  0.1128  PU
               Z0   Impedance: 0.0273 + J  0.0139  Ohms/1000 ft        1.18 + J  0.6033  PU

CBL-0001       UTILITY-480V-2  MDP-4            10    480   20.0  FEET     600     Copper
               Duct Material: Non-Magnetic     Insulation Type:        PVC    Insulation Class:       THWN
               +/-  Impedance: 0.0237 + J  0.0371  Ohms/1000 ft      0.0206 + J  0.0322  PU
               Z0   Impedance: 0.0376 + J  0.0943  Ohms/1000 ft      0.0326 + J  0.0819  PU

CBL-0002       UTILITY-480V-2  MDP-3            10    480   20.0  FEET     600     Copper
               Duct Material: Non-Magnetic     Insulation Type:        PVC    Insulation Class:       THWN
               +/-  Impedance: 0.0237 + J  0.0371  Ohms/1000 ft      0.0206 + J  0.0322  PU
               Z0   Impedance: 0.0376 + J  0.0943  Ohms/1000 ft      0.0326 + J  0.0819  PU

CBL-0003       UTILITY-480V-2  MDP-1            10    480   20.0  FEET     600     Copper
               Duct Material: Non-Magnetic     Insulation Type:        PVC    Insulation Class:       THWN
               +/-  Impedance: 0.0237 + J  0.0371  Ohms/1000 ft      0.0206 + J  0.0322  PU
               Z0   Impedance: 0.0376 + J  0.0943  Ohms/1000 ft      0.0326 + J  0.0819  PU

CBL-0006       UTILITY-480V-2  MDP-2            10    480   20.0  FEET     600     Copper
               Duct Material: Non-Magnetic     Insulation Type:        PVC    Insulation Class:       THWN
               +/-  Impedance: 0.0237 + J  0.0371  Ohms/1000 ft      0.0206 + J  0.0322  PU
               Z0   Impedance: 0.0376 + J  0.0943  Ohms/1000 ft      0.0326 + J  0.0819  PU

CBL-0009       MDP-1           HMDP#1 (BUS#1)   10    480   75.0  FEET     500     Copper
               Duct Material:     Magnetic     Insulation Type:        PVC    Insulation Class:       THWN
               +/-  Impedance: 0.0294 + J  0.0466  Ohms/1000 ft      0.0957 + J  0.1517  PU
               Z0   Impedance: 0.0926 + J  0.1147  Ohms/1000 ft      0.3014 + J  0.3734  PU

CBL-0010       MDP-2           HMDP#2 (BUS#2)   10    480   75.0  FEET     500     Copper
               Duct Material:     Magnetic     Insulation Type:        PVC    Insulation Class:       THWN
               +/-  Impedance: 0.0294 + J  0.0466  Ohms/1000 ft      0.0957 + J  0.1517  PU
               Z0   Impedance: 0.0926 + J  0.1147  Ohms/1000 ft      0.3014 + J  0.3734  PU
```

TRANSFORMER INPUT DATA

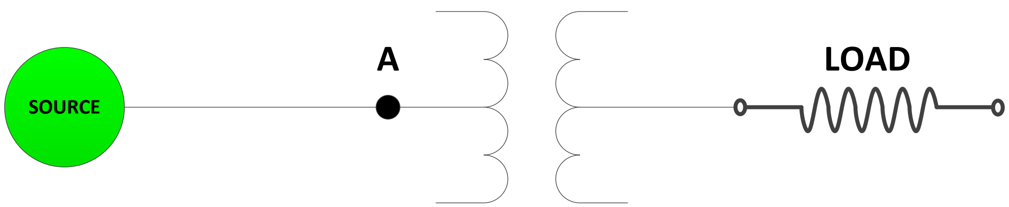
```
==============================================================================================
TRANSFORMER    PRIMARY RECORD      VOLTS   * SECONDARY RECORD    VOLTS   FULL-LOAD    NOMINAL
NAME           NO NAME             L-L       NO NAME             L-L     KVA          KVA
==============================================================================================
UTIL-TRANS-214 UTIL-PRI-2144  YG 22860.0   UTILITY-480V-2 YG    480.00 2000.00      2000.00
               Pos. Seq. Z%:    0.572 + J   5.72    (Zpu  0.286 + j   2.86 )    Shell Type
               Zero Seq. Z%:    0.572 + J   5.72    (     Pri - Sec: 0.286 + j   2.86 )
               Taps  Pri. 0.000 %  Sec. 0.000 %  Phase Shift (Pri. Leading Sec.):  0.000 Deg.

UTIL-TRANS-214 UTIL-PRI-2145  YG 22860.0   UTILITY-480V-2 YG    480.00 2000.00      2000.00
               Pos. Seq. Z%:    0.572 + J   5.72    (Zpu  0.286 + j   2.86 )    Shell Type
               Zero Seq. Z%:    0.572 + J   5.72    (     Pri - Sec: 0.286 + j   2.86 )
               Taps  Pri. 0.000 %  Sec. 0.000 %  Phase Shift (Pri. Leading Sec.):  0.000 Deg.

UTIL-TRANS-239 UTIL-PRI-2391  YG 22860.0   UTILITY-480V-2 YG    480.00 2000.00      2000.00
               Pos. Seq. Z%:    0.572 + J   5.72    (Zpu  0.286 + j   2.86 )    Shell Type
               Zero Seq. Z%:    0.572 + J   5.72    (     Pri - Sec: 0.286 + j   2.86 )
               Taps  Pri. 0.000 %  Sec. 0.000 %  Phase Shift (Pri. Leading Sec.):  0.000 Deg.

UTIL-TRANS-239 UTIL-PRI-2392  YG 23000.0   UTILITY-480V-2 YG    480.00 2000.00      2000.00
               Pos. Seq. Z%:    0.572 + J   5.72    (Zpu  0.286 + j   2.86 )    Shell Type
               Zero Seq. Z%:    0.572 + J   5.72    (     Pri - Sec: 0.286 + j   2.86 )
               Taps  Pri. 0.000 %  Sec. 0.000 %  Phase Shift (Pri. Leading Sec.):  0.000 Deg.
```

```
                       GENERATION  CONTRIBUTION  DATA
======================================================================================
BUS            CONTRIBUTION    VOLTAGE
NAME           NAME               L-L     MVA      X"d    X/R
======================================================================================
UTIL-PRI-2144  AVAIL SC CLP 2  23000.0  131.78
                  Three Phase          Contribution:    3308.00 AMPS       2.76
                  Single Line to Ground Contribution:    2301.00 AMPS       1.30
                  Pos  Sequence Impedance (100 MVA Base)  0.2586 + J   0.7134 PU
                  Zero Sequence Impedance (100 MVA Base)    1.48 + J     1.17 PU

UTIL-PRI-2145  AVAIL SC CLP 2  23000.0  131.78
                  Three Phase          Contribution:    3308.00 AMPS       2.76
                  Single Line to Ground Contribution:    2301.00 AMPS       1.30
                  Pos  Sequence Impedance (100 MVA Base)  0.2586 + J   0.7134 PU
                  Zero Sequence Impedance (100 MVA Base)    1.48 + J     1.17 PU

UTIL-PRI-2391  AVAIL SC CLP 2  23000.0  131.78
                  Three Phase          Contribution:    3308.00 AMPS       2.76
                  Single Line to Ground Contribution:    2301.00 AMPS       1.30
                  Pos  Sequence Impedance (100 MVA Base)  0.2586 + J   0.7134 PU
                  Zero Sequence Impedance (100 MVA Base)    1.48 + J     1.17 PU

UTIL-PRI-2392  AVAIL SC CLP 2  23000.0  131.78
                  Three Phase          Contribution:    3308.00 AMPS       2.76
                  Single Line to Ground Contribution:    2301.00 AMPS       1.30
                  Pos  Sequence Impedance (100 MVA Base)  0.2586 + J   0.7134 PU
                  Zero Sequence Impedance (100 MVA Base)    1.48 + J     1.17 PU
```

Impedance and Fault Data

(The data below is used to calculate the maximum available Symmetrical Fault Current at the primary bus "A" of an Eversource transformer.)

Date:	3 November 2020
Customer Name:	United States Post Office
Address:	141 Weston Street
Town:	Hartford
Source Substation:	Northwest Hartford 2N
Source Circuit:	2N10, Voltage Base = 23 kV
First Up-Stream Protective Device:	200E Power Fuse
Transformer Size:	Pad# 2144, 2145, 2391, 2392: all pads are 2000 kVA, 22860 – 480 / 277 volts.
Transformer Connections:	Primary: Grounded Wye / Grounded WyeSecondary
Transformer Impedance:	Nameplate: 5.75% [assumed], on its own power base (R is assumed to be 10% of X)
Impedance at "A":	Z_1=Z_2= 1.368+ j3.774, Z_0 = 5.780+ j7.522 in Ω.
	Z_1=Z_2= + j , Z_0 = + j in per unit (pu). Use Z_Ω *100/ $(kV_{LL})^2$
	(PowerBase = 100 MVA; Voltage Base = Primary Voltage in kV)
Fault Current:	$I_{3\phi Fault}$ = 3308 Amps, $I_{1\phi Fault}$ = 2301 Amps



The values provided by Eversource Energy are per its existing normal configuration. Please note that the Eversource system configuration can change at any time, temporarily or permanently, without notice to customers, as required by Eversource to meet its capacity and safe operating needs.

No.	DATE	DESCRIPTION	No.	DATE	DESCRIPTION
		REVISIONS			REVISIONS

PROJ. MANAGER:
CHIEF DESIGNER:
REVIEWED BY: DATE

SEAL

SCALE:
HORZ.:NONE
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

POWER ENGINEERS, LLC
Duxbury, MA 02332
(508) 612-0382
www.PowerEngineersLLC.com
Electrical Engineering, Power, Lighting, Technical Studies and Utility Consulting

USPS HARTFORD PDC
SWGR REPLACEMENT - POWER STUDY
COMPUTER MODEL ONE-LINE DIAGRAM
141 WESTON STREET, HARTFORD CONNECTICUT

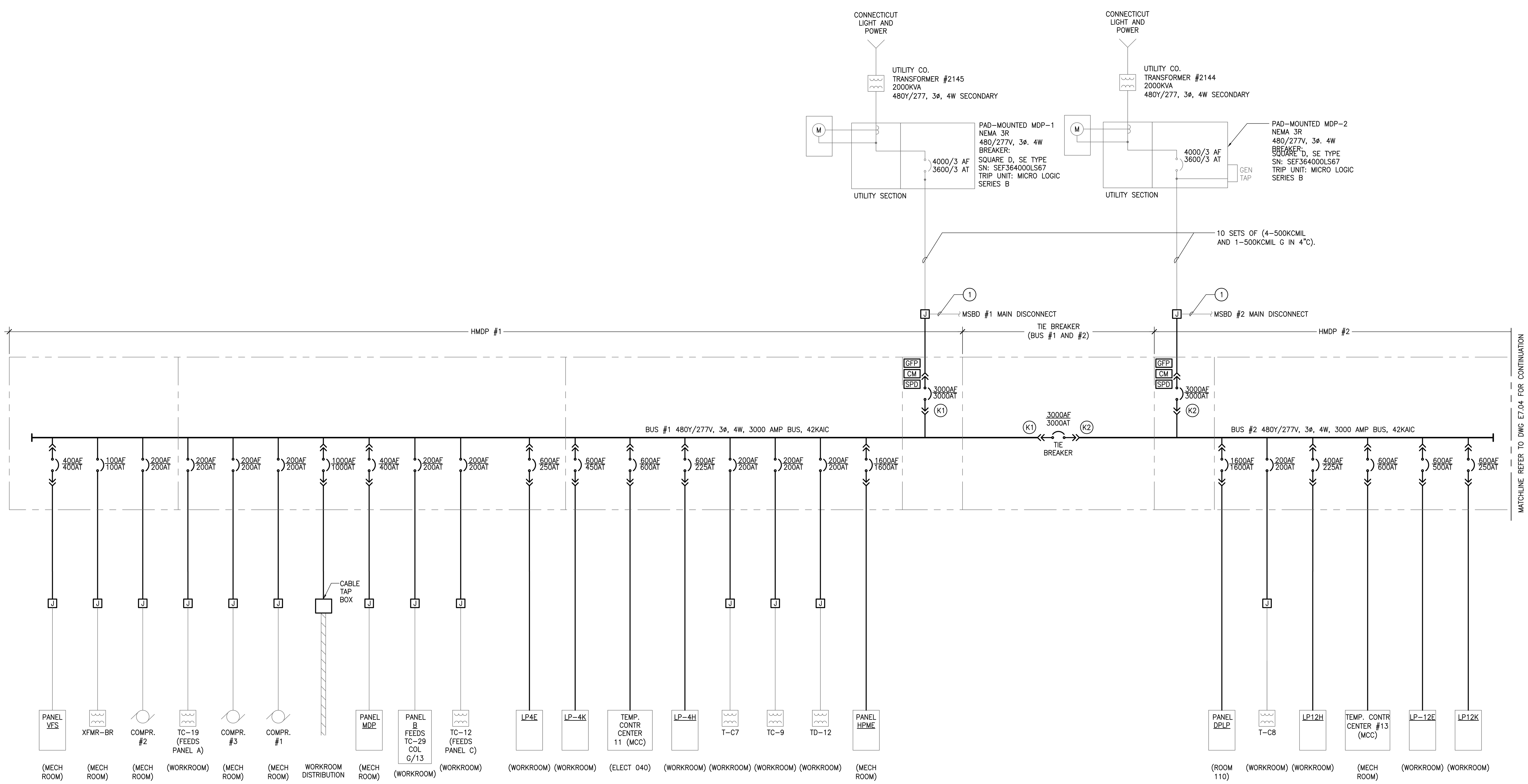
PROJ. No.: 473A
DATE: JANUARY 2021
OL-1
SIZE: D REV: 1

NOTES

1. FOR ELECTRICAL LEGEND, PHASING NOTES AND GENERAL NOTES, REFER TO DRAWING E0.01.
2. FIELD VERIFY THAT ALL END LOADS ORIGINATING FROM EXISTING SWITCHBOARDS MATCH THE CONFIGURATION SHOWN. REPORT ANY DISCREPANCIES TO THE A/E. PROVIDE TO THE A/E A HANDMARKED ONE-LINE OF ANY CHANGES.
3. REMOVAL SHOWN ON THIS PLAN SHALL BE SEQUENCED IN ACCORDANCE WITH THE APPROVED CUTOVER PLAN. SEE DRAWING E0.01.

KEY NOTES:

(1) MAINTAIN NOTED CONNECTIONS TO MSBD #1 AND MSBD #2 MAIN DISCONNECTS PER THE CUTOVER PLAN. THE CONNECTION SHALL BE REMOVED UPON COMPLETION OF THE CUTOVER PLAN.



PARTIAL ONE LINE DIAGRAM NEW WORK

(1) SCALE: NOT TO SCALE

McKINNELL McKINNELL & TAYLOR Inc.
ARCHITECTS-ENGINEERS-PLANNERS
SUITE 201
164 WASHINGTON STREET
NORWELL, MA 02061
PHONE: (781) 878-8223
FAX: (781) 878-8920

30% SUBMISSION (NOT FOR CONSTRUCTION) 12-08-20

SWITCHGEAR REPLACEMENT
PROCESSING & DISTRIBUTION CENTER
141 WESTON ST
HARTFORD, CONNECTICUT 06101-9612

UNITED STATES POSTAL SERVICE

Facilities – Northeast R&A, 955 Goffs Falls Road, Manchester, NH 03103-9998

E7.03 PARTIAL ONE LINE DIAGRAM - NEW WORK

SCALE: AS NOTED DATE:
A/E PROJECT NO.: 18034.00
USPS PROJECT NO.: B43529
REVISIONS: DATE:

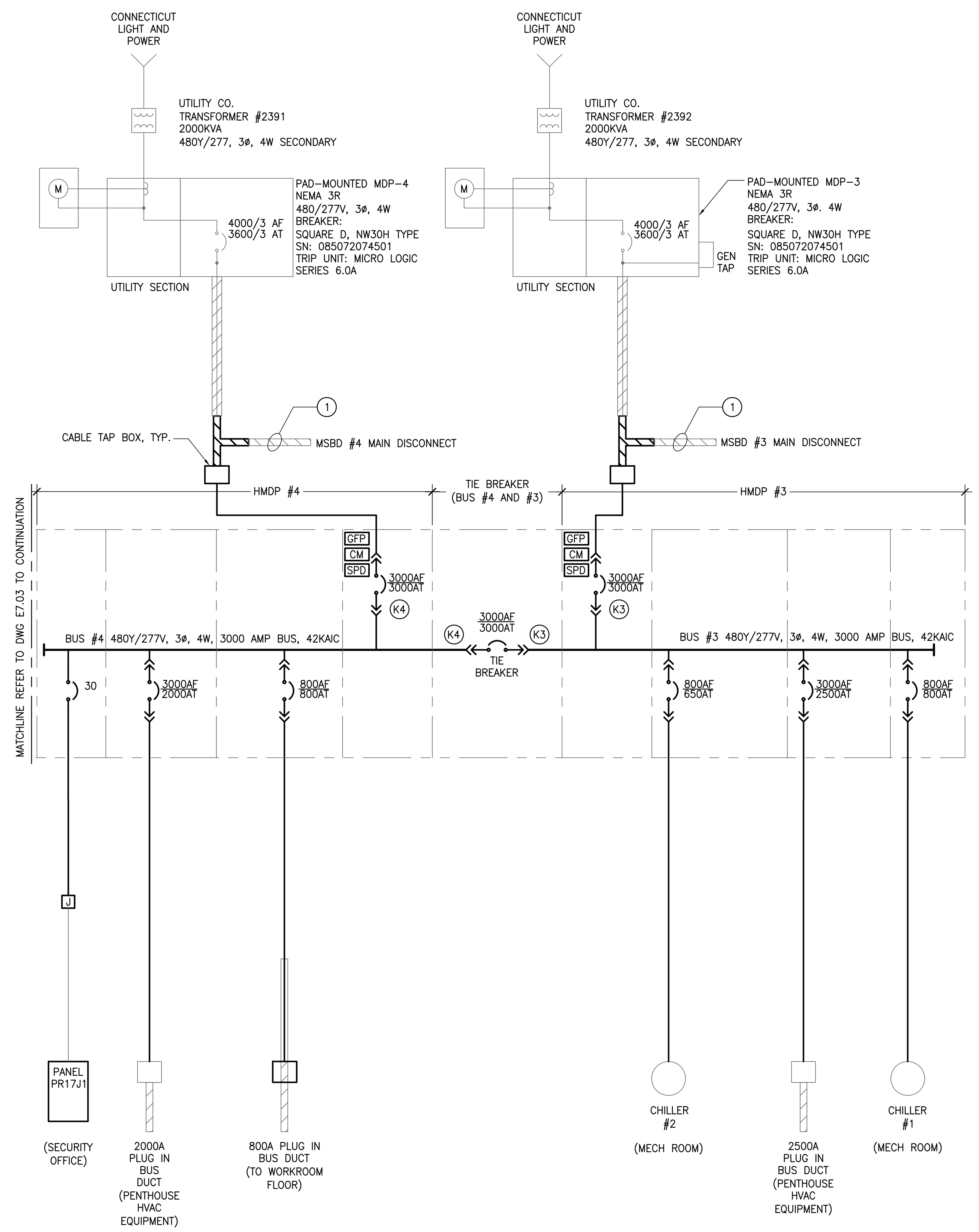
F:\ACAD\18034-Hartford PDC-Switchgear\CD\18034.00 ELEC-DIAG.dwg, E7.03, 12/9/2020 1:37:47 PM, clezotte

NOTES

1. FOR ELECTRICAL LEGEND, PHASING NOTES AND GENERAL NOTES, REFER TO DRAWING E0.01.
2. FIELD VERIFY THAT ALL END LOADS ORIGINATING FROM EXISTING SWITCHBOARDS MATCH THE CONFIGURATION SHOWN. REPORT ANY DISCREPANCIES TO THE A/E. PROVIDE TO THE A/E A HANDMARKED ONE-LINE OF ANY CHANGES.
3. REMOVAL SHOWN ON THIS PLAN SHALL BE SEQUENCED IN ACCORDANCE WITH THE APPROVED CUTOVER PLAN. SEE DRAWING E0.01.

KEY NOTES:

(1) MAINTAIN NOTED CONNECTION TO MSBD #3 AND MSBD #4 MAIN DISCONNECTS PER THE CUTOVER PLAN. THE CONNECTION SHALL BE REMOVED UPON COMPLETION OF THE CUTOVER PLAN.



(1) PARTIAL ONE LINE DIAGRAM NEW WORK

SCALE: NOT TO SCALE

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12-08-20

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PROCESSING & DISTRIBUTION CENTER
141 WESTON ST
HARTFORD, CONNECTICUT 06101-9612

UNITED STATES POSTAL SERVICE

Facilities – Northeast R&A, 955 Goffs Falls Road, Manchester, NH 03103-9998

REVISIONS: DATE:

E7.04 PARTIAL ONE LINE DIAGRAM - NEW WORK

SCALE: AS NOTED DATE:
A/E PROJECT NO.: 18034.00
USPS PROJECT NO.: B43529

F:\ACAD\18034-Hartford PDC-Switchgear\CD\18034.00 ELEC-DIAG.dwg, E7.04, 12/9/2020 1:39:20 PM, cbozite