

Exhibit A

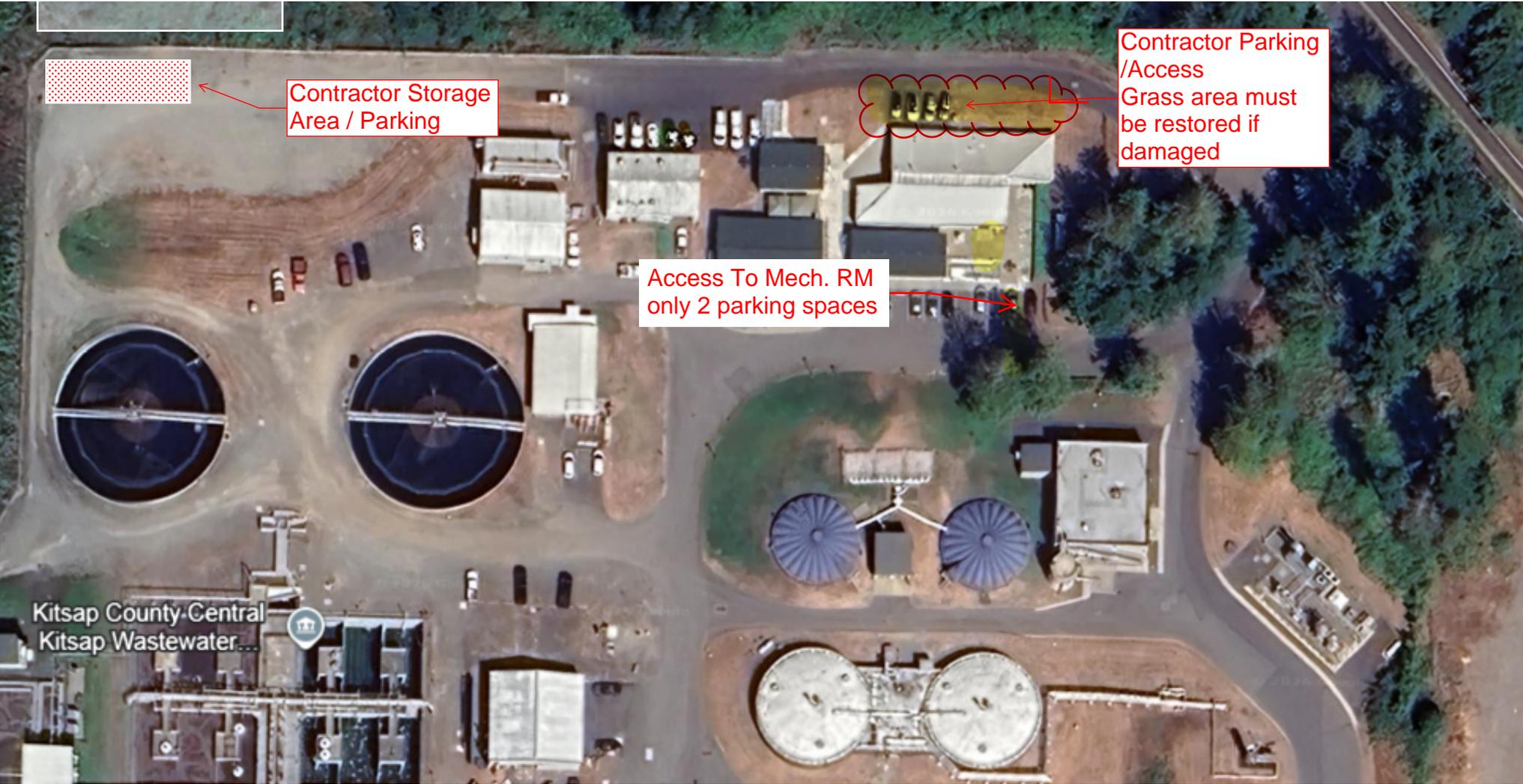


Exhibit B

Spare Conduit

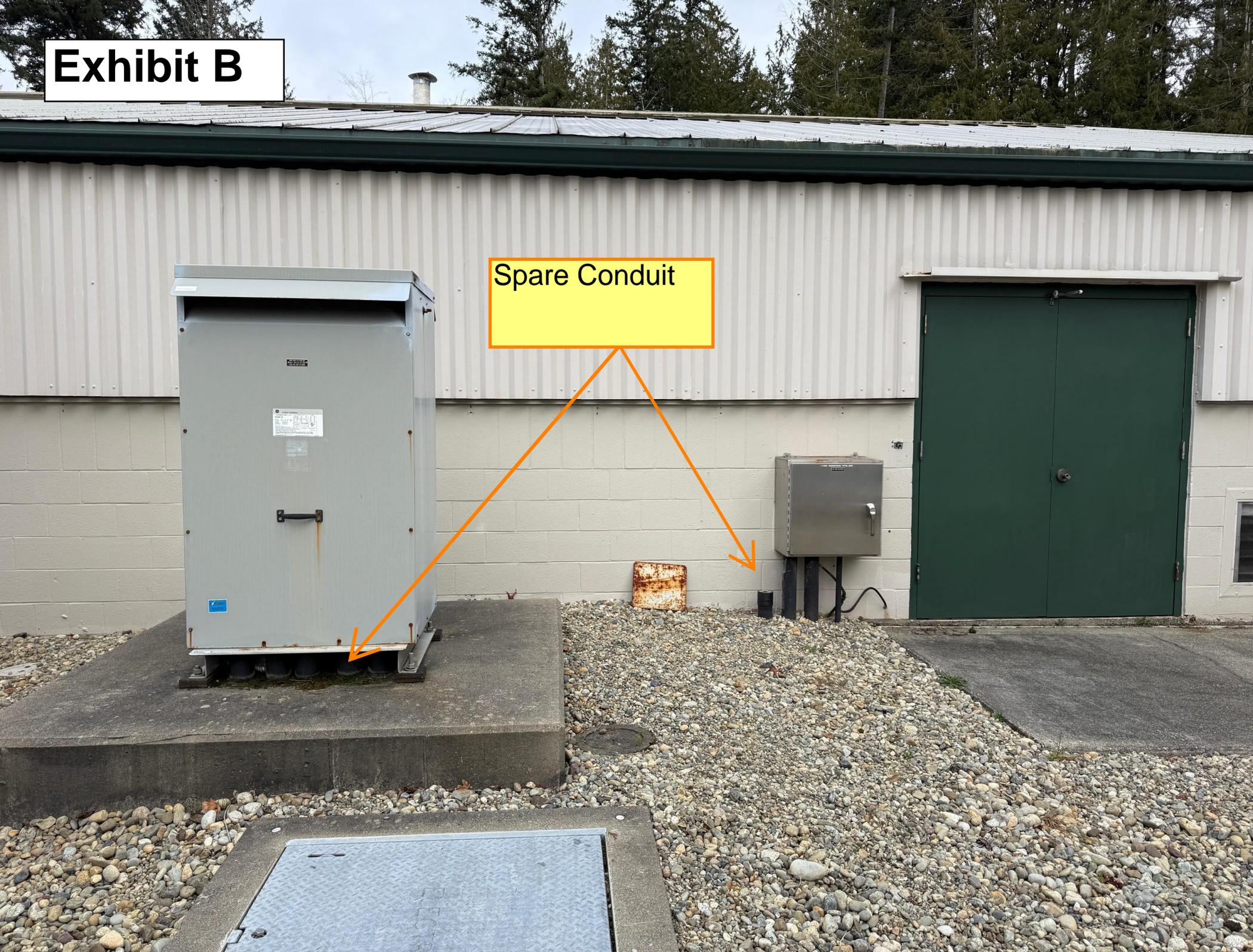


Exhibit C

SUBSTITUTION REQUEST FORM For Substitution Requests During Bid Phase

Advancement of Construction Technology
The Construction Specifications Institute

TO: Brian Stewart

PROJECT: Central Kitsap WWT Lab Admin Bldg

SPECIFIED ITEM:

Section	Page	Paragraph	Description
086200	229	2.01	Modular Skylights - Option A

The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: DeaMor Thermally Broken Skylights, installed on curbs as shown in Option B. This is the same system installed on the Portland Airport Terminal Expansion.

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are ALL correct:

1. THE PROPOSED SUBSTITUTION DOES NOT AFFECT DIMENSIONS SHOWN ON DRAWINGS. DeaMor skylights install on the standard curb in plane as shown for Option B for superior adjustability and curb tolerance.
2. THE UNDERSIGNED WILL PAY FOR CHANGES TO THE BUILDING DESIGN, INCLUDING ENGINEERING DESIGN, DETAILING AND CONSTRUCTION COSTS CAUSED BY THE REQUESTED SUBSTITUTION.
3. THE PROPOSED SUBSTITUTION WILL HAVE NO ADVERSE EFFECT ON OTHER TRADES, THE CONSTRUCTION SCHEDULE, OR SPECIFIED WARRANTY REQUIREMENTS.
4. MAINTENANCE AND SERVICE PARTS WILL BE LOCALLY AVAILABLE FOR THE PROPOSED SUBSTITUTION. DeaMor skylights are manufactured in Washington and installed by the manufacturer for single-source responsibility.

The undersigned further states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Submitted by:

Signature R. Jody Moore, President

Firm DeaMor Associates

Address: 6210 S 11th Street
Ridgefield WA 98642

Date: February 11, 2026

Telephone: 360-903-3704

For use by Design Consultant:

Accepted Accepted as noted
 Not Accepted Received too late

By: _____

Date: _____

Remarks: _____

Attachments: Features for Envelope Performance, NFRC Certification and the only US-EPD Skylight Certification.
Typical skylight details on curbs in plane of skylight slope (as shown for Option B) for superior tolerance and integration with waterproofing.

Design Features for Envelope Performance

Project: Central Kitsap Treatment Plant HVAC Upgrades

Architect: Rolluda Architects

Rain Screen Design: Primary and Secondary Water Control

- **Flush-Glazed Horizontal Joints allow water to flow freely off the surface**
Water flows freely off the skylight over flush silicone seals at all horizontal joints, including the eave, preventing ponding of water and unsightly staining on the glass.
- **Internal Cascading Gutter directs moisture to the exterior through a weep valve**
Continuous internal gutters on the rafters and horizontal purlins direct condensation moisture in the system to the exterior through our weep valve onto the eave apron flashing.
- **Weep Valve controls both water and air**
Our unique weep valve allows moisture to get out of the system but prevents air from getting in!
- **Perimeter Integrates with Air and Water Barrier Systems**
Compatible membranes and flashings are fully supported and properly lapped to provide permanent waterproofing of the opening.
- **Structurally Glazed Option-- In Shop with Special Inspection**
Structurally glazed systems provide superior thermal performance and meet extreme water control requirements. Structural adhesives are applied and cured in shop controlled conditions, with a Special Inspection to ensure engineering and application procedures are followed.

Sustainability in Materials and Quality

- **Environmental Product Declaration – the only US Skylight manufacturer with a US EPD!**
[Certified Green Products Guide | SCS Global Services](#)
- **Health Product Declaration**
 - <https://hpdrepository.hpd-collaborative.org/>
 - https://hpdrepository.hpd-collaborative.org/repository/HPDs/1404_Glass_Skylights.pdf
- **No Red List Components – Thermally broken with No PVC - ever!**
Nylon strut structural thermal blocks are integrated into the perimeter of the aluminum skylight system and all gaskets and sealants are 100% Low VOC silicone.
- **Designed to perform for the Lifetime of the Building**
Professionally engineered extruded aluminum systems are crafted by our experienced union sheetmetal journeymen who understand the critical performance features that require precision.

Thermal Design Certified by National Fenestration Rating Council

- **Thermally Broken and Fully Insulated System**
Insulated flashing closures complete thermal isolation that moderates the temperature of interior and exterior surfaces to eliminate condensation.
- **NFRC- Certified Systems**
DeaMor skylights are certified with the glass on your project to meet the most stringent energy code requirements and to help moderate operating costs.
 - Please see the following page for NFRC System Certification for this project.

Design Features for Envelope Performance

NFRC-Certified Product Directory Listing for an example glazing product

- Glass: Vitro Solarban 70 Low E (#2 surface) Ref. Glass specified in 086200
- U-Value specified: none. DeaMor NFRC System U: 0.40
- 2.05. A.4: Solar Heat Gain Coefficient specified 23% DeaMor NFRC System SHGC: 0.25
- Visible Light Transmission specified; None DeaMor NFRC VLT: 55%

CPD #	U-factor	SHGC	VT	Condensation Resistance	Air Leakage	Ventilation Rating (Standard Screen)	Ventilation Rating (Enhanced Screen)	Close			
DAI-K-9-00046-00001	0.40	0.25	0.55	65							

Group ID	Manufacturer Product Code	Frame/Sash Type	Glazing Layers	Low-E	Gap Widths	Spacer	Gap Fill	Grid	Divider	Tint
1	"SB70 / Arg / 1/4"Clr-060PVB-1/4"Clr - 1-5/16"(1/4"-9/16")"	AT/NA	2	0.018(2)	0.5	TS-D	Fill 1: ARG/AIR(90/10)	N	-	CL

Designed and Warranted for Performance

- **Detailed for Ease of Watertight Installation**
 - The true test of a skylight is how it works when it is installed, exposed to the elements; performance is in the details and our installer-friendly designs assure proper execution.
- **Glass seal integrity is protected :**
 - Extruded blocking against sliding and lateral movement prevents shear between the glass panes that will lead to seal failure.
 - Silicone glazing gaskets are mechanically interlocked into the system providing waterproof seals against the glass that are compatible with weatherseal sealants.
 - Weep holes on every glass supporting member protect the seals from prolonged contact with incidental moisture, which is the primary cause for seal failure
- **Ten-year warranties** are standard, and your project will qualify for a 10-year warranty on insulated glass due to the integrity of the DeaMor skylight system design.

Tested and Engineered for Your Project

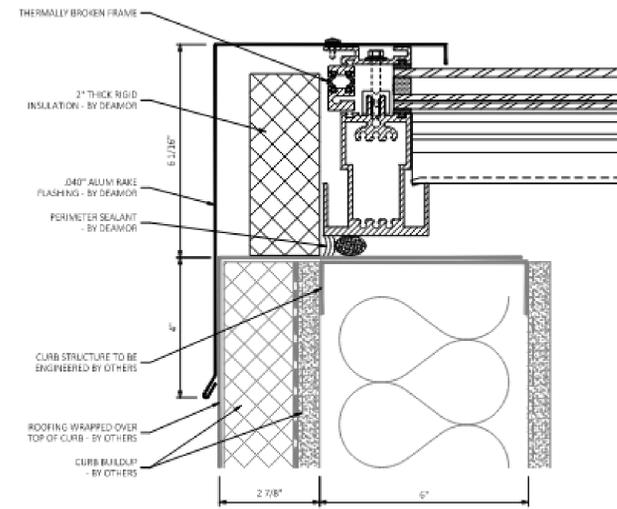
- **Engineered for installation in every US state**
Our structural engineers, registered in the state of Colorado, design for specific project requirements. Stamped calculations and drawings are always provided, with supplementary documents for securing dimensions, building permits and coordinating structural requirements.
- **Access for maintenance and glass replacement**
DeaMor designs skylight glass for a 300-pound concentrated load, with a safety factor of 2, to support short-term access for maintenance and installation personnel.
- **ASTM Testing for Air and Water Barriers**
DeaMor Skylights are tested by rigorous ASTM static and AAMA dynamic pressure procedures to provide resistance to extreme weather conditions.
 - Please see the following page for Test procedures, pressures and results.

Design Features for Envelope Performance

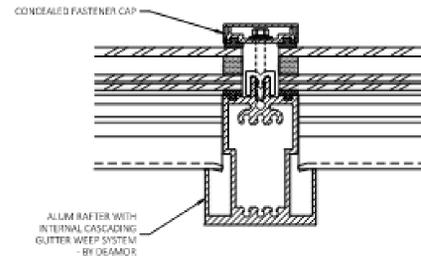
Tested to the most rigorous Fenestration Standards

- **ASTM Testing for Air and Water Barriers**
 - **Water Penetration: ASTM E331**
 - Static negative pressure: 15 psf
 - No water penetration
 - **Dynamic Water Penetration: AAMA 501**
 - Dynamic pressure: 15 psf
 - No water penetration
 - **Air Infiltration: ASTM E283**
 - Static negative pressure: 6.24 psf
 - 0.01 CFM Air Infiltration

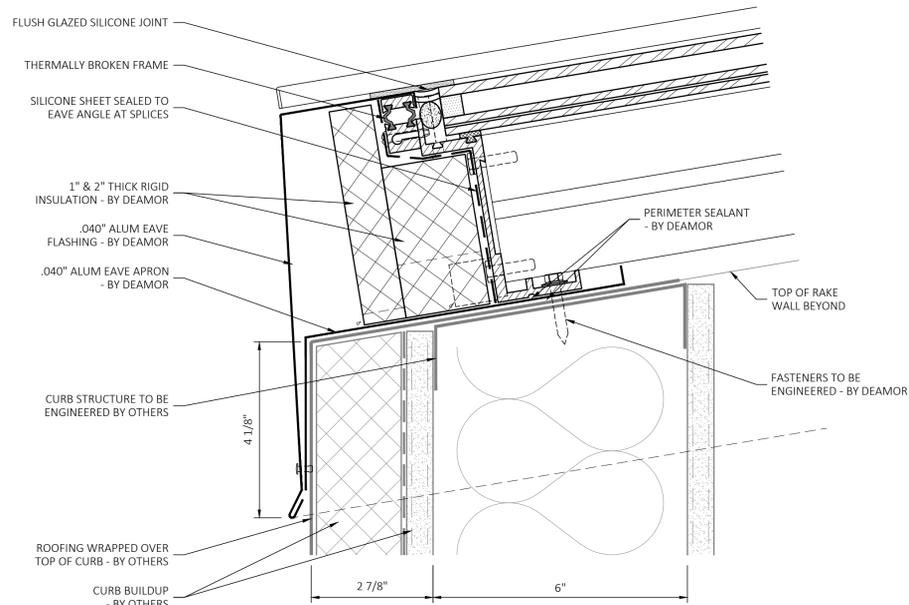
REV	DRAWN BY	CHECKED BY	DATE
	MP		7/6/23



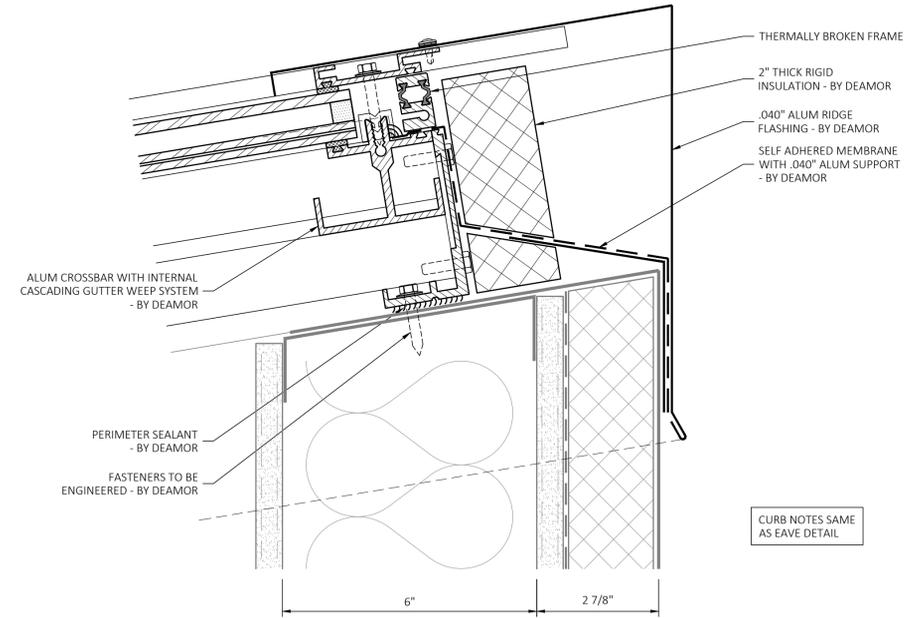
1 RAKE RAFTER DETAIL
D3 6"=1'-0" ARCH. REF. =



2 TYPICAL RAFTER DETAIL
D3 6"=1'-0" ARCH. REF. =



1 EAVE DETAIL
D1 6"=1'-0" ARCH. REF. = 5B/ A1.10



3 RIDGE DETAIL
D1 6"=1'-0" ARCH. REF. = 56B/ A1.10

ENGINEER STAMP

PRELIMINARY
UN-ENGINEERED

Project: Central Kitsap Treatment Plant
HVAC Upgrades
Architect: Rolluda Architects

3-5 Capped Glass Shed Skylight
Standard Sales Details

DeaMor
Associates, Inc.
6210 S. 11th St.
Ridgefield, WA 98642
(509) 284-6799 (360) 574-3449
FAX: (360) 574-3487

Exhibit D



2222 West Valley Hwy North,
Suite 160
Auburn, WA 98001
(253) 736-6010
FAX (253) 736-6015
www.ers.assetweb.com

10/1/2012

Attention: Mr. Scott Wakefield

Subject: Power System Study
Reference No. 3162884

Dear Mr. Scott Wakefield

Enclosed is the subject revised Power System Study. It was our pleasure to be of service to you on this project at Central Kitsap Waste Water Treatment Plant.

The comments from the engineer call for the recommended settings to be implemented and for the labels to be based on the recommended settings. Please note that prior to affixing any labels based on "recommended" settings, the "recommended" settings must be implemented. Changing settings on the devices could cause them to trip; thus, outages should be scheduled to allow settings to be implemented.

Within 30 days ERS will call you to discuss the report and to obtain your direction regarding which basis should be used. After the labels are printed, reprinting the labels and/or a study revision may result in additional charges.

If you have any questions, or if we can be of further assistance, please do not hesitate to call.

Sincerely,
Gloria Marinescu.

Power Systems Engineer
Electrical Reliability Services, Inc.

Enclosures



2222 West Valley Hwy North,
Suite 160
Auburn, WA 98001
(253) 736-6010
FAX (253) 736-6015
www.ers.assetweb.com

REPORT ACCEPTANCE FORM

Subject: Short Circuit, Protective Device Coordination, and Arc Flash Study
Job #: 3162884
Report Submitted: 9/4/2012
Scott Wakefield
Central Kitsap Waste Water Treatment Plant

Please Respond by: 10/26/2012

I have reviewed the above referenced report and accept it as complete. I understand that some reasonable engineering assumptions were used in this report when data was not available and find them acceptable based on my knowledge of the studied electrical system and its operation.

I have also reviewed the included arc flash labels and agree with the naming conventions used in this report. My desire is to print the arc flash labels associated with this report based on:

_____Recommended system settings

Signature

Date

Printed name/position

Please sign and return this form to the author of the report via email or via fax at the fax Number above.

Power System Study

Emerson Network Power | Electrical Reliability Services

Purchase Order #: 220-033-001

ERS Job # 3162884

Prepared for:

PSW Electric
PO Box 5615
Bremerton, WA 98312

Facility:

Central Kitsap Waste Water Treatment Plant
12351 Brownsville HWY NE
Poulsbo, WA 98370-7940

AC Short Circuit Analysis
Device Evaluation
Time-Current Coordination Analysis
Arc Flash Analysis

Submitted: 9/4/2012

Primary Engineer:

Gloria Marinescu
Power Systems Engineer

Assisting Engineer:

Paul Boomer.
Power Systems Engineer

2222 West Valley Hwy North,
Suite 160
Auburn, WA 98001
(253) 736-6010
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1.0 EXECUTIVE SUMMARY

1.1 Objectives

- Compare calculated fault duties with the withstand and interrupting ratings for distribution panels and protective devices.
- Recommend protective device settings which selectively isolate faults in a manner which is consistent with the basic system design and applicable codes and standards. These recommendations will be given to achieve an optimum balance between protection and selective fault isolation.
- Determine arc flash incident energy levels and PPE requirements.
- Note areas of deficiency and make general recommendations.

1.2 Short Circuit Analysis

Panels or individual switching devices within the scope of the project were found to be applied at locations where the calculated available short circuit currents exceed the associated withstand or interrupting ratings and therefore require replacement. These under-rated devices could fail catastrophically at any time while subjected to, or called upon to interrupt, a fault, and should be replaced immediately. (Alternatively, it may be possible to reduce the available fault current by reconfiguring the system.)

Device Evaluation Summary

Location	Device Type	Evaluation
MCC4 PANEL	Panel Rating	Fail (Panel rating)
OFFICE LAB SWITCHES	UL 98 DS	Fail (Breaker rating)
PLATE DEWATER PRESS	Panel Rating	Fail (Panel rating)
PNL-1090 PLANT WW SMP PNL	Panel Rating	Fail (Panel rating)
S101 PANEL	Panel Rating	Fail (Panel rating)
SLUDGE BLDG AHU-2	UL 98 DS	Fail (Switch rating)
SLUDGE BLDG RM EXH FAN	UL 98 DS	Fail (Switch rating)

Please refer to Sections 3 and 4 for more detailed information.

1.3 Protective Device Coordination

The recommended device settings provided in this report should provide acceptable system protection and coordination except as noted below.

- There are cases of unavoidable non-selectivity, but the settings provided are the best available with the existing equipment.
- The 100KVA single phase transformer (8A Full Load) that powers the lab and office building is improperly protected with 100A fuses. These fuses should be replaced as soon as possible.
- There are no overcurrent relays applied in the 60HZ portion of the system studied.
- Motor circuit protectors are applied without overload relays at some locations. Overload relays should be installed.

Please refer to Section 4.2 for more detailed information.

1.4 Arc Flash Evaluation

All calculations are based on the assumption that all of the equipment in the circuits will work as per the manufacturer's published materials and industry standards. Equipment must be maintained and calibrated regularly in order to operate within specifications when required. No work should be performed on or around any energized equipment without the use of a proper level of PPE and adequate training.

The attached arc flash hazard calculations show the calculations for both the “Existing” settings, and the “Recommended” settings. No labels have been printed at this time. Once the report and label content has been approved, and communicated to the ERS study engineer, labels will be printed.

1.5 Arc Flash Results Summary

While most of the locations studied were found to have incident energy levels that are within Category 0-4 protection, there are areas that were identified as being too dangerous to perform energized work in, even when recommended settings are implemented.

Switchgear 2960 both A and B sides

Generator 2995

As per NFPA 70E, protective clothing is not sufficient to protect workers where incident energy levels exceed $40\text{Cal}/\text{cm}^2$ due to the concussive forces that are present in addition to the arc energy present. Energized work must not be performed near these areas. See Section 4.

No work should be performed on or around any energized equipment without the use of a proper level of PPE and adequate training.

1.6 Arc Flash Labeling for locations with under rated devices

Devices within the scope of the project were found to be applied at locations where the calculated available short circuit current exceeds the associated withstand or interrupting ratings and therefore require replacement. These under-rated devices could fail catastrophically at any time while subjected to, or called upon to interrupt, a fault, and should be replaced immediately. (Alternatively, it may be possible to reduce the available fault current by reconfiguring the system.) Please refer to Sections 4.1 for more detailed information. Special arc flash labels will be applied to warn that energized work is prohibited at these locations, and locations immediately downstream of these locations.

1.7 Harmonic Mitigation is Not Required

The results of the calculations required in Section 16925 of the specification were reviewed. The variable speed drive equipment added at MCCs 2975 and 2976 are not predicted to cause the harmonic levels at the 2000KVA transformers or the utility transformer to exceed IEEE 519 guidelines. Therefore no harmonic mitigation appears to be necessary due to the new equipment.

1.8 Changes Made In Revision 1

The comments dated 9/18/2012 were addressed and Appendix 10 contains a table with those comments and the responses to those comments.

2.0 OBJECTIVES/PURPOSE

Power system studies were performed to analyze the quality of protection for the electrical power distribution system at the client's facility. The studies performed included short circuit, protective device coordination and arc flash evaluation for the equipment as indicated on the attached study drawing(s) in Appendix 9.

2.1 Objectives

- Compare calculated fault duties with withstand and interrupting ratings for distribution panels and protective devices.
- Recommend protective device settings which selectively isolate faults in a manner which is consistent with the basic system design and applicable codes and standards. These recommendations will be given to achieve an optimum balance between protection and selective fault isolation.
- Determine arc flash incident energy levels and PPE requirements.
- Note areas of deficiency and make general recommendations.

3.0 ANALYSIS AND METHODS

3.1 Sources of Data

System data for the power system study was obtained from ERS field gathered data and data supplied by PSW Electric personnel. Any system changes after the time of data collection/submittal will render the findings in this report inaccurate and a study revision will be required.

3.2 Fault Duty Data

Utility fault duties (listed below) were provided by Puget Sound Energy Personnel. The complete correspondence is contained in Appendix.

Available Short Circuit Currents:

Max 3-Phase Fault = 2560.0A (X/R ratio = 1.39178)

Max 1-Phase Fault = 1820.9A (X0/R0 ratio = 2.32860)

3.3 Utility Upstream Protection Data

Utility upstream protection information was unchanged.

3.4 System Analysis Scenarios

Table 1: Modeling Scenarios

SCENARIO NAME	DESCRIPTION
Normal Power Case	Power from the utility through the SWGR 2950, generators off line, and ATS units connected to utility power. All 480V ties were modeled as open, and power to MCC-283 from 2960 Main A. The calculations from this case were used in the coordination and arc flash analyses.
Normal Power Maximum Short Circuit Case	Power from the utility through the SWGR 2950, generators off line, and ATS units connected to utility power. All 480V ties were modeled as closed, and power to MCC-283 from 2960 Main A. The main transformer with the higher impedance and the one of the conductors (longest) to each MCC pair were taken out of service. The calculations from this case were used in the short circuit, coordination and arc flash analyses.
Normal Power Minimum Fault Case -	Same as case 2 except the main transformer with the lower impedance and the shorter lines to each MCC pair were taken out of service. In addition, all the motors were taken out of service.
Generator Powered Normal	Same configuration as Case 1 except that ATS-1 and ATS-2 are connected to their generator sources, and Lab MTS is connected

	to the emergency source.
Generator Powered Minimum	Generator Powered Minimum - Same as Case 3 except only the smaller generator is in service.

3.5 Short Circuit Analysis

A computer model of the electrical system was created based on data obtained for the studies. A model was developed utilizing the SKM System Analysis, Inc. PowerTools for Windows A_FAULT program and analyzed to determine the maximum fault levels at the switchgear and panels covered within the study. Complete short circuit analysis input & output reports as well as device evaluation tables are contained in the Appendices. For Further information on calculation methods, see Appendix 2.

- Calculations at single phase locations were made by extending the 3 phase model using the techniques listed in IEEE Std 551-2006 Chapter 3, Page 68.

3.6 Protective Device Coordination

Time-Current Curve (TCC) sets for the systems studied are contained in the Appendix. Each curve set contains a simplified single-line diagram that graphically describes the relationship between the devices studied. The "Recommended" settings were chosen to provide the best compromise between complete selectivity and device protection.

The study was performed by plotting protective device time-current characteristics on a log-log graph as operating time versus current. These coordination curves illustrate graphically the quality of protection and coordination provided by the protective devices.

As stated in ANSI/IEEE Standard 242-2001 (p. 2), "Whether minimizing the risk of equipment damage or preserving service continuity is the more important objective depends upon the operating philosophy of the particular industrial plant or commercial business." .

Starting with the device nearest the source, the TCC's are plotted with the objective of maintaining an adequate coordination interval between devices in series. The TCC's of the devices are terminated at the maximum fault magnitude available at the device's location. The more devices applied in series the less likely that adequate intervals can be maintained. All of the steps above are performed with the use of the SKM Systems Analysis Inc. CAPTOR program. See Appendix 2 for additional details on procedures.

3.7 Arc Flash Evaluation

Arc flash evaluations are used in conjunction with the client's/facility operator's safety policy to determine the required personal protective equipment (PPE) when working on energized equipment. NFPA 70-2011 (NEC) requires equipment to be field marked to indicate where a flash hazard exists:

NEC 110-16 – Arc Flash Hazard Warning

Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling occupancies, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

NFPA 70E-2012, Standard for Electrical Safety In the Workplace, states that

“When an employee is working within the arc flash boundary, he or she shall wear protective clothing and other personal protective equipment in accordance with 130.5. All parts of the body inside the arc flash boundary shall be protected.”

The calculations used in this study comply with NFPA 70E requirements in that the incident energy levels are calculated and the corresponding minimum category of PPE that is required is identified. A table summarizing the results for all locations evaluated is included in the Appendix.

The results of the arc-flash calculations are based on the values of fault current magnitudes calculated in the short-circuit analysis and the associated clearing times of the over current protective devices as determined by the coordination study.

See Appendix 2 for additional details and discussion.

4.0 FINDINGS & RECOMMENDATIONS

4.1 Short Circuit Analysis Findings

Models were created as listed in Section 3. Fault current calculations were made and the worst case values for each location were compared to the interrupting and/or withstand ratings of the devices studied. Complete short circuit analysis input and output reports as well as device evaluation tables are contained in the Appendices.

4.2 Under Rated Device Recommendations

Devices were found to be under-rated as summarized in the Tables below, and as indicated as “Fail” on the attached device evaluation tables in the Appendix. Consequently, these devices must be replaced with suitably rated devices.

- Some control panel equipment had short circuit ratings on their nameplates and were applied at locations where the available short circuit currents exceed those ratings.
 - Plate Dewater Press
 - S101 Panel
 - Panel 1090

This equipment should be replaced or revised, and relabeled.

- MCC4 has equipment with no nameplates that are in poor condition and have been estimated to have 5KA interrupting ratings. This equipment should be replaced.
- Safety switches (which are labeled under UL98) that are not applied with fuses have an interrupting rating of 10KA. The high X/R ratio of the 300KVA transformer is primarily responsible for the difference between the calculated 3 phase fault values and the values used to perform the device evaluations. The following switches are applied at locations where the available short circuit currents exceed 10KA,
 - Office Label Manual Transfer Switch,
 - Sludge BLDG AHU-2 Disconnect Switch,
 - Sludge BLDG RM Exhaust Fan Disconnect Switch.These switches could fail catastrophically if closed into a fault or when opened during a fault. They should be replaced or upgraded with fuses as soon as possible.

4.3 Protective Device Coordination Findings

The coordination curves sets provided in Appendix 7 illustrate the coordination between devices under normal conditions with all devices operating as per the manufacturers specifications and published time current characteristic curves. Only equipment that has been adequately maintained and tested according to manufacturer's and industry standards is likely to operate in this manner.

4.3.1 Confirmation or Implementation of Settings Required

Curve sets for existing conditions are based on “As found” equipment settings at the time the data was collected. Settings have been known to be changed without warning, and where “Recommended” settings

are not implemented, the “As found” settings listed in Appendix 6 should be compared to actual equipment settings.

Where “Recommended” device settings are provided, they were chosen to maximize system reliability while minimizing conditions of jeopardized system selectivity. Settings of all equipment should be set to the values recommended in Appendix 6.

Existing equipment where no changes to settings are recommended should still have the settings confirmed to make sure they are still at the settings listed in Appendix 6.

WARNING! Since the arc flash incident energy calculations are based on the settings presented in Appendix 6, all settings must be successfully implemented or confirmed prior to affixing of the arc flash hazard labels.

4.3.2 Adequate Protection Possible with Settings Changes

The “As found” device settings do not provide adequate coordination, do not provide proper overcurrent protection as required by the relevant standards, or have arc flash exposure at levels higher than can be achieved without sacrificing adequate coordination.

Setting changes are recommended in order to provide adequate system protection and coordination. Locations where changes have been recommended include:

Table 2: Locations with recommended Settings Changes

Location	# of Devices with Changes Recommended
Switchgear 2960	16 of the circuit breakers have settings changes recommended mainly to limit downstream incident energy levels to workable levels.
MCC 2971	2 Circuit breakers have settings changes recommended mainly to improve coordination
MCC 2972	1 Circuit breaker
MCC 2981	2 Circuit breakers
MCC 2982	1 Circuit breaker

4.3.3 Coordination Issues: Unavoidable Non-Selectivity

There are a few cases of unavoidable non-selectivity between levels of protective devices as indicated by the overlapping of characteristic

curves. These cases are inevitable due to the particular characteristics of each device. The “Recommended” settings were chosen to maximize system reliability while minimizing conditions of jeopardized system selectivity.

4.3.4 Improperly Protected Medium Voltage Transformers

The following transformers have no primary protection or have inadequate protection, based on available information. It is recommended that protection be installed in accordance with table 450.3 of the NEC.

Improperly Protected Transformers

Device ID	Description	Rated Current (A)	Required Protection (A)	Present Protection (A)
100KVA	100KVA Transformer	8A	20A	100A

4.3.5 VFD Protected by MCP Only

Motor loads P1001, P1002, P7241, and P7242 all appear to have been retrofitted with VFD units by connecting those VFDs to the MCP directly; thus bypassing the overload units. These circuits require both overcurrent and short circuit protection. Other VFD applications use circuit breakers.

4.4 Arc Flash Evaluation

Incident energy calculations were based on the system configurations as described in Section 3. One set of calculations was prepared for each configuration. An arc flash hazard summary/data table is included in the Appendix which provides full details of the analysis and the results. At each location, the worst case incident energy values were used to generate the warning labels. A sample of those labels and an explanations of the information contained in the labels are provided in Appendix 8.

IMPORTANT NOTE: The Arc flash hazard analysis methods and calculations used within this study are based on the protective devices operating as designed and being applied, maintained and tested as per the manufacturer's specifications and accepted industry standards. Periodic maintenance and testing of the electrical equipment is highly recommended as endorsed by the NFPA-70B Standard, Recommended Standard for Electrical Equipment Maintenance, to confirm the safe and acceptable operation of the power system equipment and protective devices.

4.4.1 Incident Energy Results

The arc flash hazard calculations within this study are based on the “Recommended” settings. These recommended settings were typically chosen to provide optimum protective device selectivity while minimizing the resulting arc flash incident energy at each location where possible. An arc flash hazard summary/data table is included in the Appendix 8 which provides full details of the analysis and the results.

While most of the locations studied were found to have incident energy levels that are within Category 0-4 protection, some areas were identified as being too dangerous to perform energized work in. [Category Dangerous]

As per NFPA 70E, protective clothing is not sufficient to protect workers where incident energy levels exceed $40\text{Cal}/\text{cm}^2$ due to the concussive forces that present in addition to the arc energy present. Energized work must not be performed near these areas, listed in the table below

Dangerous Locations with Recommended Settings

Location	Mitigation Possible
Generator 2995	Do not work on Generator when it is energized.
Switchgear 2960 both A and B sides	Add a disconnect between the switchgear and the transformers that can detect and clear low level faults.

No work should be done on or around any energized equipment without the use of a proper level of PPE and adequate training. Note that there are many more locations that are predicted to have incident energy levels over $40\text{Cal}/\text{sq cm}$ when only the existing settings are considered.

4.4.2 Incident Energy Results

The arc flash hazard calculations within this study include both the “As found” Settings results and the “Recommended” settings results. An arc flash hazard summary/data table is included in the Appendix 9 which provides full details of the analysis and the results.

At the time of this report, NO LABELS HAVE BEEN PRINTED. The report and label names must be approved before the labels can be printed. Prior to installing the labels the recommended settings must be implemented and the existing settings should be confirmed.

4.5 Arc Flash Mitigation

- The Generator 2995 location is location where administrative controls must be used. There is no way to work on that generator while it is operating. The only way to work on the generator is when it is de-energized.
- Switchgear 2960 both A and B sides are the first locations downstream from the main transformers. The fuses applied at the primary terminals of the transformers are not able to detect worst case arcing faults quickly enough to limit the incident energy levels below 40Cal/sq cm. Adding disconnects between the transformers and the switchgear would move that problem to the new disconnects if the disconnects were properly selected. Alternately, the 12470V switches could be replaced with vacuum contactors or circuit breaker that could be controlled with relays. Those relays could be programmed to detect arcing faults and limit the available fault levels to workable levels. Unfortunately, the location of the switches would make this kind of replacement expensive due to the need to wire to and from sensors in the switchgear or the transformers.

-

4.6 **Arc Flash Labeling and Under-Rated Devices.**

Protective devices that have been identified as under-rated, that is, equipment where the maximum available fault current exceeds the equipment rating, will be marked with special warning labels. Equipment immediately downstream of such devices will also be marked with these special warning labels. Such labels will include the following statements:

ENERGIZED WORK PROHIBITED

IMMEDIATE CORRECTIVE ACTION IS NEEDED

THE OVERCURRENT PROTECTIVE DEVICE AT THIS LOCATION OR THE DEVICE PROTECTING THIS LOCATION IS NOT RATED TO WITHSTAND THE MAXIMUM AVAILABLE FAULT CURRENT. CONSEQUENTLY, THE PROTECTIVE DEVICE MAY FAIL CATASTROPHICALLY AND THE ARC FLASH INCIDENT ENERGY THAT COULD BE RELEASED AT THIS LOCATION IS UNKNOWN.

It is recommended that all instances of under rated devices be corrected.

If further assistance and engineering services are desired in this area, please contact your ERS sales representative or the author of this report, for a quotation for these services.

APPENDIX 1:GLOSSARY OF TERMS

GLOSSARY OF TERMS

SHORT CIRCUIT STUDIES

Series Rating: A tested combination of protective devices that allow the use of protective devices in locations that exceed the nameplate rating by operation of a main or upstream protecting devices. Operation of the series rated combination allows the devices to share the interrupting energies.

COORDINATION STUDIES

Time-Current Curve (TCC): A graphical representation of the operating characteristics of an over current protective device. Typically shown on a log-log chart, this information details the operating time of the breaker over a range of currents.

Time-Current Curve Set: A group of TCC's arranged to show the operating characteristics of a portion of an electrical system.

Selectivity (also referred to as Coordination): Refers to the capacity or lack of capacity of a system to isolate a fault to the smallest portion of a system possible.

ARC FLASH EVALUATIONS

PPE (Personal Protective Equipment): Clothing or tools used to protect personnel from potentially hazardous conditions while working.

ATPV (Arc Thermal Performance exposure Value): A rating (in Cal/cm^2) given to PPE in terms of its ability to protect against the thermal energy resulting from an arcing fault. The incident energy from an arcing fault can be compared with the ATPV values to determine what amount (or number of layers) of PPE is required for safe energized work.

Natural Fiber Clothing: Long sleeve shirts and pants made of cotton or wool. This clothing is not flame-resistant (NON FR), but will char instead of melting like synthetic fibers.

Flame Resistant (FR) Clothing: Aramid (i.e. Dupont Nomex) or treated natural fiber (Indura or Proban) clothing of various types and weights that are resistant to ignition when exposed to flames.

Flash Suit: A three-piece multiple layer FR outfit that includes pants (with bib), jacket, and face shield with hood to offer protection in areas where arc flash levels are high (medium voltage equipment and large low voltage switchgear). Also referred to as a Blast Suit or Switching Suit.

Incident Energy: The thermal energy measured in calories per square centimeter (Cal/cm^2) seen by a person or object as a result of exposure to an electric arc.

Flash Boundary: The distance from a location to where the incident energy from an arc is below 1.2 Cal/cm^2 . This is considered the minimum distance to unqualified personnel.

Flash Hazard Analysis: A method to determine the risk of personal injury as a result of exposure to incident energy from an electrical arc flash.

Shock Hazard: A dangerous condition associated with the possible release of energy caused by contact or approach to live parts.

Working Distance: The dimension between the possible arc point and the head and body of the worker positioned in place to perform the assigned task.

Energized: Electrically connected to or having a source of voltage.

Exposed (live parts): Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts that are not suitably guarded, isolated, or insulated.

Electrical Hazard: A dangerous condition in which inadvertent or unintentional contact or equipment failure can result in shock, arc-flash burn, thermal burn, or blast.

Electrical Shock: Physical stimulation that occurs when electrical current passes through the body.

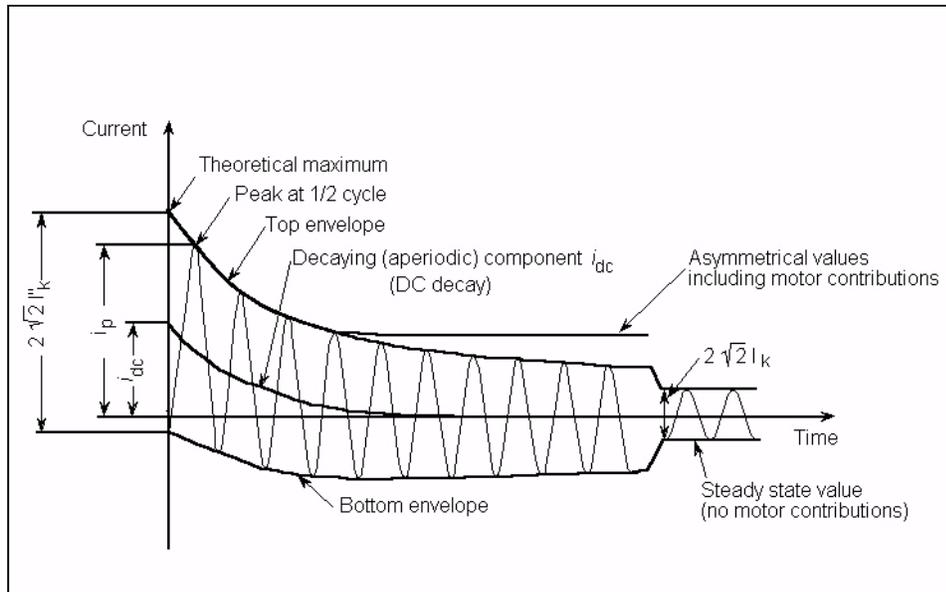
APPENDIX 2:ENGINEERING BIBLIOGRAPHY

ENGINEERING BIBLIOGRAPHY & REFERENCE MATERIALS

IEEE 1584-2002/1584a-2004, IEEE Guide for Performing Arc Flash Hazard Calculations.
NFPA 70-2008, National Electrical Code.
ANSI/NFPA 70E-2009, Standard For Electrical Safety In The Workplace.
ANSI/IEEE Std 141-1993, IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants (IEEE Red Book).
ANSI/IEEE Std 142-2007, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book).
IEEE STD 242-2001, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book).
IEEE STD C37.010-1999, IEEE Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
IEEE STD C37.20.7-2007, IEEE Guide for Testing Medium-Voltage Metal-Enclosed Switchgear for Internal Arcing Faults.
ANSI/IEEE Std 399-1997, IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (IEEE Brown Book).
Beeman, D.L., INDUSTRIAL POWER SYSTEMS HANDBOOK, McGraw-Hill, 1955.
Bussmann, Cooper Industries, SELECTING PROTECTIVE DEVICES, ELECTRICAL PROTECTION HANDBOOK, Bussmann, Cooper Industries, 1990.
SKM Systems Analysis, Inc., POWER TOOLS FOR WINDOWS, CAPTOR/DAPPER/A FAULT DISTRIBUTION ANALYSIS FOR POWER PLANNING EVALUATION AND REPORTING, SKM Systems Analysis, 1998 and 2003.

A2.1. Short Circuit Analysis

The PowerTools for Windows A_FAULT program used for the study complies with the ANSI/IEEE C37.13 standard for calculation of fault currents. The primary concern is with the initial fault current that is asymmetrical and has a DC component (See the figure below). This initial fault current can last several cycles and typically impacts the short time and instantaneous trip times on circuit breakers.



The SKM program calculates crest current values and interrupting ratings required for the selection of power circuit breakers, insulated and molded case breakers, and fuses.

At each low voltage bus, the minimum interrupting rating required for both power circuit breakers and molded case breakers is reported. To evaluate the interrupting rating of low voltage breakers, the crest current is calculated. These values are based on the ANSI (NEMA) specified power factor for these breakers as shown below:

Protective Device	Test PF (%)	Test X/R	Tested Asymmetrical withstand Capability
LV Fuse	15	6.6	1.62
LV Power Circuit Breaker	15	6.6	1.62
Molded Case Circuit Breaker (AIC >20KA)	20	4.9	1.53
Molded Case Circuit Breaker (AIC 10-20KA)	30	3.2	1.38
Molded Case Circuit Breaker (AIC =10KA)	50	1.7	1.15

The asymmetrical duty can be calculated as follows.

$$I_{asymrms1/2cycle} = I_{rmssymm} \times \sqrt{1 + 2e^{\frac{-2\pi}{X/R}}}$$

This value should not exceed the equipment rating times the appropriate test factor for the device.

For devices where the calculated X/R ratio is greater than the test X/R ratio listed above, then there is a symmetrical multiplying factor that must be evaluated as well. The symmetrical duty is defined as:

$$I_{symmLVF} = I_{rmssymm} \times \frac{\sqrt{1 + 2e^{\frac{-2\pi}{X/R^{system}}}}}{\sqrt{1 + 2e^{\frac{-2\pi}{X/R^{test}}}}}$$

If the equipment rating exceeds both the asymmetrical and symmetrical duty, then it is considered adequate for the installed location.

Evaluation of medium voltage equipment falls into two classifications: momentary and interrupting ratings. The momentary rating is the asymmetrical current seen ½ cycle after the fault occurs. The interrupting rating reflects the fault duties at time when a protective device will operate to clear a fault (typically 2, 3, 5 or 8 cycles).

ANSI allows a simplified momentary rating calculation of 1.6 times the symmetrical fault duty. It can be more accurately calculated as follows.

$$I_{momentaryrms} = I_{symrms} \times \sqrt{1 + 2e^{\frac{-4\pi}{X/R^c}}}$$

where c is ½ cycle

The Device Evaluation Report in the Appendix summarizes the fault duties and compares the calculated fault duties (with appropriate ANSI multiplying factors) with the equipment ratings for each location within the system modeled. The full analysis output report contains the fault duties for three-phase, single-line to ground, line-to-line, and double-line to ground faults. Also included is the average three-phase asymmetrical and RMS current at one half cycle.

When evaluating the ability of the protective devices to interrupt the available fault duties two ratings can be used: self-protected or series ratings.

Self-protected ratings are the manufacturer's nameplate interrupting ratings for the devices and equipment. If the available fault duties exceed these

ratings they can fail during operation, resulting in injury to personnel and damage to equipment.

Series ratings are applied to tested combinations of devices. For fault levels that exceed the rating of a device, one or more devices upstream operate simultaneously thereby sharing the interrupting energies. Peak let-through of current-limiting devices is not accepted for use with molded case circuit breakers due to the dynamic impedance seen by the system during their operation. To conform with the National Electrical Code, Section 110-22, where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturer, equipment enclosure(s) must be legibly marked in the field to indicate the equipment has been applied with a series combination rating.

A2.2. **Protective Device Coordination**

Time-Current Curve (TCC) sets for the systems studied are contained in the Appendix. Each curve set contains a simplified single-line diagram that graphically describes the relationship between the devices studied. The recommended settings were chosen to provide the best compromise between complete selectivity and device protection.

The study was performed by plotting protective device time-current characteristics on a log-log graph as operating time versus current. These coordination curves illustrate graphically the quality of protection and coordination provided by the protective devices.

As stated in ANSI/IEEE Standard 242-2001 (p. 2), "Whether minimizing the risk of equipment damage or preserving service continuity is the more important objective depends upon the operating philosophy of the particular industrial plant or commercial business." The equipment applications within the Facility have been compared with acceptable practices and with industry standards, and no violations were noted. When the selectivity of a system is examined, many more factors must be considered. While suggestions can be made, the client/facility operator must make some of the final decisions based on the unique requirements of the loads being serviced by the distribution system.

The recommended settings are often the best compromise between coordination, protection, and service continuity. The client/facility operator should evaluate supporting information and assumptions included in this report since they were used to develop settings. Where necessary, new settings based on unique requirements should be requested.

Where many devices are in series, the time needed for good coordination of devices may allow an unacceptable amount of damage to occur. In other cases the time current characteristics of devices will not allow for good

coordination because existing devices are non-adjustable or are beyond the control of plant personnel.

Two protective devices are considered to be directly in series if there are no branches between them. First example: If a feeder breaker in one panel serves a single main breaker in a downstream panel, they are considered directly in series. If the downstream panel does not have a main breaker, then the feeder breaker in the supplying panel cannot be considered directly in series with the feeder breakers in the downstream panel (because there are multiple downstream breakers). Second example: If a feeder breaker in one panel serves a transformer and its secondary is connected to a main breaker that supplies downstream loads, this feeder breaker and main breaker are directly in series. The discussions that follow will not address the lack of selectivity due to protective devices directly in series.

Where series protective ratings are applied, there is an implied lack of selectivity since multiple devices must operate simultaneously for proper protection. The lack of selectivity of series rated devices is not discussed, except where these devices compromise another aspect of protection.

Ground fault coordination differs from phase fault protection in that pick-ups are typically set below the load level and the number of ground fault devices in a system is typically small (main breakers and large feeders only).

A curve set consists of the time current characteristic curves (TCC's) of devices plotted on a log-log graph in current vs. time. The first step in the analysis is to determine the voltage, current scale, drawing name, and description. These are indicated in the title block area of the curve set.

Starting with the device nearest the source, the TCC's are plotted with the objective of maintaining an adequate coordination interval between devices in series. The TCC's of the devices are terminated at the maximum fault magnitude available at the device's location. The more devices applied in series the less likely that adequate intervals can be maintained. All of the steps above are performed with the use of the SKM Systems Analysis Inc. CAPTOR program. Each curve set is accompanied by a curve set report and a small single line representing all devices included in the curve set.

A2.3. **Arc Flash Evaluation**

Arc flash evaluations are used in conjunction with the client's/facility operator's safety policy to determine the required personal protective equipment (PPE) when working on energized equipment. Many electrical injuries (as much as 80%) are burns that are the result from exposure to the energies liberated during an arcing fault. The burns are typically second and third degree in nature and are frequently fatal.

NFPA 70-2008 (NEC) requires equipment to be field marked to indicate where a flash hazard exists:

NEC 110-16 - Flash Protection

Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers, that are in other than dwelling occupancies, and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

NFPA 70E-2012, Standard for Electrical Safety In the Workplace, states that

“When an employee is working within the arc flash boundary, he or she shall wear protective clothing and other personal protective equipment in accordance with 130.5. All parts of the body inside the arc flash boundary shall be protected.”

In addition, OSHA standard 1910.269 prohibits synthetic materials (acetate, nylon, polyester, rayon or blends) unless the fabric has been treated to withstand the conditions that may be encountered.

OSHA regulations represent the other major source of standards that apply to arc flash hazards. The primary regulations are in 29CFR 1910 Subparts I, and S. These can be broken down into three general areas, hazard identification and PPE selection, training, and proficiency.

1910.132(d) Hazard assessment and equipment selection

The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall: Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment; Communicate selection decisions to each affected employee; and, Select PPE that properly fits each affected employee.

The employer shall verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and, which identifies the document as a certification of hazard assessment.

1910.335(a)(1)(i) Personal Protective Equipment

Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.

1910.132(f) Training

The employer shall provide training to each employee who is required by this section to use PPE. Each such employee shall be trained to know at least the following: When PPE is necessary; What PPE is necessary; How to properly don, doff, adjust, and wear PPE; The limitations of the PPE; and, The proper care, maintenance, useful life and disposal of the PPE.

Each affected employee shall demonstrate an understanding of the training specified in paragraph (f)(1) of this section, and the ability to use PPE properly, before being allowed to perform work requiring the use of PPE.

1910.132(f)(3) Proficiency & Retraining

When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required by paragraph (f)(2) of this section, the employer shall retrain each such employee. Circumstances where retraining is required include, but are not limited to, situations where: Changes in the workplace render previous training obsolete; or Changes in the types of PPE to be used render previous training obsolete; or Inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill.

The employer shall verify that each affected employee has received and understood the required training through a written certification that contains the name of each employee trained, the date(s) of training, and that identifies the subject of the certification.

The calculations used in this study comply with NFPA 70E requirements in that the incident energy levels are calculated and the corresponding category of PPE that would be needed is identified. A table summarizing the results for all locations evaluated is included in the Appendix.

The results of the arc-flash calculations are based on the values of fault current magnitudes calculated in the short-circuit analysis and the associated clearing times of the over current protective devices as determined by the coordination study.

A2.4. Basis for Arc Flash Evaluation

Results from the short circuit and coordination study yield the fault duties and clearing times at locations where arc flash evaluations are to be performed. Per IEEE Std 1584-2002, a maximum arc time of two seconds is utilized to limit incident energy values. The two second value is intended to simulate the likely egress time of a worker exposed to an electrical arc.

IEEE Std 1584-2002 IEEE Guide for Performing Arc-Flash Hazard Calculations contains calculation methods developed through testing by several sources to determine boundary distances for unprotected personnel and the incident energy at the working distance for qualified personnel working on energized equipment. The incident energy level can be used to determine the proper PPE required for personnel.

The equations developed in the IEEE standard assess the arc flash hazard based on the available (bolted) fault current, voltage, clearing time, equipment type, grounding, and working distance. The working voltage is also used to determine other variables.

The SKM PowerTools for Windows software uses these techniques to determine the required PPE for energized work (typically 18 inch working

distance for low voltage locations), the flash boundary and the incident energy at various distances from the location. Typical ATPV values for protective equipment is used if site-specific manufacturer's data is not available.

In locations where no safe level of PPE exists, either energized work should be prohibited or extension tools (i.e. hot stick, remote controls) should be used to distance personnel from the potential arc point. The incident energy at the working distance dictates the required PPE.

A2.5. Protective Equipment Description

Depending upon the incident energy levels present at a location, different levels of PPE are required for safe work. The recommended PPE for each location presented in Appendix 8. Appendix 8 also contains a page that explains the arc flash labels and a page that presents samples of those labels.

The following information is based on hazard risk categories and PPE descriptions included in the NFPA 70E standard. Where site specific PPE descriptions and ATPV information is not available, the data in this table is used for the evaluation.

TABLE 3.3.2 ARC FLASH HAZARD RISK/PPE CATEGORIES

HAZARD RISK CATEGORY	INCIDENT ENERGY (Cal/cm ²)	PPE DESCRIPTION
0	0-1.2	Long Sleeve Shirt & Pants, Safety Glasses, Hearing Protection, Leather Gloves
1	1.2-4	FR Shirt & Pants (AR 4), Hardhat & Safety Glasses, Faceshield (AR 4), Hearing Protection, Leather Gloves & Work Shoes
2	4-8	FR Shirt & Pants (AR 8), Hardhat, Safety Glasses, Faceshield (AR 8), Flash Suit Hood, Hearing Protection, Leather Gloves & Work Shoes
3	8-25	FR Shirt & Pants with FR Coverall all with combined AR of at least 25, Hardhat, Safety Glasses, Flash Suit Hood, Hearing Protection, Arc-Rated Gloves & Leather Work Shoes
4	25-40	FR Shirt & Pants Plus Flash Suit and Hood all with combined AR of at least 40, Hardhat, Safety Glasses, Hearing Protection, Arc-Rated Gloves & Leather Work Shoes
DANGER!	>40	ENERGIZED WORK PROHIBITED! (No safe PPE is available for all hazards at this level)

- Arc Flash Hazard Labels

Based on the PPE descriptions detailed above, all resulting arc flash hazard labels will be similar to that as shown in the figure below.

	 DANGER
	QUALIFIED WORKERS ONLY PPE REQUIRED
Flash Hazard Boundary – (Threshold at which burn level exceeds 1.2 cal/cm ²)	17 inch Flash Hazard Boundary
Calculated Incident Energy (at indicated working distance)	1.1 cal/cm ² Flash Hazard at 18 inches
Hazard Risk Category & PPE Description (See Table 3.3.2)	Category 0 Long Sleeve Shirt & Pants, Safety Glasses, Hearing Protection, Leather Gloves
Equipment Rated Voltage	480 VAC Shock hazard when cover is removed
Required Electrical Glove Class	00 Class Glove with Leather Protectors
Shock Hazard Boundaries (based on equipment voltage rating)	42 inch Limited Approach (Fixed Circuit)
	12 inch Restricted Approach
	1 inch Prohibited Approach
Panel or Device name	Location: PNL 0
	 Electrical Reliability Services, Inc. 10606 Bloomfield Avenue Santa Fe Springs, CA 90670 (562) 236-9555
	Job #: SAMPLE 1 Prepared on: 08/03/07 By: ERS Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements

APPENDIX 3: SHORT CIRCUIT FAULT ANALYSIS INPUT REPORT

Boomer, Paul [NETPWR/ERS/DENV]

From: Todd Prentiss [todd@pswelectric.com]
Sent: Wednesday, September 19, 2012 8:32 AM
To: scott@pswelectric.com
Subject: FW: Fault study Water Treatment Plant at 12351 Brownsville Highway NE, Poulsbo WA 98370

Importance: High

Scott,
Here is the Email chain for the Utility Information at CKWWTP.

Todd

From: Twietmeyer, Rob [<mailto:rob.twietmeyer@pse.com>]
Sent: Friday, February 03, 2012 3:43 PM
To: Todd Prentiss
Subject: RE: Fault study Water Treatment Plant at 12351 Brownsville Highway NE, Poulsbo WA 98370
Importance: High

Todd, I'm not sure if this was sent directly to you. If you have any further questions please contact Ruly.

From: Robinson, Dale H - Transmission
Sent: Friday, February 03, 2012 13:34
To: Twietmeyer, Rob; Parikesit, Ruly
Subject: FW: Fault study requested for primary metered customer

Thank you Ruly.

Rob, you'll find the requested information below...

Dale Robinson

*PSE, Puget Sound Energy
System Planning
Kitsap, Jefferson, & Vashon Island
Office 360.475.7025
Cell 206.604.5993*

From: Parikesit, Ruly
Sent: Friday, February 03, 2012 1:29 PM
To: Robinson, Dale H - Transmission

Cc: Savage, Mark

Subject: RE: Fault study requested for primary metered customer

Dale

Below are the 12.47 kV fault duties at the Water Treatment Plant at 12351 Brownsville Highway NE, Poulsbo WA 98370 on South Keyport SKE-23 circuit. Please be aware that the information below were studied under our present conditions for service. Our system configuration can change at any time and without notice. Therefore it would be my recommendation to review the information for continued accuracy.

Available Short Circuit Currents:

Max 3-Phase Fault = 2560.0A (X/R ratio = 1.39178)

Max 1-Phase Fault = 1820.9A (X0/R0 ratio = 2.32860)

Thevenin Impedance:

Zth(positive sequence) = (1.77261+j2.46707) ohm

Zth(negative sequence) = (1.77266+j 2.4672) ohm

Zth(zero sequence) = (2.68817+j6.25968) ohm

Bases (these are actually optional since actual, not per unit, fault currents were used):

MVA base = 100MVA

kV base = 13.09kV

Please let me know if you need anything else.

Ruly Parikesit, P.E.

System Protection

PUGET SOUND ENERGY

Office: (425) 456-2490 (X 81-2490)

Cell: (425) 766-5980

E-mail: ruly.parikesit@pse.com

355-110th Ave. NE

Bellevue WA 98009-0868

www.PSE.com

From: Todd Prentiss [<mailto:todd@pswelectric.com>]

Sent: Tuesday, January 24, 2012 07:16

To: Twietmeyer, Rob

Subject: FW:



Electrical Reliability Services, Inc.

Client: PSW Electric

Project: Central Kitsap WWTP

Job#: 3130462

**Appendix 3 - Sources
Short Circuit Fault Analysis
Input Report**

Utility Sources

Contribution	Contribution	To	Bus	Contrib.	3 PH	3PH	SLG	SLG	Per Unit Impedance Values (100MVA Base)				Notes
Name	Point	Bus	Volts	Units	Contrib.	X/R	Contrib.	X/R	Rpos	Xpos	Rzero	Xzero	
UTIL SC	UTIL INTERFACE	UTIL INTERFACE	13090	CU_AMPS	2560.0	1.391	1820.0	2.328	1.1082	1.5415	0.9455	4.2778	

Synchronous Generator Sources

Generator	Connect	Rated	Rated	Rated	Rated	X"d	X'd	Xd	Per Unit Impedance Values (100MVA Base)				Notes
Name	Point	KW	KVA	Volts	PF	(pu)	(pu)	(PU)	Rpos	Xpos	Rzero	Xzero	
GEN 2994	GENERATOR 2994	500.0	625.0	480	0.800	0.1500	0.2900	2.7500	1.2000	24.0000	1.2000	24.0000	
GEN 2995	GENERATOR 2995	900.0	1125.0	480	0.800	0.1280	0.2900	2.7500	0.5689	11.3778	0.4889	9.7778	



Electrical Reliability Services, Inc.

Client: PSW Electric

Project: Central Kitsap WWTP

Job#: 3130462

**Appendix 3 - Cable
Short Circuit Fault Analysis
Input Report**

Cable	From Location	To Location	# Per Phase	Cable Size	CU/AL	Duct Material	Cable Ampacity	Length Feet	Per Unit Impedance Valuse (100MVA Base)				Notes
									Rpos	Xpos	Rzero	Xzero	
BWY 2950 A	SWGR 2950 LINE	TFR 2951 PRI	2	2	Copper	Non-Magnetic	352.0	60.0	0.0039	0.0009	0.0062	0.0023	
BWY 2950 B	SWGR 2950 LINE	TFR 2952 PRI	2	4/0	Copper	Non-Magnetic	737.0	100.0	0.0020	0.0013	0.0032	0.0033	
BWY 2960 A	TFR 2951 SEC	2960 MAIN A	4	500	Copper	Magnetic	1520.0	146.0	0.4658	0.7382	1.4670	1.8171	
BWY 2960 B	TFR 2952 SEC	2960 MAIN B	7	750	Copper	Magnetic	3325.0	45.0	0.0603	0.1242	0.1897	0.3055	
BWY SWBD 2960 TIE	2960 MAIN B	2960 MAIN A	1	3000	Copper	Busway	3000.0	1.0	0.0020	0.0011	0.0118	0.0060	
CB CV6193	MCC-2	DIG WITH VLV 1	1	12	Copper	Magnetic	20.0	87.0	70.6120	2.6281	222.5373	6.4721	
CBL 2975 416	B1276 VFD	RATED GRIT TANK BLOW	1	6	Copper	Magnetic	65.0	40.0	8.8542	1.1892	27.9028	2.9288	
CBL 2976 MAIN	2960 MAIN B	MCC-2976	2	500	Copper	Non-Magnetic	874.2	685.0	4.1029	5.5448	6.5111	14.8506	
CBL A1	2960 MAIN A	AERATION BLOWER 3	2	4/0	Copper	Magnetic	460.0	40.0	0.5556	0.4314	1.7509	1.0625	
CBL A3	2960 MAIN A	MCC-2975	2	500	Copper	Non-Magnetic	874.2	685.0	4.1029	5.5448	6.5111	14.8506	
CBL A4	2960 MAIN A	MCC-2973	3	500	Copper	Non-Magnetic	1140.0	40.0	0.1597	0.2159	0.2535	0.5781	
CBL A4-B4 TIE	MCC-2973	MCC-2974	1	600	Copper	Busway	600.0	0.1	0.0009	0.0010	0.0231	0.0250	
CBL A5	2960 MAIN A	MCC-2981	3	350	Copper	Magnetic	930.0	360.0	1.9688	2.5573	6.2031	6.2969	
CBL A6	2960 MAIN A	MCC-2	2	4/0	Copper	Magnetic	460.0	380.0	5.2778	4.0985	16.6332	10.0938	
CBL A7	2960 MAIN A	SWBD 1	3	350	Copper	Non-Magnetic	930.0	70.0	0.3727	0.3980	0.5924	1.0117	
CBL A9	2960 MAIN A	MCC-2983	3	350	Copper	Magnetic	930.0	360.0	1.9688	2.5573	6.2031	6.2969	
CBL ACU7212	MCC 2983	JUDGE BLDG ELEC RM AC	1	12	Copper	Non-Magnetic	20.0	96.0	77.9167	3.7167	123.8708	9.4542	
CBL ACU7213	MCC 2983	CENT CONR AREA ACU	1	4	Copper	Non-Magnetic	85.0	85.0	11.8424	1.8668	18.2986	4.7480	
CBL AHU1281	MCC-2975	AHU1281 DISC	1	12	Copper	Magnetic	20.0	40.0	32.4653	1.5799	102.3160	3.8906	
CBL AHU1285	MCC-2975	AHU1285 DISC	1	10	Copper	Magnetic	30.0	40.0	20.4861	1.4826	64.5625	3.6510	
CBL AHU2901	MCC-2974	L BLDG ELEC RM AHU-290	1	12	Copper	Magnetic	20.0	45.0	36.5234	1.7773	115.1055	4.3770	
CBL AHU2910	MCC-2973	BLWR ROOM AHU2910	1	12	Copper	Magnetic	20.0	72.0	58.4375	2.8438	184.1688	7.0031	
CBL AHU7202	MCC-2983	SLUDGE BLDG AHU-2	1	10	Copper	Non-Magnetic	30.0	0.1	0.0512	0.0036	0.0814	0.0091	
CBL AHU7211	MCC 2983	SLUDGE BLDG AHU-1	1	12	Copper	Non-Magnetic	20.0	140.0	113.6285	5.4201	180.6450	13.7873	
CBL B1	2960 MAIN B	AERATION BLOWER 1	2	4/0	Copper	Magnetic	460.0	40.0	0.5556	0.4314	1.7509	1.0625	
CBL B1061	B1061 VFD	EADWORKS FOUL AIR BLW	1	2	Copper	Magnetic	115.0	140.0	12.2743	3.5547	38.6823	8.7500	
CBL B1062	MCC-2976	B1061 VFD	1	2	Copper	Magnetic	115.0	1.0	0.0877	0.0254	0.2763	0.0625	
CBL B1276 VFD	MCC-2975	B1276 VFD	1	6	Copper	Magnetic	65.0	1.0	0.2214	0.0297	0.6976	0.0732	
CBL B1277	B1277 VFD	STANDBY AIR BLOWER	1	2	Copper	Magnetic	115.0	40.0	3.5069	1.0156	11.0521	2.5000	
CBL B1277 VFD	MCC-2976	B1277 VFD	1	2	Copper	Magnetic	115.0	40.0	3.5069	1.0156	11.0521	2.5000	
CBL B1278	B1278 VFD	AGITATION AIR BLOWER	1	2	Copper	Magnetic	115.0	40.0	3.5069	1.0156	11.0521	2.5000	
CBL B1278 VFD	MCC-2975	B1278 VFD	1	2	Copper	Magnetic	115.0	1.0	0.0877	0.0254	0.2763	0.0625	
CBL B2	2960 MAIN B	MCC-2972	3	500	Copper	Magnetic	1140.0	40.0	0.1701	0.2697	0.5359	0.6638	
CBL B2541	MCC 2971	CHANNEL AIR BLOWER 1	1	10	Copper	Magnetic	30.0	75.0	38.4115	2.1289	121.0547	5.2409	
CBL B2542	MCC-2972	CHAN 2 AIR BLWR	1	10	Copper	Magnetic	30.0	75.0	38.4115	2.7799	121.0547	6.8457	



Electrical Reliability Services, Inc.

Client: PSW Electric

Project: Central Kitsap WWTP

Job#: 3130462

**Appendix 3 - Cable
Short Circuit Fault Analysis
Input Report**

Cable	From Location	To Location	# Per Phase	Cable Size	CU/AL	Duct Material	Cable Ampacity	Length Feet	Per Unit Impedance Valuse (100MVA Base)				Notes
									Rpos	Xpos	Rzero	Xzero	
CBL B3	2960 MAIN B	AERATION BLOWER 2	2	4/0	Copper	Magnetic	460.0	40.0	0.5556	0.4314	1.7509	1.0625	
CBL B4	2960 MAIN B	MCC-2974	3	500	Copper	Magnetic	1140.0	50.0	0.2127	0.3371	0.6698	0.8297	
CBL B7191	B7192 VFD	DEWATER FOUL AIR BLWR	1	8	Copper	Non-Magnetic	50.0	85.0	29.9197	2.2246	47.5653	5.6593	
CBL B7192	MCC 2983	B7192 VFD	1	8	Copper	Non-Magnetic	50.0	2.0	0.7040	0.0523	1.1192	0.1332	
CBL B9	2960 MAIN B	MCC-2982	3	350	Copper	Magnetic	930.0	360.0	1.9688	2.5573	6.2031	6.2969	
CBL BIO FILT	MCC-2	BIO FILTER BLOWER	1	8	Copper	Magnetic	50.0	235.0	82.7192	5.8852	260.6929	14.4835	
CBL CENT 1	MEE7110 VFD PNL	CENT 1 MOTOR	2	250	Copper	Magnetic	510.0	98.0	1.1740	1.0527	3.6984	2.5925	
CBL COL2510	MCC-2971	SECONDARY CLAR COLL 1	1	10	Copper	Magnetic	30.0	470.0	240.7118	17.4210	758.6094	42.8997	
CBL COL2520	MCC-2972	SEC CLAR COLL 2	1	12	Copper	Magnetic	20.0	385.0	312.4783	15.2062	984.7913	37.4473	
CBL CON7115	MCC-2981	CENT 1 CAKE CONV	1	12	Copper	Magnetic	20.0	85.0	68.9887	3.3572	217.4215	8.2676	
CBL CV2001	MCC-2972	AER BLWR 1 VLVS	1	12	Copper	Magnetic	20.0	55.0	44.6398	2.1723	140.6845	5.3496	
CBL CV2002	MCC 2972	002AER BLW 2 IN SURGE V	1	12	Copper	Magnetic	20.0	65.0	52.7561	2.5673	166.2635	6.3223	
CBL CV2003	MCC-2971	AER BLWR 3 VLVS	1	12	Copper	Magnetic	20.0	65.0	52.7561	2.5673	166.2635	6.3223	
CBL CV21XX	MCC-2972	21XX AER TNK CNTR VLV	1	12	Copper	Magnetic	20.0	0.1	0.0812	0.0039	0.2558	0.0097	
CBL CV6194	MCC-2	DIG WITH VLV 2	1	2	Copper	Magnetic	115.0	85.0	7.4523	1.6528	23.4857	4.0692	
CBL CV7110	MCC-2981	CENT 1 SLUDGE INLET VLV	1	12	Copper	Magnetic	20.0	46.0	37.3351	1.8168	117.6634	4.4742	
CBL CV7111	MCC-2981	ENT 1 SLDG GRIND BYP VLV	1	12	Copper	Magnetic	20.0	46.0	37.3351	1.8168	117.6634	4.4742	
CBL CV7114	MCC-2981	CENT 1 FLUSH VLV	1	12	Copper	Magnetic	20.0	76.0	61.6840	3.0017	194.4004	7.3922	
CBL CV7116	MCC-2981	CENT 1 CONV DR VLV	1	12	Copper	Magnetic	20.0	83.0	67.3655	3.2782	212.3057	8.0730	
CBL CV7231	MCC-2981	DW POL AGE TANK	1	12	Copper	Magnetic	20.0	75.0	60.8724	2.9622	191.8425	7.2949	
CBL CV7232A&B	MCC-2982	DW POLY AGE TANK VLVS	1	12	Copper	Non-Magnetic	20.0	62.0	50.3212	2.4003	79.9999	6.1058	
CBL CVS5011	MCC-2976	CVS5011	1	10	Copper	Magnetic	30.0	284.0	145.4514	10.5267	458.3938	25.9224	
CBL DECANT	MCC-2971	DECANT FACILITY	1	2	Copper	Magnetic	115.0	730.0	64.0017	14.1944	201.7005	34.9475	
CBL DIG WITH P1	MCC-2	DIG WITH PMP 1	1	2	Copper	Magnetic	115.0	85.0	7.4523	1.6528	23.4857	4.0692	
CBL DIG WITH P2	MCC-2	DIG WITH PMP 2	1	2	Copper	Magnetic	115.0	85.0	7.4523	1.6528	23.4857	4.0692	
CBL E CLAR	MCC-2	EAST CLARIFIER THKNR	1	12	Copper	Magnetic	20.0	165.0	133.9193	4.9844	422.0534	12.2747	
CBL F1301	MCC-2976	PRIMARY GALLERY SUP FA	1	12	Copper	Magnetic	20.0	320.0	259.7222	12.6389	818.5278	31.1250	
CBL F1302	MCC-2976	PRIMARY GALLERY EXH FA	1	12	Copper	Magnetic	20.0	282.0	228.8802	11.1380	721.3276	27.4289	
CBL F2015	MCC 2972	F2015 UNIDOR VENT	1	10	Copper	Magnetic	30.0	190.0	97.3090	7.0425	306.6719	17.3424	
CBL F2908	MCC-2973	ELEC RM RET FAN	1	12	Copper	Magnetic	20.0	45.0	36.5234	1.7773	115.1055	4.3770	
CBL F2911	MCC-2974	BLWR RM EXH FN 1	1	12	Copper	Magnetic	20.0	80.0	64.9306	3.1597	204.6320	7.7813	
CBL F2912	MCC-2974	BLWR RM EXH FN 2	1	12	Copper	Magnetic	20.0	70.0	56.8142	2.7648	179.0530	6.8086	
CBL F7205	MCC-2983	UDGE BLD LAB AREA EXH FA	1	12	Copper	Non-Magnetic	20.0	65.0	52.7561	2.5165	83.8709	6.4013	
CBL F7207	MCC-2983	SLUDGE CHEM RM SUP FA	1	12	Copper	Non-Magnetic	20.0	55.0	44.6398	2.1293	70.9677	5.4165	
CBL F7208	MCC-2983	SLUDGE BLGD RM EXH FA	1	12	Copper	Non-Magnetic	20.0	0.1	0.0812	0.0039	0.1290	0.0098	



Electrical Reliability Services, Inc.

Client: PSW Electric

Project: Central Kitsap WWTP

Job#: 3130462

**Appendix 3 - Cable
Short Circuit Fault Analysis
Input Report**

Cable	From Location	To Location	# Per Phase	Cable Size	CU/AL	Duct Material	Cable Ampacity	Length Feet	Per Unit Impedance Valuse (100MVA Base)				Notes
									Rpos	Xpos	Rzero	Xzero	
CBL G1	2960 MAIN A	GENERATOR 2994	2	750	Copper	Non-Magnetic	950.0	98.0	0.4126	0.7571	0.6550	1.9247	
CBL G2	2960 MAIN B	GENERATOR 2995	3	500	Copper	Magnetic	1140.0	218.0	0.9273	1.4697	2.9205	3.6176	
CBL GDR1005	MCC-2971	GRINDER	1	12	Copper	Magnetic	20.0	392.0	318.1597	15.4826	1002.6966	38.1281	
CBL GDR6171	MCC-2	GRINDER #1	1	10	Copper	Magnetic	30.0	110.0	56.3368	3.1224	177.5469	7.6866	
CBL GDR6172	MCC-2	GRINDER #2	1	10	Copper	Magnetic	30.0	110.0	56.3368	3.1224	177.5469	7.6866	
CBL GEN1 HT	MCC-2974	N-2995 STBY GEN 1 JACK	1	10	Copper	Magnetic	30.0	55.0	28.1684	2.0386	88.7734	5.0202	
CBL GRD7111	MCC-2981	CENT 1 SLUDGE GRIND	1	12	Copper	Magnetic	20.0	70.0	56.8142	2.7648	179.0530	6.8086	
CBL HC-2903	MCC-2973	903 ELECT RM AHU HEAT	1	12	Copper	Magnetic	20.0	72.0	58.4375	2.8438	184.1688	7.0031	
CBL HC1281	MCC-2975	HC1281 DISC	1	10	Copper	Magnetic	30.0	40.0	20.4861	1.4826	64.5625	3.6510	
CBL HC1285	MCC-2975	HC1285 DISC	1	2	Copper	Magnetic	115.0	40.0	3.5069	1.0156	11.0521	2.5000	
CBL HC1303	MCC-2976	HC1303 DISC	1	6	Copper	Magnetic	65.0	320.0	70.8333	9.5139	223.2222	23.4306	
CBL HEAT2	SHOP HEAT 2	SHOP HEAT 1	1	8	Copper	Magnetic	50.0	40.0	14.0799	1.0017	44.3733	2.4653	
CBL HOIST	S101 PANEL	HOIST	1	12	Copper	Magnetic	20.0	40.0	32.4653	1.2083	102.3160	2.9757	
CBL LAB PNL A (1PH)	OFFICE LAB SWITCHES	PANEL A	1	500	Copper	Non-Magnetic	380.0	90.0	3.2327	3.6426	5.1302	9.7567	
CBL LAB PNL B (1PH)	OFFICE LAB SWITCHES	PANEL B	1	500	Copper	Non-Magnetic	380.0	180.0	6.4654	7.2853	10.2603	19.5133	
CBL MCC 2983/2984	MCC-2983	MCC-2984	2	3/0	Copper	Magnetic	400.0	15.0	0.2620	0.1689	0.8258	0.4160	
CBL MCC-2971	2960 MAIN A	MCC-2971	3	500	Copper	Non-Magnetic	1140.0	40.0	0.1597	0.2159	0.2535	0.5781	
CBL MCC-2972 5C (1PH)	MCC-2972	LV TFR LAB PRI	1	4	Copper	Magnetic	85.0	1300.0	181.1198	35.6597	570.7813	87.7951	
CBL MCC-4	SWBD 1	WIREWAY CLOR BLDG	1	4/0	Copper	Non-Magnetic	230.0	415.0	11.4017	5.9800	18.1202	15.2023	
CBL MCC4 PANEL	WIREWAY CLOR BLDG	MCC4 PANEL	1	2	Copper	Non-Magnetic	115.0	3.0	0.2630	0.0508	0.4181	0.1292	
CBL ME-2907	MCC-2973	ELEC RM COND UNIT	1	8	Copper	Magnetic	50.0	49.0	17.2478	1.6036	54.3573	3.9472	
CBL ME1018	MCC-2971	EAST PRIMARY CLARIFIER	1	12	Copper	Magnetic	20.0	325.0	263.7804	12.8364	831.3173	31.6113	
CBL ME1019	MCC-2972	WEST PRI CLAR	1	12	Copper	Magnetic	20.0	525.0	426.1068	20.7357	1342.8972	51.0645	
CBL MEE1100	MCC-2976	MEE1100 480V	1	6	Copper	Magnetic	65.0	232.0	51.3542	6.8976	161.8361	16.9872	
CBL MEE5012 (1PH)	MCC-2975	SEPTAGE PWR CENTER	1	10	Copper	Non-Magnetic	30.0	210.0	107.5521	6.6354	170.9805	16.8711	
CBL MEE7110	MCC-2981	MEE7110 VFD PNL	2	250	Copper	Magnetic	510.0	98.0	1.1740	1.0527	3.6984	2.5925	
CBL MME7100	MCC-2983	PLATE DEWATER PRESS	1	10	Copper	Non-Magnetic	30.0	80.0	40.9722	2.8576	65.1354	7.2674	
CBL MME7106	MCC-2981	PRESS PRES WASH	1	12	Copper	Magnetic	20.0	75.0	60.8724	2.9622	191.8425	7.2949	
CBL MME7131	MCC-2983	CENT RM HOIST	1	10	Copper	Non-Magnetic	30.0	80.0	40.9722	2.8576	65.1354	7.2674	
CBL MXR 2166	MCC-2972	ACTIV SLUDGE MIXER 4	1	10	Copper	Magnetic	30.0	170.0	87.0660	6.3012	274.3907	15.5169	
CBL MXR2115	MCC 2971	CTIVATED SLUDGE MIXER	1	10	Copper	Magnetic	30.0	205.0	104.9913	7.5985	330.8828	18.7116	
CBL MXR2116	MCC-2972	ACTIV SLUDGE MIXER 2	1	10	Copper	Magnetic	30.0	225.0	115.2344	8.3398	363.1641	20.5371	
CBL MXR2165	MCC 2971	CTIVATED SLUDGE MIXER	1	10	Copper	Magnetic	30.0	170.0	87.0660	6.3012	274.3907	15.5169	
CBL MXR7231	MCC-2981	DW POLY AGE TNK MIX	1	12	Copper	Magnetic	20.0	65.0	52.7561	2.5673	166.2635	6.3223	
CBL MXR7232	MCC-2982	EWAT POL-AGE TANK 2 MI	1	12	Copper	Non-Magnetic	20.0	67.0	54.3793	2.5939	86.4515	6.5982	



Electrical Reliability Services, Inc.

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**Appendix 3 - Cable
Short Circuit Fault Analysis
Input Report**

Cable	From Location	To Location	# Per Phase	Cable Size	CU/AL	Duct Material	Cable Ampacity	Length Feet	Per Unit Impedance Valuse (100MVA Base)				Notes
									Rpos	Xpos	Rzero	Xzero	
CBL N TRAIL	TX TRAIL SEC	NORTH TRAILER	1	2	Copper	Magnetic	115.0	190.0	49.9480	11.0776	157.4105	27.2736	
CBL P1001	P1001 VFD	PRI SLUDGE PMP 1	1	10	Copper	Magnetic	30.0	392.0	200.7639	14.5299	632.7125	35.7802	
CBL P1001 VFD	MCC-2971	P1001 VFD	1	10	Copper	Magnetic	30.0	2.0	1.0243	0.0741	3.2281	0.1826	
CBL P1002	VFD P1002	PRIMARY SLUDGE PMP 2	1	10	Copper	Magnetic	30.0	400.0	204.8611	14.8264	645.6250	36.5104	
CBL P1003	MCC-2972	SCUM PUMP 1	1	12	Copper	Magnetic	20.0	405.0	328.7109	15.9961	1035.9493	39.3926	
CBL P1004	MCC-2971	SCUM PUMP	1	12	Copper	Magnetic	20.0	365.0	296.2457	14.4162	933.6333	35.5020	
CBL P1111	MCC-2975	GRIFT PUMP 1	1	8	Copper	Magnetic	50.0	262.0	92.2231	8.5741	290.6449	21.1056	
CBL P1112	MCC-2975	GRIFT PUMP 2	1	8	Copper	Magnetic	50.0	277.0	97.5030	9.0650	307.2849	22.3139	
CBL P1121	MCC-2976	GRIT PUMP-3	1	8	Copper	Magnetic	50.0	302.0	106.3030	9.8832	335.0182	24.3278	
CBL P1122	MCC-2976	GRIT PUMP-4	1	8	Copper	Magnetic	50.0	317.0	111.5829	10.3740	351.6581	25.5361	
CBL P1251	PNL 1250	EQUIP GALL SUMP P1	1	12	Copper	Magnetic	20.0	10.0	8.1163	0.3950	25.5790	0.9727	
CBL P1252	PNL 1250	EQUIP GALL SUMP P2	1	12	Copper	Magnetic	20.0	10.0	8.1163	0.3950	25.5790	0.9727	
CBL P1253	MCC-2975	TANK DRAIN PUMP	1	12	Copper	Magnetic	20.0	254.0	206.1545	10.0321	649.7065	24.7055	
CBL P2011	MCC 2972	SAN DRAIN PMP 1	1	12	Copper	Magnetic	20.0	150.0	121.7448	5.9245	383.6849	14.5898	
CBL P2012	MCC 2972	SAN DRAIN PMP 2	1	12	Copper	Magnetic	20.0	150.0	121.7448	5.9245	383.6849	14.5898	
CBL P2511	MCC 2971	RET ACT SLUDGE PMP 1	1	12	Copper	Magnetic	20.0	405.0	328.7109	15.9961	1035.9493	39.3926	
CBL P2512	MCC 2971	RET ACT SLUDGE PMP 2	1	12	Copper	Magnetic	20.0	397.0	322.2179	15.6801	1015.4861	38.6145	
CBL P2513	MCC 2972	RET ACT SLUDGE PMP 3	1	12	Copper	Magnetic	20.0	390.0	316.5365	15.4036	997.5808	37.9336	
CBL P2514	P2514 VFD	RETURN AC SLUD PMP 4	1	12	Copper	Magnetic	20.0	405.0	328.7109	15.9961	1035.9492	39.3926	
CBL P2514 VFD	MCC-2972	P2514 VFD	1	12	Copper	Magnetic	20.0	1.0	0.8116	0.0395	2.5579	0.0973	
CBL P2515	P2515 VFD	RETURN AC SLUD PMP 5	1	12	Copper	Magnetic	20.0	398.0	323.0295	15.7196	1018.0439	38.7117	
CBL P2515 VFD	MCC-2972	P2515 VFD	1	12	Copper	Magnetic	20.0	1.0	0.8116	0.0395	2.5579	0.0973	
CBL P2531	VFD P2531	WAS PUMP 1	1	12	Copper	Magnetic	20.0	410.0	332.7691	16.1936	1048.7388	39.8789	
CBL P2532	MCC-2972	WAS PUMP 2	1	12	Copper	Magnetic	20.0	410.0	332.7691	16.1936	1048.7388	39.8789	
CBL P3001	MCC-2971	PROCESS WATER PUMP 1	1	4	Copper	Magnetic	85.0	405.0	56.4258	11.1094	177.8203	27.3516	
CBL P3002	MCC-2972	PROCESS WTR PMP 2	1	4	Copper	Magnetic	85.0	420.0	58.5156	11.5208	184.4063	28.3646	
CBL P3003	MCC-2971	PROCESS WATER PUMP 3	1	4	Copper	Magnetic	85.0	385.0	53.6393	10.5608	169.0391	26.0009	
CBL P6011	MCC-2	THKND SLUDGE PMP #1	1	10	Copper	Magnetic	30.0	85.0	43.5330	2.4128	137.1953	5.9397	
CBL P6013	MCC-2	SLUDGE MIXING P1	1	10	Copper	Magnetic	30.0	65.0	33.2899	1.8451	104.9141	4.5421	
CBL P6021	MCC-2	THKND SLUDGE PMP #2	1	10	Copper	Magnetic	30.0	92.0	47.1181	2.6115	148.4938	6.4288	
CBL P6023	MCC-2	SLUDGE MIXING P2	1	10	Copper	Magnetic	30.0	65.0	33.2899	1.8451	104.9141	4.5421	
CBL P6112	MCC-2	SLUDGE RECIRC P1	1	12	Copper	Magnetic	20.0	65.0	52.7561	1.9635	166.2635	4.8355	
CBL P6122	MCC-2	SLUDGE RECIRC P2	1	12	Copper	Magnetic	20.0	65.0	52.7561	1.9635	166.2635	4.8355	
CBL P7054	MCC-2984	NALGEAR PMP	1	12	Copper	Non-Magnetic	20.0	140.0	113.6285	5.4201	180.6450	13.7873	
CBL P7101	MCC 2983	FILT FEED PMP 1	1	8	Copper	Non-Magnetic	50.0	80.0	28.1597	2.0938	44.7674	5.3264	



Electrical Reliability Services, Inc.

Client: PSW Electric

Project: Central Kitsap WWTP

Job#: 3130462

**Appendix 3 - Cable
Short Circuit Fault Analysis
Input Report**

Cable	From Location	To Location	# Per Phase	Cable Size	CU/AL	Duct Material	Cable Ampacity	Length Feet	Per Unit Impedance Valuse (100MVA Base)				Notes
									Rpos	Xpos	Rzero	Xzero	
CBL P7103A	MCC-2983	UPLEX SEAL WATER PMP	1	12	Copper	Non-Magnetic	20.0	62.0	50.3212	2.4003	79.9999	6.1058	
CBL P7103B	MCC-2982	LEX SEAL WATER UNIT P	1	12	Copper	Non-Magnetic	20.0	84.0	68.1771	3.2521	108.3870	8.2724	
CBL P7112	P7112 VFD	CENT 1 SLUDGE FEED PMP	1	6	Copper	Magnetic	65.0	65.0	14.3880	1.9325	45.3420	4.7593	
CBL P7112 VFD	MCC-2981	P7112 VFD	1	6	Copper	Magnetic	65.0	3.0	0.6641	0.0892	2.0927	0.2197	
CBL P7151	MCC-2983	CENTRATE PMP 1	1	10	Copper	Non-Magnetic	30.0	85.0	43.5330	3.0362	69.2064	7.7216	
CBL P7152	MCC-2982	CENTRATE PMP 2	1	10	Copper	Non-Magnetic	30.0	85.0	43.5330	3.0362	69.2064	7.7216	
CBL P7161	MCC-2983	SEPTAGE PMP 1	1	10	Copper	Non-Magnetic	30.0	95.0	48.6545	3.3934	77.3483	8.6300	
CBL P7162	MCC-2984	SEPTAGE PMP 2	1	10	Copper	Non-Magnetic	30.0	140.0	71.7014	5.0009	113.9870	12.7179	
CBL P7209	MCC-2983	SLDG BLDG HT WT PMP	1	12	Copper	Non-Magnetic	20.0	50.0	40.5816	1.9358	64.5161	4.9240	
CBL P7210	MCC-2983	ALUM METE PMP	1	12	Copper	Non-Magnetic	20.0	80.0	64.9306	3.0972	103.2257	7.8785	
CBL P7241	P7241 VFD	DW POLY FEED PMP	1	12	Copper	Magnetic	20.0	75.0	60.8724	2.9622	191.8425	7.2949	
CBL P7242	MCC-2982	DW POLY 2 PMP	1	12	Copper	Non-Magnetic	20.0	78.0	63.3073	3.0198	100.6451	7.6815	
CBL P7242 VFD	MCC-2981	P7241 VFD	1	12	Copper	Magnetic	20.0	1.0	0.8116	0.0395	2.5579	0.0973	
CBL P7310	MCC-2981	HYPO CIRC PMP 1	1	12	Copper	Magnetic	20.0	65.0	52.7561	2.5673	166.2635	6.3223	
CBL P7320	MCC-2983	HYPO REC PMP 2	1	12	Copper	Non-Magnetic	20.0	52.0	42.2049	2.0132	67.0967	5.1210	
CBL PNL 1023	MCC-2976	PNL 1023	1	12	Copper	Magnetic	20.0	60.0	48.6979	2.3698	153.4740	5.8359	
CBL PNL 1025	MCC-2975	PNL 1025	1	12	Copper	Non-Magnetic	20.0	40.0	32.4653	1.3698	51.6128	3.4844	
CBL PNL 1027	MCC-2975	PNL 1027	1	12	Copper	Magnetic	20.0	80.0	64.9306	3.1597	204.6320	7.7813	
CBL PNL 1028	MCC-2976	PNL 1028	1	12	Copper	Magnetic	20.0	75.0	60.8724	2.9622	191.8425	7.2949	
CBL PNL 1070	MCC-2975	PNL 1070	1	10	Copper	Magnetic	30.0	450.0	230.4688	16.6797	726.3282	41.0742	
CBL PNL 2958	MCC-2974	TFR-2958 PRI	1	10	Copper	Magnetic	30.0	3.0	1.5365	0.1112	4.8422	0.2738	
CBL PNL 5010	MCC-2976	PNL 5010	1	6	Copper	Magnetic	65.0	280.0	61.9792	8.3247	195.3195	20.5017	
CBL PNL 5020	MCC-2976	PNL 5020	1	8	Copper	Magnetic	50.0	300.0	105.5990	9.8177	332.7995	24.1667	
CBL PNL 7225	MCC-2981	L 7225 DEWAT POL DIST F	1	12	Copper	Magnetic	20.0	90.0	73.0469	3.5547	230.2110	8.7539	
CBL PNL-1090	MCC-2973	L-1090 PLANT WW SMP P	1	4	Copper	Magnetic	85.0	90.0	12.5391	2.4688	39.5156	6.0781	
CBL PNL-1250	MCC-2975	PNL 1250	1	10	Copper	Magnetic	30.0	237.0	121.3802	8.7846	382.5328	21.6324	
CBL PNL1021	MCC-2975	PNL 1021	1	12	Copper	Non-Magnetic	20.0	40.0	32.4653	1.3698	51.6128	3.4844	
CBL PNL1026	MCC-2975	PNL 1026	1	12	Copper	Magnetic	20.0	70.0	56.8142	2.7648	179.0530	6.8086	
CBL PNL3100	MCC-2973	UV PWR DIST CHNL 1	1	350	Copper	Non-Magnetic	310.0	245.0	3.9132	3.4878	6.2207	8.8685	
CBL PNL3200	MCC-2974	UV PWR DIST CHAN 2	1	350	Copper	Magnetic	310.0	245.0	4.0195	5.2211	12.6647	12.8561	
CBL PNL7030	MCC-2983	SERV AIR COMP 1 PNL	1	10	Copper	Non-Magnetic	30.0	90.0	46.0938	3.2148	73.2774	8.1758	
CBL PNL7031	MCC-2984	SERV AIR CMP 2 PNL	1	8	Copper	Non-Magnetic	50.0	85.0	29.9197	2.2246	47.5653	5.6593	
CBL S TRAIL	TX TRAIL SEC	SOUTH TRAILER	1	2	Copper	Magnetic	115.0	120.0	31.5461	6.9964	99.4172	17.2254	
CBL S101 PANEL	WIREWAY CLOR BLDG	S101 PANEL	1	2	Copper	Non-Magnetic	115.0	1.0	0.0877	0.0169	0.1394	0.0431	
CBL SEAL	MCC-2	SEAL WATER	1	10	Copper	Magnetic	30.0	85.0	43.5330	2.4128	137.1953	5.9397	



Electrical Reliability Services, Inc.

Client: PSW Electric

Project: Central Kitsap WWTP

Job#: 3130462

**Appendix 3 - Cable
Short Circuit Fault Analysis
Input Report**

Cable	From Location	To Location	# Per Phase	Cable Size	CU/AL	Duct Material	Cable Ampacity	Length Feet	Per Unit Impedance Valuse (100MVA Base)				Notes
									Rpos	Xpos	Rzero	Xzero	
CBL SHOP HEAT1	S101 PANEL	SHOP HEAT 1	1	8	Copper	Magnetic	50.0	40.0	14.0799	1.0017	44.3733	2.4653	
CBL SWGR 2950	SWGR 1	SWGR 2950 LINE	1	4/0	Copper	Non-Magnetic	274.4	390.0	0.0161	0.0117	0.0255	0.0297	
CBL SWGR1	UTIL INTERFACE	SWGR 1	1	2	Copper	Non-Magnetic	144.1	390.0	0.0507	0.0137	0.0805	0.0349	
CBL TFR-1990 (1PH)	MCC-2971	TFR 1990 PRI	1	250	Copper	Magnetic	255.0	380.0	9.1042	8.1641	28.6814	20.1050	
CBL TFR-2957	MCC-2973	TFR-2957 PRI	1	10	Copper	Magnetic	30.0	3.0	1.5365	0.1112	4.8422	0.2738	
CBL UVB-3110	TX PANEL 3100	UVB-3110	1	350	Copper	Magnetic	310.0	55.0	1.0739	1.3949	3.3835	3.4347	
CBL UVB-3120	TX PANEL 3100	UVB-3120	1	350	Copper	Magnetic	310.0	55.0	1.0739	1.3949	3.3835	3.4347	
CBL UVB-3210	TX PANEL 3200	UVB-3210	1	350	Copper	Magnetic	310.0	55.0	1.0739	1.3949	3.3835	3.4347	
CBL UVB-3220	TX PANEL 3200	UVB-3121	1	350	Copper	Magnetic	310.0	55.0	1.0739	1.3949	3.3835	3.4347	
CBL VFD P1002	MCC 2972	VFD P1002	1	10	Copper	Magnetic	30.0	1.0	0.5122	0.0371	1.6141	0.0913	
CBL VFD P2531	MCC-2971	VFD P2531	1	12	Copper	Magnetic	20.0	2.0	1.6233	0.0790	5.1158	0.1945	
CBL W CLAR	MCC-2	WEST CLARIFIER THKNR	1	12	Copper	Magnetic	20.0	165.0	133.9193	4.9844	422.0534	12.2747	
CBL-MCC 2791-MCC2792 TIE	MCC 2971	MCC-2972	1	600	Copper	Busway	600.0	0.1	0.0009	0.0010	0.0231	0.0250	



Electrical Reliability Services, Inc.

Client: PSW Electric

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Appendix 3 - Xformers and Sources

Short Circuit Fault Analysis

Input Report

Transformers

Transformer Name	From Location	To Location	Nominal KVA	Primary Volts	Primary Connect.	Secondary Volts	Secondary Connect.	Percent Z	Per Unit Impedance Values (100MVA Base)				Notes
									Rpos	Xpos	Rzero	Xzero	
LV TFR LAB (1PH)	LV TFR LAB PRI	LV LAB XFMR SEC	37.5	480	Delta	277	Wye-Ground	1.4999	11.3040	38.3680	11.3040	38.3680	
TFR 2951	TFR 2951 PRI	TFR 2951 SEC	2000.0	12470	Delta	480	Wye-Ground	5.9000	0.4008	2.9227	0.4008	2.9227	
TFR 2952	TFR 2952 PRI	TFR 2952 SEC	2000.0	12470	Delta	480	Wye-Ground	6.1400	0.4172	3.0415	0.4172	3.0415	
TFR LAB (1PH)	SWGR 1	LAB ATS NORMAL TERM	100.0	12470	Delta	277	Wye-Ground	1.9999	4.6850	19.4430	4.6850	19.4430	
TFR-2957	TFR-2957 PRI	PNL 2973	30.0	480	Delta	208	Wye-Ground	2.5000	32.7300	76.6367	32.7300	76.6367	
TFR-2958	TFR-2958 PRI	PNL 2958	30.0	480	Delta	208	Wye-Ground	2.5000	32.7300	76.6367	32.7300	76.6367	
TFR-2981	MCC-2981	PNL 2981	45.0	480	Delta	208	Wye-Ground	5.2400	37.9556	110.0844	37.9556	110.0844	
TFR-2982	MCC-2982	PNL 2982	30.0	480	Delta	208	Wye-Ground	6.0900	69.9367	190.5733	69.9367	190.5733	
TRR 1990 (1PH)	TFR 1990 PRI	PANEL 1990	37.5	480	Delta	277	Delta	1.4999	11.3040	38.3680	open	open	
TX MEE1100	MEE1100 480V	MEE1100	15.0	480	Delta	208	Wye-Ground	2.0000	50.0400	123.5867	50.0400	123.5867	
TX MEE5012	SEPTAGE PWR CENTER	MEE5012 SEPTAGE PANEL	15.0	480	Delta	277	Wye-Ground	1.0000	21.7333	63.0267	21.7333	63.0267	
TX MP	DECANT FACILITY	PANEL MP	30.0	480	Delta	208	Wye-Ground	2.4000	27.5600	75.1033	27.5600	75.1033	



Electrical Reliability Services, Inc.

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Appendix 3 - Xformers and Sources

Short Circuit Fault Analysis

Input Report

TX PNL 2975	MCC-2975	PNL 2975	30.0	480	Delta	208	Wye-Ground	2.8000	32.1533	87.6200	32.1533	87.6200	
TX PNL 2976	MCC-2976	PNL 2976	15.0	480	Delta	208	Wye-Ground	4.5000	112.5933	278.0667	112.5933	278.0667	
TX PNL C (1PH)	SWBD 1	PNL C	10.0	480	Delta	277	Wye-Ground	1.2500	43.0600	117.3500	43.0600	117.3500	
TX PNL-3100	UV PWR DIST CHNL 1	TX PANEL 3100	220.0	480	Delta	440	Wye-Ground	4.5000	5.1091	19.8064	5.1091	19.8064	
TX PNL-3200	UV PWR DIST CHAN 2	TX PANEL 3200	220.0	480	Delta	440	Wye-Ground	4.5000	5.1091	19.8064	5.1091	19.8064	
TX-SL02 (1PH)	S101 PANEL	S102 PANEL	37.5	480	Delta	277	Wye-Ground	1.4999	11.3040	38.3680	11.3040	38.3680	
TX-TRAIL (1PH)	S101 PANEL	TX TRAIL SEC	37.5	480	Delta	277	Wye-Ground	2.7500	20.7253	70.3440	20.7253	70.3440	



Electrical Reliability Services, Inc.

Client: PSW Electric

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**Appendix 3 - Motors
Short Circuit Fault Analysis
Input Report**

Induction Motors

Motor Name	Connect Point	Rated HP	Rated KW	Rated Amps	Rated Volts	Rated PF (Lag)	X"d (pu)	X/R Ratio	Per Unit Impedance Values (100MVA Base)				Notes
									Rpos	Xpos	Rzero	Xzero	
MTR ACU7212	SLUDGE BLDG ELEC RM ACU	15.0	11.2	18.0	480	0.800000	0.1692	10.0000	112.80	1128.0			
MTR ACU7213	CENT CONR AREA ACU	29.9	22.3	36.1	480	0.800000	0.1692	10.0000	56.400	564.00			
MTR AHU1285	FU AHU1285	5.0	3.7	6.0	480	0.800000	0.1692	10.0004	337.47	3374.9			
MTR AHU2901	BL BLDG ELEC RM AHU-2901	5.0	3.7	6.0	480	0.800000	0.1692	10.0004	337.47	3374.9			
MTR AHU2910	BLWR ROOM AHU2910	7.5	5.6	9.0	480	0.800000	0.1692	10.0000	224.99	2249.9			
MTR AHU7202	SLUDGE BLDG AHU-2	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR AHU7211	SLUDGE BLDG AHU-1	7.5	5.6	9.0	480	0.800000	0.1692	10.0000	224.99	2249.9			
MTR B1061	HEADWORKS FOUL AIR BLWR	40.0	29.8	48.2	480	0.800000	0.1692	10.0000	42.186	421.86			
MTR B1276	AERATED GRIT TANK BLOWER	25.0	18.6	30.2	480	0.800000	0.1692	10.0000	67.498	674.98			
MTR B1277	STANDBY AIR BLOWER	40.0	29.8	48.2	480	0.800000	0.1692	10.0000	42.186	421.86			
MTR B1278	AGITATION AIR BLOWER	40.0	29.8	48.2	480	0.800000	0.1692	10.0000	42.186	421.86			
MTR B2001	AERATION BLOWER 1	250.0	186.5	263.8	480	0.900000	0.1692	10.0004	7.7158	77.160			
MTR B2002	AERATION BLOWER 2	250.0	186.5	263.8	480	0.900000	0.1692	10.0004	7.7158	77.160			
MTR B2003	AERATION BLOWER 3	250.0	186.5	263.8	480	0.900000	0.1692	10.0004	7.7158	77.160			
MTR B2342	CHAN 2 AIR BLWR	13.3	9.9	16.0	480	0.800000	0.1692	10.0004	126.87	1268.7			
MTR B7191	DEWATER FOUL AIR BLWR	30.0	22.4	36.2	480	0.800000	0.1692	10.0000	56.248	562.48			
MTR BIO FILTER	BIO FILTER BLOWER	20.0	14.9	24.1	480	0.800000	0.1692	10.0000	84.373	843.73			
MTR CENT 1	CENT 1 MOTOR	200.0	149.2	241.2	480	0.800000	0.1692	10.0000	8.4373	84.373			
MTR CLARIFIER THKNR E	EAST CLARIFIER THKNR	1.6	1.2	2.0	480	0.800000	0.1692	10.0000	1022.7	10227.			
MTR CLARIFIER THKNR W	WEST CLARIFIER THKNR	1.6	1.2	2.0	480	0.800000	0.1692	10.0000	1022.7	10227.			



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**Appendix 3 - Motors
Short Circuit Fault Analysis
Input Report**

MTR COL2510	SECONDARY CLAR COLL 1	0.8	0.6	0.9	480	0.800000	0.1692	10.0004	2249.8	22499.			
MTR COL2520	SEC CLAR COLL 2	0.8	0.6	0.9	480	0.800000	0.1692	10.0004	2249.8	22499.			
MTR CON7115	CENT 1 CAKE CONV	3.0	2.2	3.6	480	0.800000	0.1692	10.0004	562.46	5624.8			
MTR CV2001	AER BLWR 1 VLVS	0.0	0.0	0.0	480	0.800000	0.1692	10.0004	84369.	843732			
MTR CV6193	DIG WITH VLV 1	1.0	0.7	1.2	480	0.800000	0.1692	10.0000	1687.4	16874.			
MTR CV6194	DIG WITH VLV 2	1.0	0.7	1.2	480	0.800000	0.1692	10.0000	1687.4	16874.			
MTR CV7110	CENT 1 SLUDGE INLET VLV	0.3	0.2	0.3	480	0.800000	0.1692	10.0004	6749.5	67498.			
MTR CV7111	CENT 1 SLDG GRIND BYP VLV	0.5	0.4	0.6	480	0.800000	0.1692	10.0004	3374.7	33749.			
MTR CV7114	CENT 1 FLUSH VLV	0.3	0.2	0.3	480	0.800000	0.1692	10.0004	6749.5	67498.			
MTR CV7116	CENT 1 CONV DR VLV	2.0	1.5	2.4	480	0.800000	0.1692	10.0004	843.69	8437.3			
MTR CV7231	DW POL AGE TANK	0.2	0.1	0.2	480	0.800000	0.1692	10.0004	8436.9	84373.			
MTR CV7232A&B	DW POLY AGE TANK VLVS	0.2	0.1	0.2	480	0.800000	0.1692	10.0004	8436.9	84373.			
MTR F1301	PRIMARY GALLERY SUP FAN	1.5	1.1	1.8	480	0.800000	0.1692	10.0004	1124.9	11249.			
MTR F1302	PRIMARY GALLERY EXH FAN	0.5	0.4	0.6	480	0.800000	0.1692	10.0004	3374.7	33749.			
MTR F2015	F2015 UNIDOR VENT	15.0	11.2	18.1	480	0.800000	0.1692	10.0000	112.49	1124.9			
MTR F2911	BLWR RM EXH FN 1	5.0	3.7	6.0	480	0.800000	0.1692	10.0004	337.47	3374.9			
MTR F2912	BLWR RM EXH FN 2	2.0	1.5	2.4	480	0.800000	0.1692	10.0004	843.69	8437.3			
MTR F7205	SLUDGE BLD LAB AREA EXH FAN	0.5	0.4	0.6	480	0.800000	0.1692	10.0000	3374.9	33749.			
MTR F7207	SLUDGE CHEM RM SUP FAN	1.0	0.7	1.2	480	0.800000	0.1692	10.0000	1687.4	16874.			
MTR F7208	SLUDGE BLDG RM EXH FAN	2.0	1.5	2.4	480	0.800000	0.1692	10.0000	843.73	8437.3			
MTR GDR6171	GRINDER #1	5.0	3.7	6.0	480	0.800000	0.1692	10.0000	337.49	3374.9			
MTR GDR6172	GRINDER #2	5.0	3.7	6.0	480	0.800000	0.1692	10.0000	337.49	3374.9			
MTR GRD7111	CENT 1 SLUDGE GRIND	5.0	3.7	6.0	480	0.800000	0.1692	10.0004	337.47	3374.9			
MTR HOIST	HOIST	2.0	1.5	2.4	480	0.800000	0.1692	10.0000	843.73	8437.3			
MTR ME1019	WEST PRI CLAR	0.5	0.4	0.6	480	0.800000	0.1692	10.0004	3374.7	33749.			



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**Appendix 3 - Motors
Short Circuit Fault Analysis
Input Report**

MTR ME2907	ELEC RM COND UNIT	11.0	8.2	13.3	480	0.800000	0.1692	10.0000	153.40	1534.0			
MTR MME7106	PRESS PRES WASH	7.5	5.6	9.0	480	0.800000	0.1692	10.0000	224.99	2249.9			
MTR MME7131	CENT RM HOIST	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR MXR2115	ACTIVATED SLUDGE MIXER 1	3.0	2.2	3.6	480	0.800000	0.1692	10.0004	562.46	5624.8			
MTR MXR2116	ACTIV SLUDGE MIXER 2	3.0	2.2	3.6	480	0.800000	0.1692	10.0004	562.46	5624.8			
MTR MXR2165	ACTIVATED SLUDGE MIXER 3	3.0	2.2	3.6	480	0.800000	0.1692	10.0004	562.46	5624.8			
MTR MXR2166	ACTIV SLUDGE MIXER 4	3.0	2.2	3.6	480	0.800000	0.1692	10.0004	562.46	5624.8			
MTR MXR7231	DW POLY AGE TNK MIX	2.0	1.5	2.4	480	0.800000	0.1692	10.0004	843.69	8437.3			
MTR MXR7232	DEWAT P0L-AGE TANK 2 MIX	2.0	1.5	2.4	480	0.800000	0.1692	10.0004	843.69	8437.3			
MTR P1003	SCUM PUMP 1	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P1111	GRIFT PUMP 1	10.0	7.5	12.1	480	0.800000	0.1692	10.0004	168.73	1687.4			
MTR P1112	GRIFT PUMP 2	10.0	7.5	12.1	480	0.800000	0.1692	10.0004	168.73	1687.4			
MTR P1121	GRIT PUMP-3	10.0	7.5	12.1	480	0.800000	0.1692	10.0004	168.73	1687.4			
MTR P1122	GRIT PUMP-4	10.0	7.5	12.1	480	0.800000	0.1692	10.0004	168.73	1687.4			
MTR P1251	EQUIP GALL SUMP P1	5.1	3.8	6.2	480	0.800000	0.1692	10.0000	328.94	3289.4			
MTR P1252	EQUIP GALL SUMP P2	5.1	3.8	6.2	480	0.800000	0.1692	10.0000	328.94	3289.4			
MTR P1253	TANK DRAIN PUMP	5.0	3.7	6.0	480	0.800000	0.1692	10.0000	337.49	3374.9			
MTR P2011	SAN DRAIN PMP 1	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P2511	RET ACT SLUDGE PMP 1	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P2512	RET ACT SLUDGE PMP 2	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P2513	RET ACT SLUDGE PMP 3	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P2514	RETURN AC SLUD PMP 4	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P2515	RETURN AC SLUD PMP 5	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P2532	WAS PUMP 2	5.0	3.7	6.0	480	0.800000	0.1692	10.0004	337.47	3374.9			



Electrical Reliability Services, Inc.

Client: PSW Electric

Project: Central Kitsap WWTP

Job#: 3130462

**Appendix 3 - Motors
Short Circuit Fault Analysis
Input Report**

MTR P3001	PROCESS WATER PUMP 1	40.0	29.8	48.2	480	0.800000	0.1692	10.0004	42.184	421.86			
MTR P3003	CB P3003 DISC	40.0	29.8	48.2	480	0.800000	0.1692	10.0004	42.184	421.86			
MTR P6011	THKND SLUDGE PMP #1	7.5	5.6	9.0	480	0.800000	0.1692	10.0000	224.99	2249.9			
MTR P6013	SLUDGE MIXING P1	15.0	11.2	18.1	480	0.800000	0.1692	10.0000	112.49	1124.9			
MTR P6021	THKND SLUDGE PMP #2	7.5	5.6	9.0	480	0.800000	0.1692	10.0000	224.99	2249.9			
MTR P6023	SLUDGE MIXING P2	15.0	11.2	18.1	480	0.800000	0.1692	10.0000	112.49	1124.9			
MTR P6112	SLUDGE RECIRC P1	7.5	5.6	9.0	480	0.800000	0.1692	10.0000	224.99	2249.9			
MTR P6122	SLUDGE RECIRC P2	7.5	5.6	9.0	480	0.800000	0.1692	10.0000	224.99	2249.9			
MTR P6191	DIG WITH PMP 1	40.0	29.8	48.2	480	0.800000	0.1692	10.0000	42.186	421.86			
MTR P6192	DIG WITH PMP 2	40.0	29.8	48.2	480	0.800000	0.1692	10.0000	42.186	421.86			
MTR P7054	NALGEAR PMP	3.0	2.2	3.6	480	0.800000	0.1692	10.0004	562.46	5624.8			
MTR P7101	FILT FEED PMP 1	25.0	18.6	30.2	480	0.800000	0.1692	10.0004	67.495	674.98			
MTR P7103A	DUPLEX SEAL WATER PMP 1	2.0	1.5	2.4	480	0.800000	0.1692	10.0004	843.69	8437.3			
MTR P7103B	DUPLEX SEAL WATER UNIT PMP 2	2.0	1.5	2.4	480	0.800000	0.1692	10.0004	843.69	8437.3			
MTR P7112	CENT 1 SLUDGE FEED PMP	40.0	29.8	48.2	480	0.800000	0.1692	10.0004	42.184	421.86			
MTR P7151	CENTRATE PMP 1	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P7152	CENTRATE PMP 2	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P7161	SEPTAGE PMP 1	15.0	11.2	18.1	480	0.800000	0.1692	10.0004	112.49	1124.9			
MTR P7162	SEPTAGE PMP 2	15.0	11.2	18.1	480	0.800000	0.1692	10.0004	112.49	1124.9			
MTR P7209	SLDG BLDG HT WT PMP	1.0	0.7	1.2	480	0.800000	0.1692	10.0004	1687.3	16874.			
MTR P7210	ALUM METE PMPs	1.0	0.7	1.2	480	0.800000	0.1692	10.0004	1687.3	16874.			
MTR P7241	DW POLY FEED PMP	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P7242	DW POLY 2 PMP	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR P7310	HYP0 CIRC PMP 1	2.0	1.5	2.4	480	0.800000	0.1692	10.0004	843.69	8437.3			
MTR P7320	HYP0 REC PMP 2	2.0	1.5	2.4	480	0.800000	0.1692	10.0000	843.73	8437.3			
MTR PNL7030	SERV AIR COMP 1 PNL	15.0	11.2	18.1	480	0.800000	0.1692	10.0004	112.49	1124.9			
MTR-AHU1281	FU AHU1281	3.0	2.2	3.6	480	0.800000	0.1692	10.0004	562.46	5624.8			



Electrical Reliability Services, Inc.

Client: PSW Electric

Project: Central Kitsap WWTP

Job#: 3130462

**Appendix 3 - Motors
Short Circuit Fault Analysis
Input Report**

MTR-B2541	CHANNEL AIR BLOWER 1	20.0	14.9	24.1	480	0.800000	0.1692	10.0004	84.369	843.73			
MTR-CV2003	AER BLWR 3 VLVS	0.0	0.0	0.0	480	0.800000	0.1692	10.0004	84369.	843732			
MTR-F2908	ELEC RM RET FAN	1.5	1.1	1.8	480	0.800000	0.1692	10.0004	1124.9	11249.			
MTR-GDR1005	GRINDER	3.0	2.2	3.6	480	0.800000	0.1692	10.0004	562.46	5624.8			
MTR-ME1018	EAST PRIMARY CLARIFIER	0.5	0.4	0.6	480	0.800000	0.1692	10.0004	3374.7	33749.			
MTR-P1001	PRI SLUDGE PMP 1	10.0	7.5	12.1	480	0.800000	0.1692	10.0004	168.73	1687.4			
MTR-P1002	PRIMARY SLUDGE PMP 2	10.0	7.5	12.1	480	0.800000	0.1692	10.0004	168.73	1687.4			
MTR-P1004	SCUM PUMP	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR-P2012	SAN DRAIN PMP 2	7.5	5.6	9.0	480	0.800000	0.1692	10.0004	224.98	2249.9			
MTR-P2531	WAS PUMP 1	5.0	3.7	6.0	480	0.800000	0.1692	10.0004	337.47	3374.9			
MTR-P3002	PROCESS WTR PMP 2	40.0	29.8	48.2	480	0.800000	0.1692	10.0004	42.173	421.75			
MTRs PNL 5020	PNL 5020	1.5	1.1	1.8	480	0.800000	0.1692	10.0000	1124.9	11249.			
MTRs PNL7031	SERV AIR CMP 2 PNL	25.0	18.6	30.2	480	0.800000	0.1692	10.0004	67.495	674.98			

LISTEN.
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BULLETIN 140U Molded Case Circuit Breakers



Bulletin 140U Molded Case Circuit Breakers

Product Overview



Bulletin 140U Molded Case Circuit Breakers

- 15...1200 A Molded Case Circuit Breakers
 - Thermal-Magnetic 15...800 A
 - Electronic 70...1200 A
 - LS — Long Time/Short Time
 - LSI — Long Time/Short Time/High Instantaneous
 - LSG — Long Time/Short Time/Ground Fault
 - LSIG — Long Time/Short Time/High Instantaneous/Ground Fault
 - Molded Case Switches 125...1200 A
- Factory- or field-installed accessories
- Flex cable operating mechanisms
- Rotary variable-depth operating mechanisms
- High interrupting ratings in compact dimensions
- Globally rated and approved product line for worldwide application

Conformity to Standards

UL 489
CSA 22.2, No. 5
IEC 60947-2

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800 A, M-Frame..... 31

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1200 A, N-Frame..... 36

Approvals

UL Listed
CSA Certified
CE
KEMA-KEUR

							
Frame Reference	G-Frame	H-Frame	J-Frame	K-Frame	L-Frame	M-Frame	N-Frame
Max. Current I_n	100 A	125 A	250 A	400 A	600 A	800 A	1200 A
Current Range	15...100 A	15...125 A	70...250 A	100...400 A	300...600 A	300...800 A	600...1200 A
Thermal Magnetic	✓	✓	✓	✓	✓	✓	—
Electronic:	—	—	✓	✓	✓	✓	—
LS	—	—	✓	✓	✓	✓	✓
LSI	—	—	✓	✓	✓	✓	✓
LSG	—	—	✓	✓	✓	✓	✓
LSIG	—	—	✓	✓	✓	✓	✓
Interrupting Ratings:							
380...415V (I_{cu})	14 22	25 40 70	25 40 70	40 65 100	45 70	50 70	50 70 100
480V	14 22	25 35 65	25 35 65	35 65 100	35 65	50 65	50 65 100
600V	14 22	18 22 25	18 18 25	25 35 50	25 35	25 35	25 35 50
690V (I_{cu})	14 22	3 4 6	6 6 7	10 13 18	20 25	20 25	20 25 30
Molded Case Switches	✓	✓	✓	✓	✓	✓	✓
Flex Cable Operators	✓	✓	✓	✓	✓	✓	✓
Rotary Operators	✓	✓	✓	✓	✓	✓	✓
Internal Control Modules (Field installed)	✓	✓	✓	✓	✓	✓	✓
Standards Compliance	✓	✓	✓	✓	✓	✓	✓
UL 489	✓	✓	✓	✓	✓	✓	✓
UL File E197878, Guide No. DIV Q	✓	✓	✓	✓	✓	✓	✓
CSA 22.2, No. 5	✓	✓	✓	✓	✓	✓	✓
CSA File Nos. 216034, 216035, 219884 Class No. 1432-01	✓	✓	✓	✓	✓	✓	✓
IEC 60947-2	✓	✓	✓	—	✓	✓	✓
CE	✓	✓	✓	—	✓	✓	✓
KEMA-KEUR	✓	✓	✓	✓	✓	✓	✓

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid cat. no. Refer to the tables on the following pages for descriptions of options.

Complete Circuit Breaker Assemblies

140U – H
6
C
3 – C50 – H

a
b
c
d
e
f
g
h

a

Bulletin No.	
Code	Description
140U	Molded Case Circuit Breaker

b

Frame/Rating	
Code	Description
H	125 A
J	250 A
K	400 A
L	600 A
M	800 A
N	1200 A

c

Interrupting Rating/Breaking Capacity (based on I _c at 480V)	
Code	Description
2	20...29 kA
3	30...39 kA
5	50...59 kA
6	60...69 kA
8	80...89 kA
0	≥100 kA

d

Protection Type	
Code	Description
C	Fixed Thermal/Fixed Magnetic
D	Fixed Thermal/Adjust Magnetic
E	Adjust Thermal/Fixed Magnetic
F	Adjust Thermal/Adjust Magnetic
G	Electronic (LSG — Long, short, ground fault)
H	Electronic (LSI — Long, short, high instant)
I	Electronic (LSIG — Long, short, high instant, ground fault)
L	Electronic (LS — Long and Short time)
S	Molded Case Switch (Isolator)

e

Poles	
Code	Description
1	1 poles
2	2 poles
3	3 poles

f

Current Range	
Code	Description
C	10 rr. A
D	100 rr0 A
E	1000 rr00 A

g

Internal Control Modules	
Code	Description
A	1 Auxiliary contact
B	2 Auxiliary contacts
D	1 Alarm contact
F	1 Auxiliary + 1 Alarm contact
G	Undervoltage release only
P	Shunt trip only
Control Module Combinations	
Code	Description
H	1 Auxiliary contact + undervoltage release
J	2 Auxiliary contacts + undervoltage release
L	1 Auxiliary + 1 Alarm contact + undervoltage release
N	1 Alarm contact + undervoltage release
Q	1 Auxiliary contact + shunt trip
R	2 Auxiliary contacts + shunt trip
T	1 Auxiliary + 1 Alarm contact + shunt trip
V	1 Alarm contact + shunt trip

h

Voltage Code	
See the following pages for voltage code descriptions:	
All frame sizes	Page 41

Bulletin 140U
Molded Case Circuit Breakers

Catalog Number Explanation

Examples given in this section are for reference purposes. This basic explanation should not be used for product selection; not all combinations will produce a valid cat. no. Refer to the tables on the following pages for descriptions of options.

Frames

140U – J 3 X 3
a *b* *c* *d* *e*

a

Bulletin No.	
Code	Description
140U	Molded Case Circuit Breaker

c

Interrupting Rating/Breaking Capacity (based on I _c at 480V)	
Code	Description
2	20...29 kA
3	30...39 kA
5	50...59 kA
6	60...69 kA
8	80...89 kA
0	≥100 kA

d

Protection Type	
Code	Description
X	Frame Only

b

Frame/Rating	
Code	Description
J	250 A
K	400 A
Q	600 A
M	800 A

e

Poles	
Code	Description
3	3 poles

Trip Units

140U – J T D 3 – D25
a *b* *c* *d* *e* *f*

a

Bulletin No.	
Code	Description
140U	Molded Case Circuit Breaker

c

Trip Unit	
Code	Description
T	Trip Unit

e

Poles	
Code	Description
3	3 poles

b

Frame/Rating	
Code	Description
J	250 A
K	400 A
L	600 A
M	800 A

d

Protection Type	
Code	Description
C	Fixed Thermal/Fixed Magnetic
D	Fixed Thermal/Adjust Magnetic
E	Adjust Thermal/Fixed Magnetic
F	Adjust Thermal/Adjust Magnetic
G	Electronic (LSG — Long, short, ground fault)
H	Electronic (LSI — Long, short, high instant)
I	Electronic (LSIG — Long, short, high instant, ground fault)
L	Electronic (LS — Long and Short time)
S	Molded Case Switch (isolator)

f

Current Range	
Code	Description
C	10 rr. A
D	100 rr0 A
E	1000 rr00 A

Product Selection — 100 A, G-Frame

- UL 489
- CSA 22.2, No. 5

Note: Terminal box lugs provided as standard

Note: Accessories cannot be field installed to the G-Frame circuit breakers. Circuit breakers with 1 auxiliary contact are also available.



14 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Interrupt Rating (50/60 Hz) $I_{cu} // I_{cs}$ [kA]			Interrupt Rating [kA] *	2 Poles	2 Poles w/ 1 aux. contact
			208V AC	240V AC	480V AC		125/250 V DC *	Cat. No.
15	15	150	65	65	14	10	140U-G1C2-C15	140U-G1C2-C15-A
20	20	200	65	65	14	10	140U-G1C2-C20	140U-G1C2-C20-A
25	25	250	65	65	14	10	140U-G1C2-C25	140U-G1C2-C25-A
30	30	300	65	65	14	10	140U-G1C2-C30	140U-G1C2-C30-A
35	35	350	65	65	14	10	140U-G1C2-C35	140U-G1C2-C35-A
40	40	400	65	65	14	10	140U-G1C2-C40	140U-G1C2-C40-A
45	45	450	65	65	14	10	140U-G1C2-C45	140U-G1C2-C45-A
50	50	500	65	65	14	10	140U-G1C2-C50	140U-G1C2-C50-A

* Time constant is 8 ms min.

22 kA, Thermal-Magnetic, Fixed Thermal-Fixed Magnetic

Rated Current I_n [A]	Thermal Trip [A] $I_r = I_n$ (Fixed)	Magnetic Trip [A] $I_m = 10 \times I_n$	Interrupt Rating (50/60 Hz) $I_{cu} // I_{cs}$ [kA]			Interrupt Rating [kA] *	3 Poles	3 Poles w/ 1 aux. contact
			208V AC	240V AC	480V AC		125/250 V DC *	Cat. No.
15	15	150	65	65	22	10	140U-G2C3-C15	140U-G2C3-C15-A
20	20	200	65	65	22	10	140U-G2C3-C20	140U-G2C3-C20-A
25	25	250	65	65	22	10	140U-G2C3-C25	140U-G2C3-C25-A
30	30	300	65	65	22	10	140U-G2C3-C30	140U-G2C3-C30-A
35	35	350	65	65	22	10	140U-G2C3-C35	140U-G2C3-C35-A
40	40	400	65	65	22	10	140U-G2C3-C40	140U-G2C3-C40-A
45	45	450	65	65	22	10	140U-G2C3-C45	140U-G2C3-C45-A
50	50	500	65	65	22	10	140U-G2C3-C50	140U-G2C3-C50-A
60	60	600	65	65	22	10	140U-G2C3-C60	140U-G2C3-C60-A
70	70	700	65	65	22	10	140U-G2C3-C70	140U-G2C3-C70-A
80	80	800	65	65	22	10	140U-G2C3-C80	140U-G2C3-C80-A
90	90	900	65	65	22	10	140U-G2C3-C90	140U-G2C3-C90-A
100	100	1000	65	65	22	10	140U-G2C3-D10	140U-G2C3-D10-A

* Time constant is 8 ms min. and 2 poles of a 3-pole circuit breaker.

Fusetron®

Dual-Element, Time-Delay Fuses

Class RK5 -- 600 Volt

FRS-R
65-600A



Catalog Symbol: FRS-R

Current-Limiting, dual-element, time-delay – 10 seconds (minimum) at 500% rated current

Ratings:

- Volts – 600Vac (or less)
- Amps – 65-600A†
- IR – 200kA RMS Sym.
- 20kA @300Vdc

Agency Information:

CE, UL Listed, Std. 248-12, Class RK5, Guide JDDZ, File E4273 CSA Certified, C22.2 No. 248.12, Class 1422-01, File 53787

Catalog Numbers

FRS-R-65	FRS-R-125	FRS-R-350
FRS-R-70	FRS-R-150	FRS-R-400
FRS-R-75	FRS-R-175	FRS-R-450
FRS-R-80	FRS-R-200	FRS-R-500
FRS-R-90	FRS-R-225	FRS-R-600
FRS-R-100	FRS-R-250	
FRS-R-110	FRS-R-300	

Carton Quantity and Weight

Ampere Ratings	Carton Qty.	Weight*	
		Lbs.	Kg.
65-100	1	0.54	0.245
101-200	1	1.22	0.544
201-400	1	3.00	1.359
401-600	1	5.00	2.268

*Weight per carton.

Recommended Fuse Blocks

These are the most commonly used fuse blocks for Class R 600V fuses.

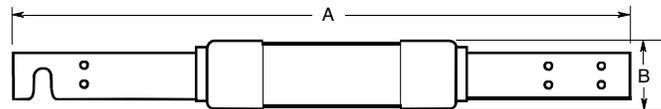
- 65-100A R60100-3CR 3-Pole**
- 110-200A R60200-3CR 3-Pole**
- 225-400A R60400-3CR 3-Pole**



For other available fuse blocks, see Data Sheet 1111.

† To obtain information for 0-60A, see Data Sheet: 1017.

Dimensions - in



Amp Ratings	A	B
65-100	7.88 (± 0.062)	1.11 (± 0.020)
110-200	9.63 (± 0.062)	1.61 (± 0.020)
225-400	11.63 (± 0.094)	2.34 (± 0.020)
450-600	13.38 (± 0.094)	2.88 (± 0.020)

General Information:

- Provides motor overload, ground fault and short-circuit protection. When used in circuits subject to surge currents such as those caused by motors, transformers and other inductive components, these fuses can be sized close to full-load amps to give maximum overcurrent protection.
- The time-delay feature makes it possible to use fuse amp ratings which are much smaller than those of non-time-delay fuses. Considerable cost saving occurs by permitting the use of smaller size switches, panels and fuses themselves.
- Provides a good degree of short-circuit protection (greater current-limitation) to help protect downstream components from high fault currents.
- Gives motor running back-up protection to motors without extra cost.
- Helps protect motors against burnout from overloads and single-phasing when sized properly.
- Simplifies and improves blackout prevention (selective coordination ratios).
- Dual-element fuses can be applied in circuits subject to temporary motor overloads and surge currents to provide both high-performance, short-circuit and overload protection.

Fuse Reducers For Class R Fuses

Equipment Fuse Clips	Desired Fuse (Case) Size	Catalog Number (Pairs) 600V
200A	100A	No. 2621-R
400A	100A	No. 2641-R
	200A	No. 642-R
600A	100A	No. 2661-R
	200A	No. 2662-R
	400A	No. 2664-R**

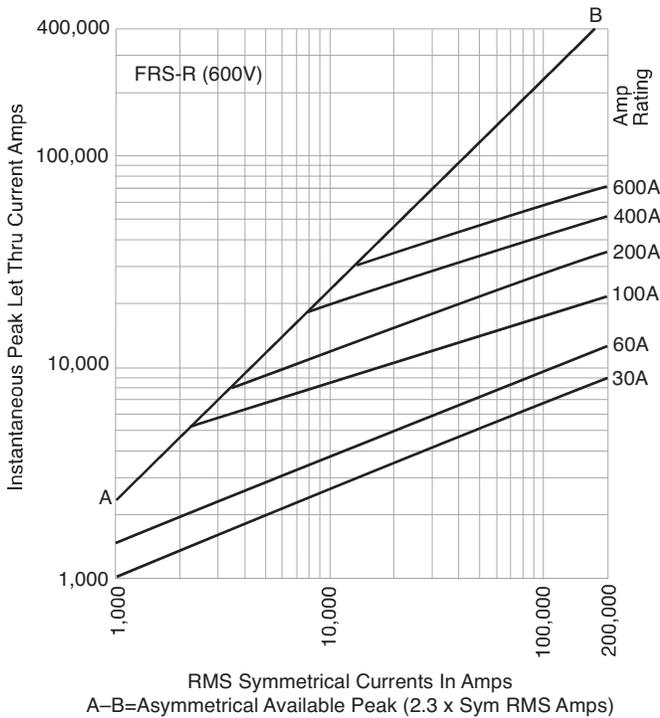
**Single reducer only (pair not required).
For additional information, see Data Sheet: 1118.

Current-Limiting Effects

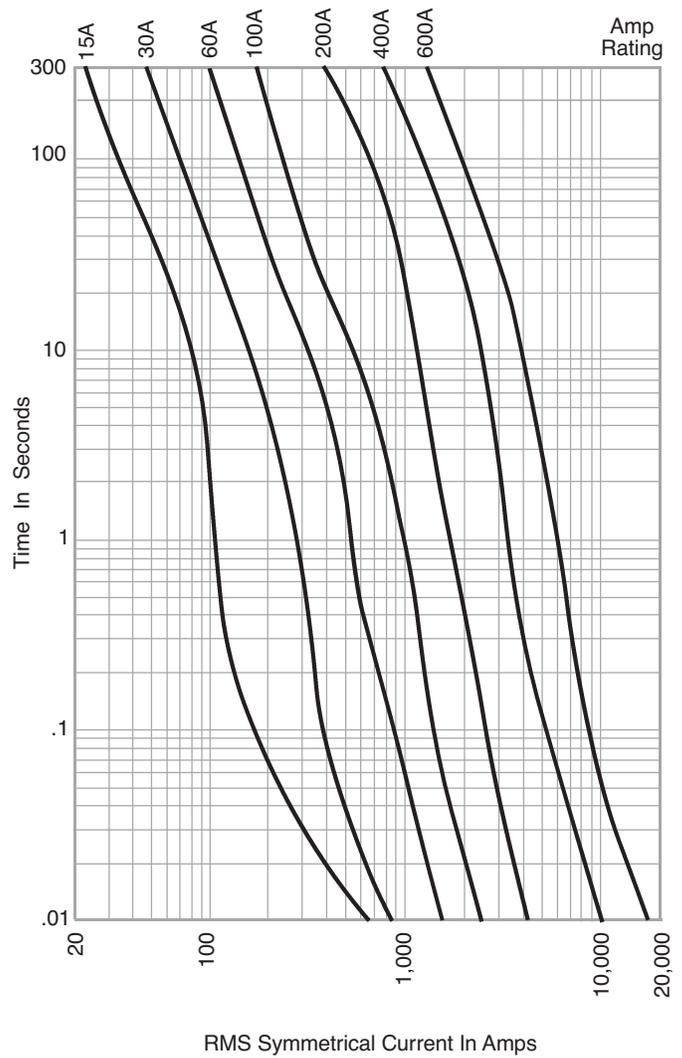
FRS-R Apparent RMS Symmetrical Let-Through Current						
Prospective SCC	30A	60A	100A	200A	400A	600A
5,000	1,400	2,000	2,900	3,950	5,000	5,000
10,000	1,850	2,650	3,600	5,100	8,550	10,000
15,000	2,200	3,200	4,100	5,950	9,750	13,700
20,000	2,450	3,550	4,500	6,600	10,700	15,000
25,000	2,700	3,900	4,850	7,150	11,500	16,100
30,000	2,900	4,280	5,150	7,650	12,200	17,050
35,000	3,100	4,400	5,400	8,100	12,800	17,900
40,000	3,300	4,760	5,600	8,500	13,400	18,700
50,000	3,550	5,150	6,050	9,250	14,400	20,050
60,000	3,800	5,500	6,400	9,850	15,250	21,250
80,000	4,300	6,100	7,000	10,950	16,750	23,300
100,000	4,500	6,600	7,550	11,900	18,000	25,000
150,000	5,200	8,000	8,600	13,800	20,550	28,450
200,000	5,800	8,500	9,400	15,350	22,550	31,200

For information on previous design FRS-R, 70-600, see Data Sheet: 1153.

Current-Limitation Curves



Time-Current Characteristic Curves-Average Melt



The only controlled copy of this Data Sheet is the electronic read-only version located on the Cooper Bussmann Network Drive. All other copies of this document are by definition uncontrolled. This bulletin is intended to clearly present comprehensive product data and provide technical information that will help the end user with design applications. Cooper Bussmann reserves the right, without notice, to change design or construction of any products and to discontinue or limit distribution of any products. Cooper Bussmann also reserves the right to change or update, without notice, any technical information contained in this bulletin. Once a product has been selected, it should be tested by the user in all possible applications.

LOW-PEAK® Time-Delay Fuses

Class L – 600 Volt

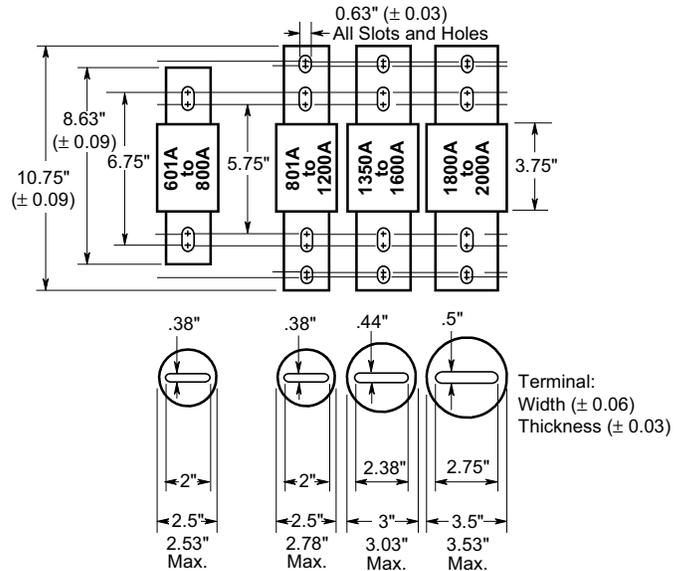
KRP-C

601-2000A



Dimensional Data

All other tolerances (± 0.02)



Catalog Symbol: KRP-C-SP

Time-Delay – 4 seconds (minimum) at 500% rated current
Current-Limiting

Ampere Rating: 601 to 2000 Amperes†

Voltage Rating: 600 Volts AC (or less) 300 Volts DC (or less)

Interrupting Rating: 300,000A RMS Sym. (UL)

Agency Approvals:

UL Listed – Special Purpose[£], Guide JFHR, File E56412
CSA Certified – (200,000 AIR), Class 1422-02, File 53787
Class L per CSA C22.2, No. 248.10

‡Use KRP-CL for current ratings below 601 amps.

*601-3000A is rated 340 VDC and 50 KAIC.

£Meets all performance requirements of UL Standard 248-10 for Class L fuses.

Ampere Ratings†

Catalog Number	Ctn. Qty.	Weight**		Catalog Number	Ctn. Qty.	Weight**	
		Lbs.	Kg.			Lbs.	Kg.
KRP-C-601SP	1	3.75	1.7	KRP-C-1350SP	1	6.50	2.948
KRP-C-650SP				KRP-C-1400SP			
KRP-C-700SP				KRP-C-1500SP			
KRP-C-750SP				KRP-C-1600SP			
KRP-C-800SP				KRP-C-1800SP			
KRP-C-801SP	1	4.5	2.041	KRP-C-1900SP	1	8.5	3.85
KRP-C-900SP				KRP-C-2000SP			
KRP-C-1000SP							
KRP-C-1100SP							
KRP-C-1200SP							

**Weight per carton.

†Special purpose rating of 300,000 AIR.

General Information:

- All-purpose silver-linked fuse for both overload and short-circuit protection for high capacity systems (mains and large feeders).
- Time-delay (minimum of four seconds at five times amp rating) for close sizing.
- Current-limiting action of the fuse generally affords considerable reduction in bus bracing.
- Interrupting rating of 300,000 amperes complies with NEC Sections 110-9 and 230-65 for today's large capacity systems.
- O-ring seals maximize pressure build-up during current-limiting action and ensure filler retention.
- High grade silica-sand filler; accelerates response of fuse to short-circuits by having quenching effect upon the fuse arc.
- 99.9% pure silver fuselinks. The high conductivity of silver gives low watt loss and low operating temperature at normal current levels; maximizes total clearing I²t fault energy let-through.
- Selective coordination (blackout prevention).
- Glass melamine tube.
- Silver-plated end bells.

CE CE logo denotes compliance with European Union Low Voltage Directive (50-1000 VAC, 75-1500 VDC). Refer to BIF document #8002 or contact Bussmann Application Engineering at 636-527-1270 for more information.

LOW-PEAK® Time-Delay Fuses
Class L – 600 Volt

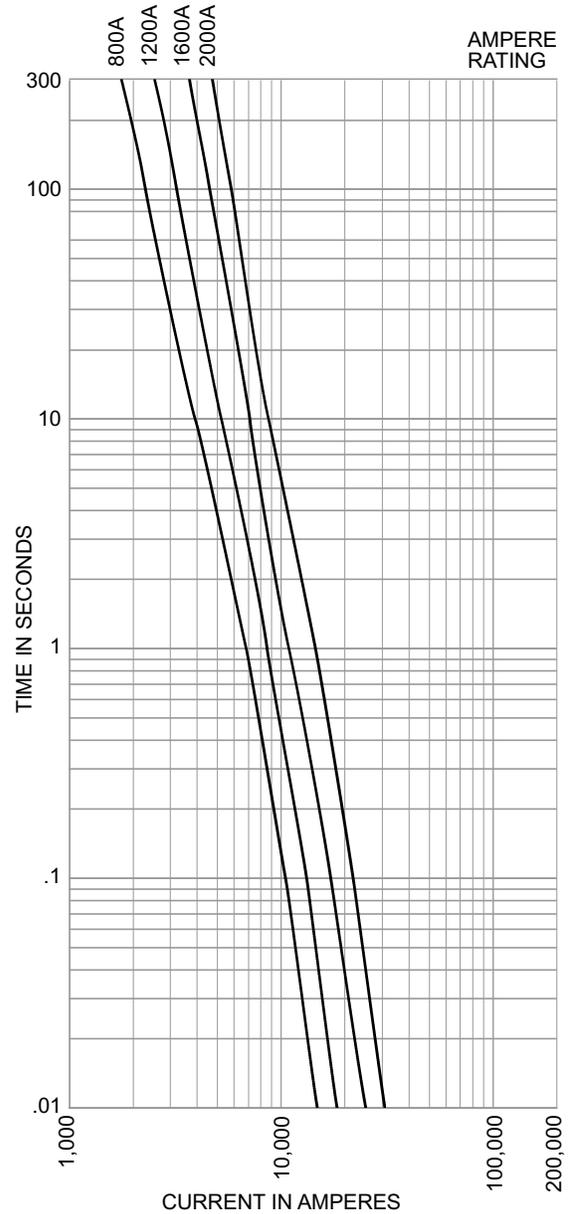
KRP-C
601-2000A

Fuseblocks: (601 - 1200 Amps)

Catalog Number	Poles
51215	1
51235	3

No reducers available.

Time-Current Characteristic Curves—Average Melt



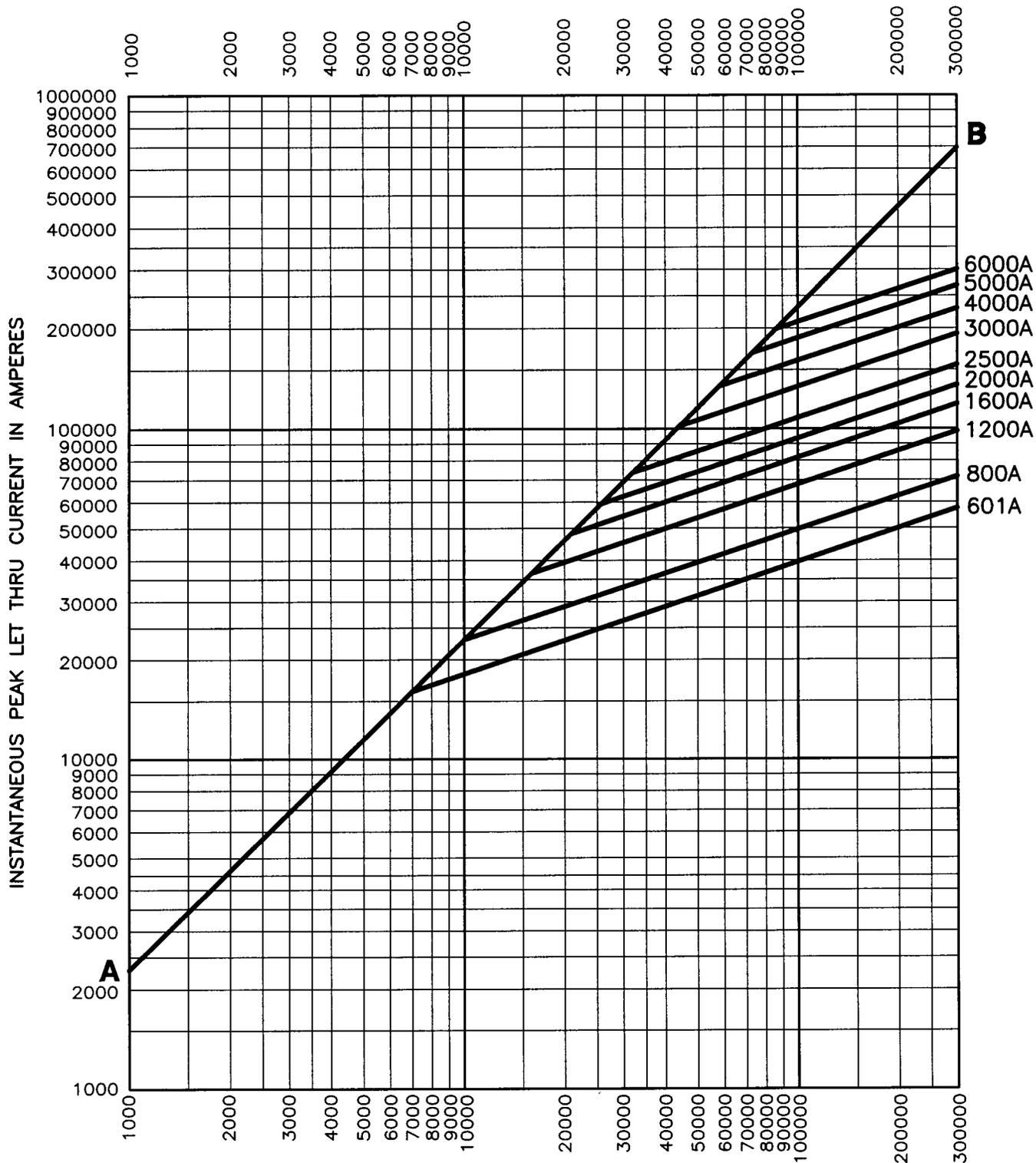
LOW-PEAK® Time-Delay Fuses

KRP-C

Class L - 600 Volt

601-2000A

Current-Limitation Curves



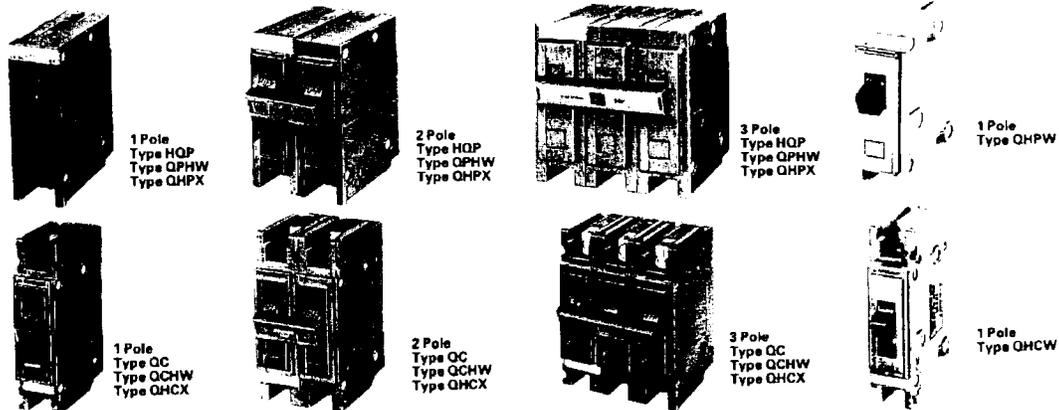
The only controlled copy of this BIF document is the electronic read-only version located on the Bussmann Network Drive. All other copies of this document are by definition uncontrolled. This bulletin is intended to clearly present comprehensive product data and provide technical information that will help the end user with design applications. Bussmann reserves the right, without notice, to change design or construction of any products and to discontinue or limit distribution of any products. Bussmann also reserves the right to change or update, without notice, any technical information contained in this bulletin. Once a product has been selected, it should be tested by the user in all possible applications.



August, 1980
Supersedes Application Data 29-160,
pages 21-22, dated September, 1976
Mailed to: E, D, C/1901, 1928/DB

Standard Types HQP, QC, QPHW, QCHW,
QHPX, QHCX, and MARK 75[®] Types QHCW
and QHPW 10-125 Amperes, 1, 2 and 3 poles,
120/240 and 240 Volts Ac.

AB DE-ION[®] Quicklag[®] Circuit Breakers



Note: MARK 75 Breaker Cases Are of Gray Molded Material

**Continuous Ampere Ratings and
Interrupting Capacity**
Underwriters' Laboratories, Inc. Listed

Types HQP, QC

10,000 Amperes Asym, and Sym. I.C. Ⓞ
1-Pole, 120/240 Volts Ac: 10 to 70 Amps.
2-Poles, 120/240 Volts Ac: 10 to 125 Amps.
2-Poles, 240 Volts Ac: 15 to 50 Amps.
3-Poles, 240 Volts Ac: 15 to 100 Amps.

Types QPHW, QCHW

22,000 Amperes Sym., 25,000 Amps
Asym. I.C.
1-Pole, 120/240 Volts Ac: 15 to 70 Amps.
2-Poles, 120/240 Volts Ac: 15 to 100 Amps.
2-Poles, 240 Volts Ac: 15 to 100 Amps.
3-Poles, 240 Volts Ac: 15 to 100 Amps.

Types QHPX, QHCX

42,000 Amperes Sym
1-Pole 120/240 Volts Ac: 15-70 Amps.
2-Pole 120/240 Volts Ac: 15-100 Amps.
2-Pole 240 Volts Ac: 15-100 Amps.
3-Pole 240 Volts Ac: 15-100 Amps.

MARK 75 Types QHCW, QHPW

65,000 Amperes Sym., 75,000 Amperes
Asym. I.C.
1-Pole, 120/240 Volts Ac: 15-30 Amps.
2-Poles, 120/240 Volts Ac: 15-30 Amps.
3-Poles, 240 Volts Ac: 15-20 Amps.

Ⓞ Panelboards using these 10,000 I.C. breakers as Branch
Breakers in series with Type CAH or DP 22,000 Amp I.C.
Main Breakers can be listed for application at 22,000 am-
peres.

Application

These breakers are designed to protect small
branch circuits in residential, commercial, or
industrial applications. Typical uses are in
loadcenters, lighting panelboards, and for
individual mounting. They are listed with
Underwriters' Laboratories Inc.

On all three-phase Delta, grounded B phase
applications, refer to Westinghouse.

Construction

Features of these breakers include arc
quenchers, quick-make, quick break trip-free
mechanisms, silver alloy contacts, electrically
welded connections, and Molded case. The
MARK 75 breakers have these same standard
features, plus a higher grade molded case
(identified by light gray color) for higher inter-
rupting capacity.

Two and three-pole breakers are common trip
to insure simultaneous manual or automatic
opening of all poles. Ferrous parts are chemi-
cally plated to insure corrosion resistance.

Federal Specification W-C-375b

See tabulation on page 20.1.

Terminals

Types HQP, QHPX, QPHW and QHPW plug-in
breakers have a female, clamp-type line ter-

minal which clips onto a bus stab projection of
a panelboard or loadcenter. Load terminals
are pressure-type connectors.

Breaker types QC, QHCW, QHCX and QCHW
line and load terminals up to 20 amperes use
binding head screws. Line and load terminals
30 amperes and above use pressure-type re-
movable connectors.

Operation

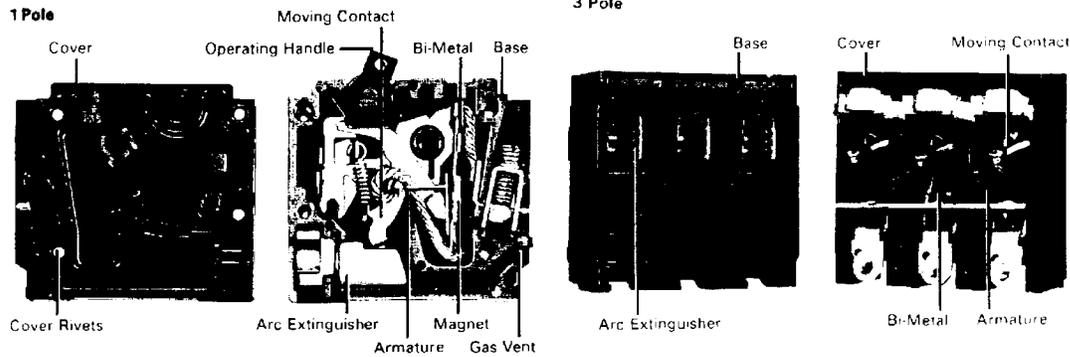
The breaker is shown in the "off" position. In
tripping, the contacts part and the handle
moves to a mid-way position. Moving handle
to extreme "off" position resets the breaker
and it can be restored to service by moving
handle to "on" position. Quicklag Breakers
are UL listed for inverted mounting and re-
verse feed.

Thermal Magnetic Trip

These breakers are equipped with a thermal
magnetic trip. On temporary overloads, the
breaker will not trip. On sustained overloads
beyond safe limits for wire, the bi-metal will
deflect, causing the breaker to trip. Instan-
taneous tripping is provided by a magnetic
element under short circuit conditions. Trip
elements are non-adjustable and non-
interchangeable. Quicklag breakers are cali-
brated at 40°C as standard. Breakers applied
in ambients higher than 40°C should be de-
rated.



Typical Exploded View (Type P Plug-in Breaker Shown)



Switching Neutral Breakers

Types HQNPL and HQCL 10,000 Amps, I.C. Only

Switching neutral breaker is available in 2-pole, 15 and 20 ampere ratings. Its application is gasoline station dispensing pump circuits. Meets the requirements of NEC (Article 514-5); "Each circuit leading to or through a dispensing pump or island shall be provided with a switch or other acceptable means to disconnect simultaneously from the source of supply all conductors of the circuit including the grounded neutral, if any".

Switching Duty

For switching duty requirements for 120 Volts Ac fluorescent light applications, use type QPHW, HQP, QCHW, QC, QHPW, QHCW, QHPX and QHCX, 15 and 20 amperes 1 pole breakers only.

Breaker Mounting

Types HQP, QHPX, QHPW, QPHW (Plug-in): The load end of the breaker is inserted under

the mounting clamp of a panelboard and the line end is merely snapped into position over the bus stab.

Types QC, QHCW, QHCX, QCHW (Bolt-on):

The breaker is mounted in a panelboard by inserting the load end under the mounting clamp and bolting the line end to bus connections. For independent mounting, face mounting plates are used for flush mounting the breakers. Base mounting plates can be used where the plates are mounted in a panel, in this method the breaker base snaps into line and load clips to hold it firm.

Circuit Breaker Removal

Before inspecting, installing or removing from a circuit, the circuit breaker should be in the "off" position, and if practicable, the circuit should be de-energized.

Inspection and Maintenance

Good maintenance procedure calls for periodic inspection of all electrical apparatus including molded case circuit breakers. Termi-

nal lugs must be tight to prevent overheating. Due to the inherent wiping action built into the moving contacts of all Westinghouse circuit breakers, operating the breaker several times under load will remove any high resistance film that may have formed.

Accessories and Modifications

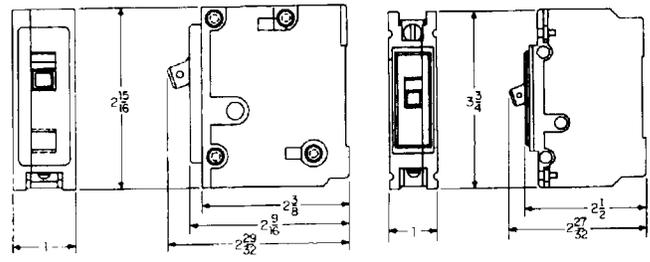
Accessories and modifications available include: lockdog, handle locks for use with padlock, moisture and fungus treatment, and handle ties for using two single-pole breakers for 120/240 volt 2 wire operation. Handle ties assure simultaneous switching, but allow either breaker to register independent trip positions.

Further Information

Prices: Price List 29-020 P WE A
Ordering Data: Tech Data 29-120 T WE A
Dimensions: Dimension Sheet 29-170
Trip Curves: 29-161 A WE A

Printed in USA

Dimensions, Inches ® Not to be used for construction purposes. See Dimension Sheet 29-170 for detailed dimensions.



Type HQP

Type QC

® 2 pole breaker is 2" wide, 3-pole is 3" wide.



September, 1976
Supersedes Application Data
29-160 all previous issues.
Mailed to: E, D, C/29-100A, 31-400A,
31-500A

Standard Types P and B
15-30 Amperes, 120 Volts Ac 1 Pole,
120/240 Volts Ac 2 Poles

AB DE-ION® Quicklag® Ground Fault Circuit Breakers

Interrupting Capacity:

10,000 Amps Sym. or Asym., and 22,000
Amps. Sym., 25,000 Amps Asym.

Sensitivity: 5 Milliamps or Greater

Westinghouse Quicklag Ground Fault circuit
breakers are UL listed as Class A, ground
fault circuit interrupters.

Application

Quicklag Ground Fault circuit breakers are
normally used in loadcenters or panelboards
to protect small branch circuits in residential,
commercial or industrial applications. They
function to protect humans from ground
faults of 5 milliamperes or greater, as well as
normal circuit protection providing inverse
time overload and instantaneous short circuit
protection.

Typical applications include protection against
ground fault hazards in circuits near swimming
pools and outdoor receptacles for which the
National Electric Code requires protection of
human life against ground faults. (Ref. N.E.C.
articles 680-31, 680-20, 680-6, and 210-8)

Construction

Quicklag Ground Fault circuit breakers are 1
or 2 pole thermal magnetic circuit breakers
which incorporate a solid state ground fault
sensing circuit to detect ground current.
Available as plug-in (Type P) or bolt-on
(Type B) design, they are interchangeable in
load centers or panelboards with standard
Westinghouse Type P plug-in and Type B
bolt-on quicklag breaker. The breaker features
a quick-make, quick-break trip free operating
mechanism, silver alloy contacts and welded
connections.

The ground fault sensing circuit consists of a
monitor, a solid state amplifier, and a shunt
trip mechanism.

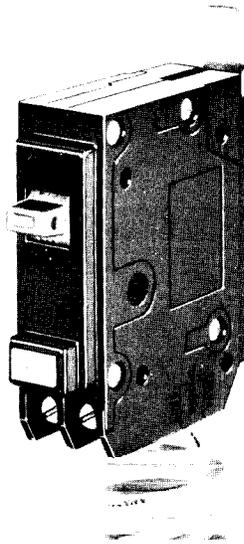
Federal Specification W-C-375b
See tabulation on page 20.1.

Terminals

Type P plug-in design has a female clamp-
type line terminal which plugs onto the bus
stab of a panelboard or loadcenter.

Type B bolt-on design has an extended tang
line terminal that bolts directly to the panel-
board bus connecting strap.

Load terminals are pressure-type connectors
suitable for use with either copper or alu-
minum wire. 15 to 25 ampere breakers accept

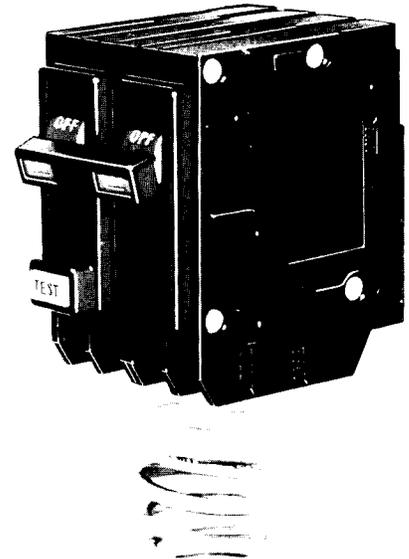


*14-#10 Cu or *12-#8 Al, and 30 ampere
breakers accept *14-#4 Cu or *8-#4 Al.

Installation

The load end of the breaker is inserted under
the mounting clamp of a panelboard, and the
line end is plugged onto the bus stab (or, in
the case of bolt-on design, bolted to the bus
connector strap).

The load end on single pole breakers has two
terminals and a white "pigtail" wire. Two
wires from the 120 volt load to be protected
are brought into the panelboard and con-
nected to the terminals. The black wire is



connected to the terminal marked Load, and
the white wire connected to the terminal
marked Load Neutral. (These wires are shown
passing through the monitor in Figure 1.)
The "pigtail" is connected to the neutral bar
in the panelboard.

Two pole breakers have three load terminals
and a white pigtail. The colored hot load
wires are connected to the outside load
terminals. The white neutral wire (if used) is
connected to the center terminal, identified
by a white mark. The pigtail is connected
to the panel neutral.

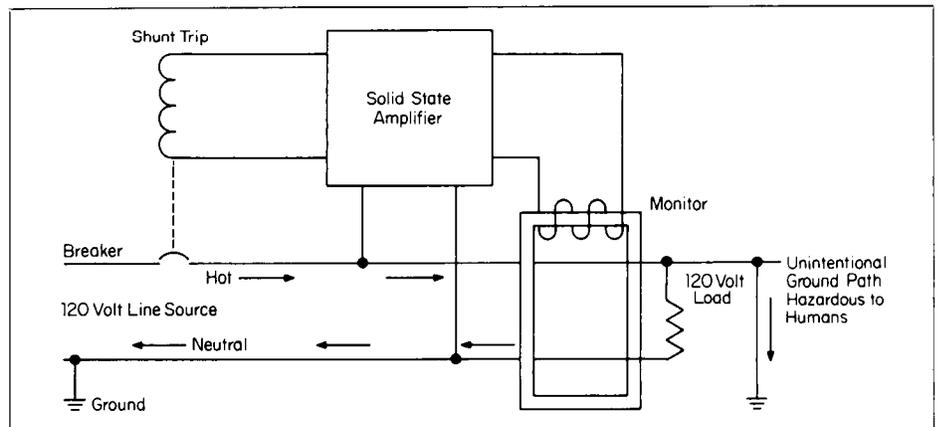


Figure 1



Operation

The Quicklag Ground Fault circuit breaker operates as any standard thermal magnetic breaker, providing protection against overloads and short circuits. The ground fault sensing circuit, Figure 1, monitors current flow in the load supply and return wires (which pass through the monitor) and opens the circuit when it senses a ground fault current of five milliamperes or greater.

Current flowing through a wire generates a magnetic field around the wire. Normally, at any one instant, the current flowing through the load supply and return wires are equal, and their magnetic fields cancel each other. Since there is no current imbalance, no current flows in the secondary winding of the monitor.

However, should an unintentional grounding of the load supply conductor occur, then an alternate path to the system ground would be established. The amount of fault current flowing depends upon the impedance (resistance) of the ground path. The resulting magnetic field, caused by the load supply current exceeding the load return current through the monitor, generates a voltage in the secondary winding. This current imbalance is amplified and fed to the shunt trip, which trips the circuit breaker, opening the circuit to the load. After the ground fault condition has been corrected, the breaker is reset in the normal manner.

Ground Fault Characteristics

The 5 milliamp sensitivity rating offers adequate protection for human life, and minimizes unnecessary operation on small electrical impulses or leakage currents not dangerous to human life. The key to safety appears to be the amount of current an individual can withstand and yet be able to "let go". The 5 milliamp rating is below the known average "let go" current for both women and men.

The Westinghouse Quicklag Ground Fault circuit breaker is UL listed under Standard 943 as a class A, ground fault circuit interrupter, which is defined as a device that will trip when the fault current to ground is within the range of 5 through 264 milliamps. An inverse trip time which varies between 7.26 seconds at 5 MA and .024 seconds at 264 MA is specified.

Inspection and Maintenance

Good maintenance procedure calls for periodic inspection of electrical apparatus. Underwriters' Laboratories, Inc. suggests that the device be checked monthly, and a test record card is provided for this purpose.

Use caution when inspecting or removing the breaker from the circuit, the breaker should be in the Off position and if practical, the circuit should be deenergized.

A test button provides for a check of the electrical system of the ground fault sensing

circuit, and the mechanical operations of the breaker.

Terminal lugs must be tight to prevent overheating. Due to the inherent wiping action built into the moving contacts of all Westinghouse circuit breakers, operating the breaker several times under load will remove any high resistance film that may have formed.

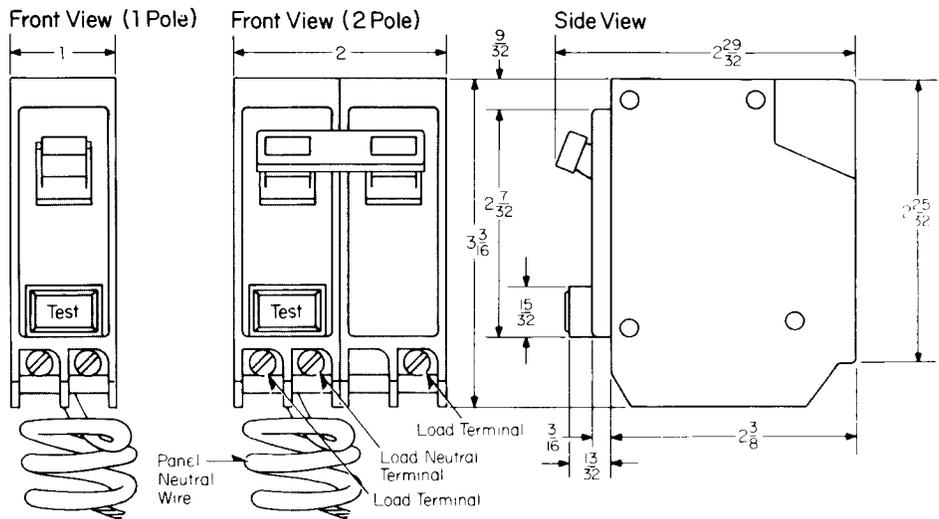
Further Information

Prices: Price List 29-020 P WE A
Ordering Data: Tech Data 29-120 T WE A
Dimensions: Dimension Sheet 29-170

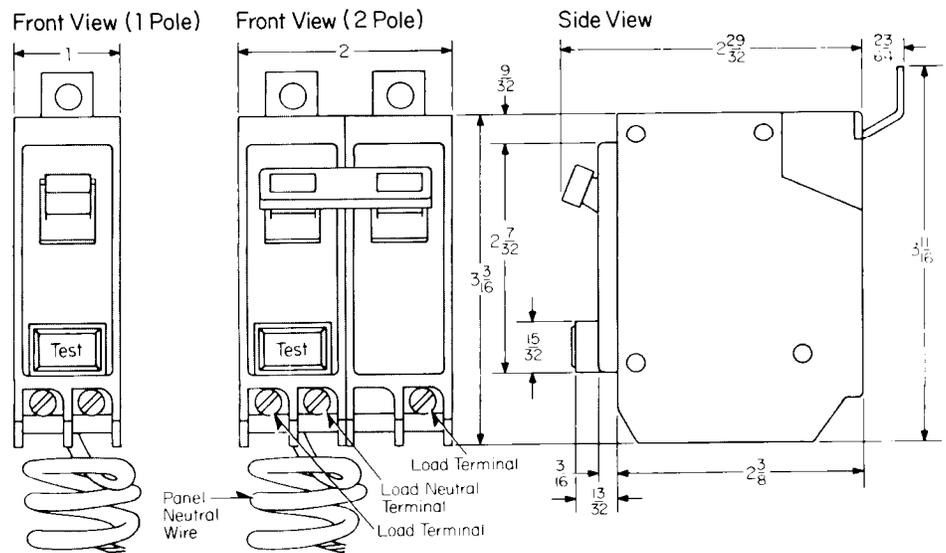
Dimensions, Inches.

Not to be used for construction purposes. See Dimension Sheet 29-170 for detailed dimensions.

Plug-In Breakers



Bolt-on Breakers

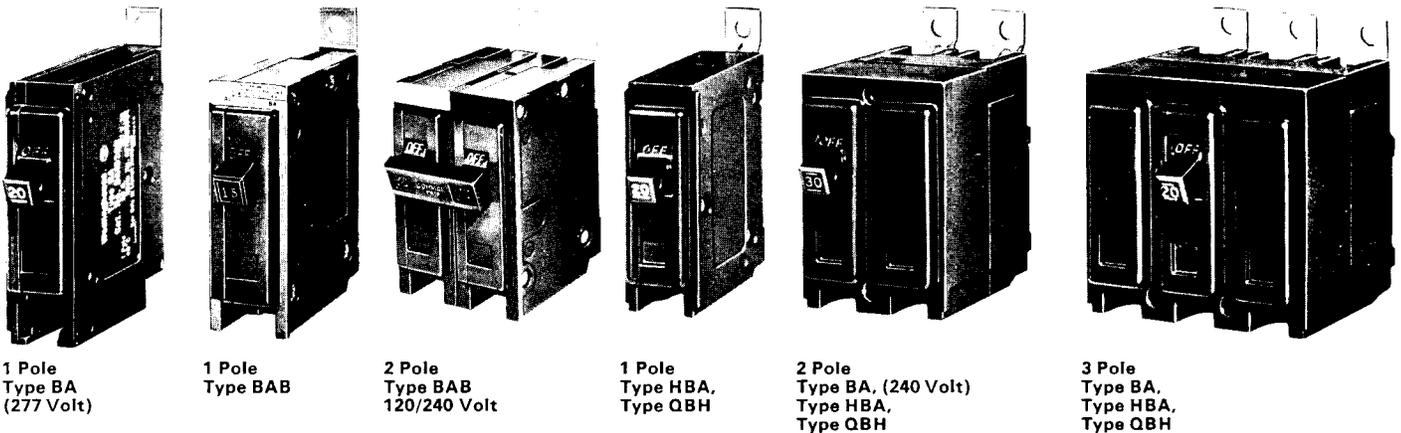




September, 1976
Supersedes Application Data
29-160 all previous issues.
Mailed to: E, D, C/29-100A, 31-400A,
31-500A

Standard Types BA, BAB and Quicklag®
Type QBH, and MARK 75® Type HBA
10-125 Amperes, 120/240, 240, 277 Volts Ac
1, 2, 3 Poles

AB DE-ION® Circuit Breakers



1 Pole
Type BA
(277 Volt)

1 Pole
Type BAB

2 Pole
Type BAB
120/240 Volt

1 Pole
Type HBA,
Type QBH

2 Pole
Type BA, (240 Volt)
Type HBA,
Type QBH

3 Pole
Type BA,
Type HBA,
Type QBH

Note: MARK 75 Cases Are of Gray Molded Material.

Continuous Ampere Ratings and Interrupting Capacities Underwriters' Laboratories, Inc. Listed

Types BAB, BA

10,000 Amperes Sym. or Asym. I.C.⊙
1 Pole, 120/240 Volts Ac: 10 to 70 Amperes
2 Poles, 120/240 Volts Ac: 10 to 125 Amperes
2 Poles, 240 Volts Ac: 15 to 50 Amperes
3 Poles, 240 Volts Ac: 15 to 100 Amperes
1 Pole, 277 Volts Ac: 15 to 30 Amperes

Quicklag Type QBH

22,000 Amperes Sym., 25,000 Amperes
Asym. I.C.
1 Pole, 120/240 Volts Ac: 15 to 70 Amperes
2 Poles, 120/240 Volts Ac: 15 to 100 Amperes
2 Poles, 240 Volts Ac: 15 to 50 Amperes
3 Poles, 240 Volts Ac: 15 to 100 Amperes

Mark 75 Type HBA

65,000 Amperes Sym., 75,000 Amperes
Asym. I.C.
1 Pole, 120/240 Volts Ac: 15-30
2 Pole, 120/240 Volts Ac: 15-30
3 Pole, 240 Volts Ac: 15-20

Application

These circuit breakers are used primarily in panelboards where a bolted line terminal connection is required. Listed by Underwriters' Laboratories, Inc. On all three phase Delta, grounded B phase applications, refer to Westinghouse.

⊙ Panelboards using these 10,000 I.C. breakers as branch breakers in series with CAH or QBH 22,000 amp I.C. main breakers can be listed for application at 22,000 amps.

Construction

Features of the Type BA, BAB & Quicklag QBH Breakers include arc quencher, quick-make, quick-break trip free mechanism, silver alloy contacts, electrically welded connections, and a molded case. The MARK 75 Type HBA has all the standard features, plus a higher grade molded case (identified by light gray color) for higher interrupting capacity. Two and three-pole breakers are common trip to insure simultaneous manual or automatic opening of all poles. Ferrous parts are chemically plated to insure corrosion resistance.

Federal Specification W-C-375b

See tabulation on page 20.1.

Terminals

Line terminals are provided in the form of an extended tang which bolts directly to the panelboard bus connecting strap. Load terminals are as follows:

- Type BA 277 volt: Pressure Type.
- Type BA, HBA, Quicklag QBH:
Binding head screw up to 30 amp and pressure type on higher ratings.
- Type BAB: Pressure Type

Thermal Magnetic Trip

These breakers are equipped with a thermal magnetic trip. On temporary overloads, the breaker will not trip. On sustained overloads beyond safe limits for wire, the bimetal will deflect, causing the breaker to trip. Instantaneous tripping is provided by a magnetic

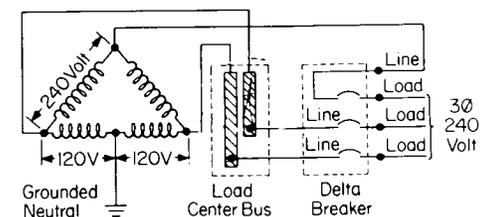
element under short circuit conditions. Trip elements are non-adjustable and non-interchangeable. These breakers are calibrated at 40°C as standard. Breakers applied in ambients higher than 40°C should be derated.

Switching Neutral Breakers

Type BA 10,000 Amps. I.C. Only
Switching neutral breaker is available in 2-pole, 15 and 20 ampere ratings. Its application is gasoline station dispensing pump circuits. Meets the requirements of NEC (Article 514-5); "Each circuit leading to or through a dispensing pump or island shall be provided with a switch or other acceptable means to disconnect simultaneously from the source of supply all conductors of the circuit including the grounded neutral, if any".

Delta Breakers

Type BA 10,000 Amps. I.C. Only

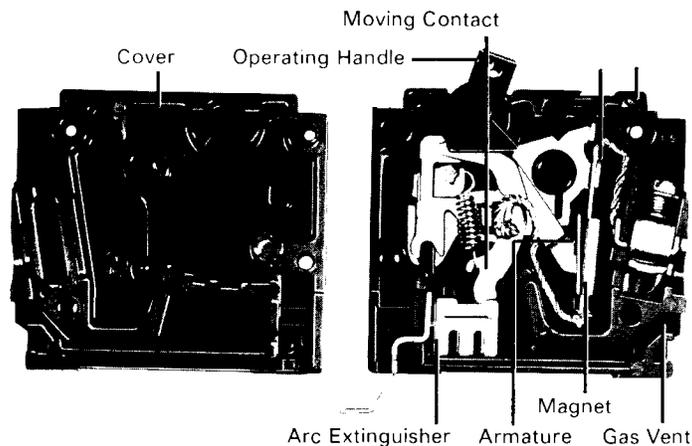


Engineered for 3-phase 4-wire 120/240 volt Ac delta applications which utilize 3-phase motor circuits, such as air conditioning and heat pump applications.

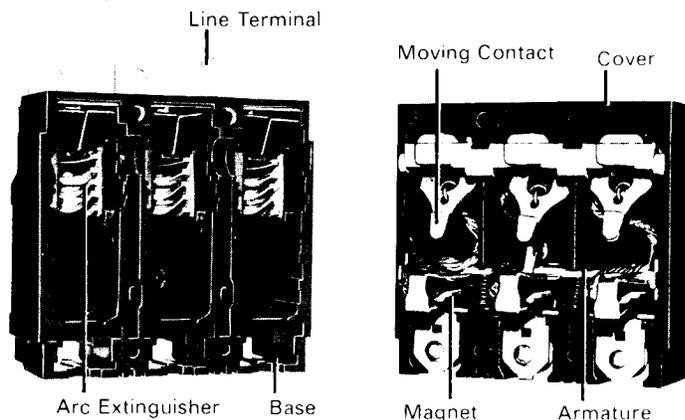


Typical Exploded View 120/240, 240 Volt Ac Breakers

1 Pole Type BAB



3 Pole Type BA



Operation

The breaker is shown in the "OFF" position. In tripping, the contacts part and the handle moves to a mid-way position. Moving handle to extreme "OFF" position resets the breaker and it can be restored to service by moving handle to "ON" position. These breakers are UL Inc. Listed for inverted mounting and reverse feed.

Mounting

The load end of the breaker is inserted under the mounting clamp of a panelboard and the line end is bolted to the bus connector strap.

Circuit Breaker Removal

Before inspecting, installing, or removing from a circuit, the circuit breaker should be in the "OFF" position, and if practicable, the circuit should be de-energized.

Inspection and Maintenance

Good maintenance procedure calls for periodic inspection of all electrical apparatus including molded case circuit breakers. Terminal lugs must be tight to prevent overheating. Due to the inherent wiping action built into the moving contacts of all Westinghouse circuit breakers, operating the breaker several times under load will remove any high resistance film that may have formed.

Accessories and Modifications

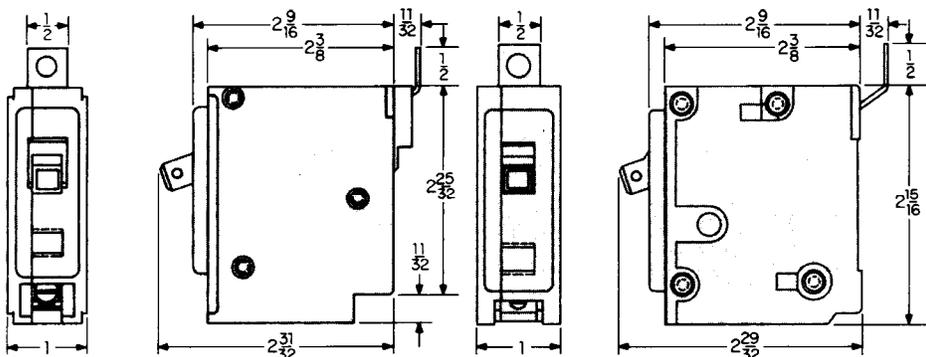
Accessories and modifications available include: lockdog, handle locks for use with padlock, moisture and fungus treatment, and handle ties for using two single pole breakers for 120/240 volt 2 wire operation. Handle ties assure simultaneous switching, but allow either breaker to register independent trip positions.

Further Information

Prices: Price List 29-020 P WE A
 Ordering Data: Tech Data 29-120 T WE A
 Dimensions: Dimension Sheet 29-170
 Trip Curves: Application Data 29-161 A WE A

Dimensions, Inches[Ⓜ]

Not to be used for construction purposes. See Dimension Sheet 29-170 for detailed dimensions.



Type BA 277 Volt

Type BAB

Ⓜ 2-pole breaker is 2" wide, 3-pole is 3" wide.

Westinghouse Electric Corporation
 Distribution and Control Business Unit
 Electrical Components Division
 Pittsburgh, Pennsylvania, U.S.A. 15220

Medium Voltage Fuses

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Medium Voltage Fuses

Originally a Westinghouse Product



Medium Voltage Fuses

Product Description

Cutler-Hammer® Medium Voltage Fuses from Eaton’s electrical business offer such a range of characteristics that almost any fuse application, within the practical range of such interrupting devices, may be satisfied. This range of characteristics is offered in part by the production of both expulsion and current-limiting power fuses.

Expulsion and current-limiting fuses provide such diverse characteristics by employing different areas of fuse technology. These differences in technology, along with the diverse characteristics, require that different questions be answered when applying expulsion and current-limiting fuses.

Product History

The Cutler-Hammer Power Fuse product line was introduced in the 1930s by Westinghouse Electric Corporation. As power systems grew in size, the need to sectionalize utility feeders and protect equipment became apparent. The initial fuse development efforts resulted in the creation of Non-Current Limiting, Expulsion Type Fuses. As the available fault currents grew, the need for a current limiting fuse was apparent and resulted in new interruption techniques.

While basic fuse technology has not changed greatly over the years, gradual improvements have been made to make the fuses more current limiting and easier to manufacture and install. Because standards for fuses (ANSI C37) detail only test methods and basic performance requirements, many different varieties of fuses (length, diameter, short circuit interruption curves) have been introduced over the years.

Eaton presently manufactures medium voltage fuses in Cabo Rojo, PR, where production was moved from East Pittsburgh, PA in 1972.

Product History Time Line

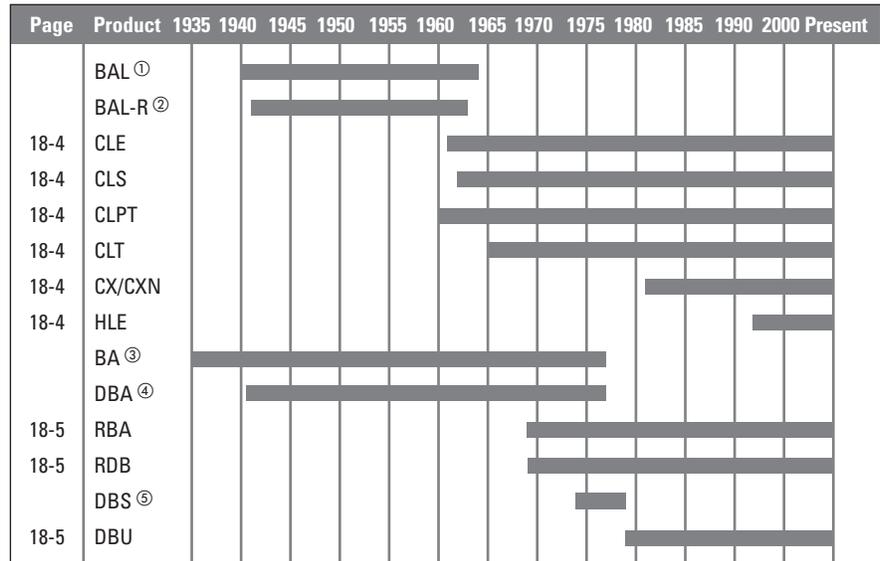


Figure 18-1. Product History Time Line

- ① BAL superseded by CLE.
- ② BAL-R superseded by CLS.
- ③ BA — Refills and holders only, new installations use RBA.
- ④ DBA — Refills only.
- ⑤ DBS — Superseded by DBU.

General Information

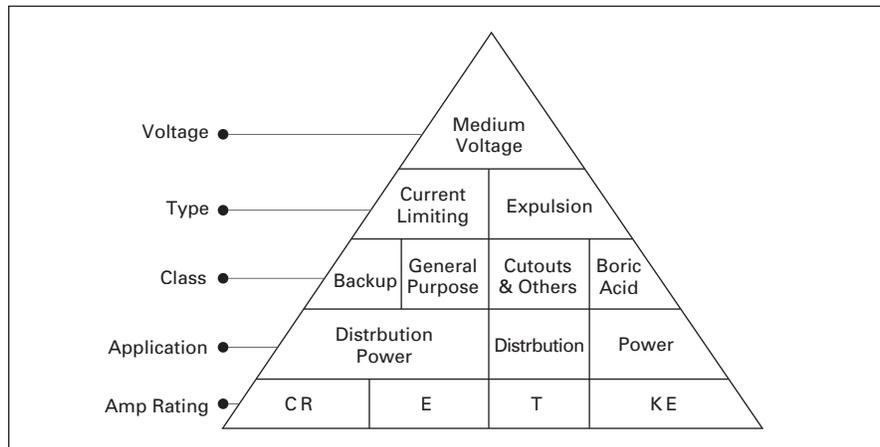


Figure 18-2. Fuses in Perspective

Advantages

Table 18-1. Medium Voltage Fuse Comparison

Expulsion	Current Limiting
Vented Electromechanical Expels Gases/Noise	Sealed Static No Gases/Noise
Interrupts at Natural Current Zero Generally Higher Voltage/Current Applications Differences in Time/Current Characteristics	Limits Fault Current Generally Higher Interrupting Ratings Differences in Time/Current Characteristics

March 2006
Aftermarket Solutions, Ref. No. [425]

Application Guide for Current Limiting and Expulsion

Application Guide

Table 18-2. Application Guide

Selection Guide				Ratings kV, Amp, kA	Feeder Circuit Section- alizing	Fused Switches	Power Trans- formers	Substation Service Trans- formers	DIP Pole	Underground Distribution Transformers	Pole Mounted Trans- formers	Pad- Mounted Distribution Transformers	Motor Starters	Potential Trans- formers	Sub- station Capacitor Banks		
Type	Class	Use	Brand														
Current Limiting	General Purpose	Power	BHLE/ CLE/ HLE/ HCL	2.4 – 15.5 kV 10E – 1350A to 85 kA	●	●	●		●							●	
		Dist.	CX/ CXN	4.3 – 15.5 kV 3.5C – 300C 50 kA				●				●					
		CLT		2.4 – 15.5 kV 4A – 150A 25 kA								●					
	Backup	Power	CLPT	2.4 – 38 kV 0.25E – 10E to 80 kA											●		
		Power	BCLS/ CLS	2.4 – 8.3 kV 2R – 36R 50 kA										●			
	Full Range	Dist.	CXF/ BCXF/ TCXF	8.3 – 23.5 kV 3A – 250A 50 kA				●			●	●	●				
Expulsion	Boric Acid	Power	RBA	4.8 – 34.5 kV 0.5E – 720E	●	●	●									●	
			RDB	4.8 – 34.5 kV 0.5E – 720E	●		●	●	●						●	●	
			DBU	14.4 – 38 kV 5E – 200E 15SE – 200SE 3K – 200K	●	●	●	●	●						●		

Guide to Names

BCLS — Bolt-in version of CLS fuse.

BHLE — Bolt-in version of HLE fuse.

CLE — Current Limiting E-Rated.

HLE/HCL — Current Limiting, E-Rated, Interchangeable with General Electric® and Gould® Shawmut.

CX/CXN — Current Limiting Interchangeable with McGraw-Edison's® NX Brand Fuses, C-Rated.

CLT — Current Limiting Transformer Fuse.

CLPT — Current Limiting E-Rated for Potential Transformers.

CLS — Current Limiting for Motor Starters, R-Rated.

CXF/BCXF/TCXF — Current Limiting Full Range Fuses that provide internal short circuit protection of distribution transformers on high fault networks.

RBA — Refillable Boric Acid Expulsion Fuse (Indoor Use).

RDB — Refillable Dropout Boric Acid Expulsion Fuse (Outdoor Use).

DBU — Dropout Boric Acid Fuse Interchangeable with S&C's SMU-20 Refill.

Guide to Ampere Ratings

"E" Designation

Fuse rated 100E or below will melt in 300 seconds at a current value between 2.0 and 2.4 times the E number.

Fuse rated above 100E will melt in 600 seconds at a current value between 2.2 and 2.64 times the E number.

If the current is higher than 2.4 or 2.64 times the E number, the user must consult the time-current curves for that particular fuse.

"R" Designation

The fuse will melt in 15 to 35 seconds when the current equals 100 times the R number.

If the current is higher than 100 times the R number, the user must consult the time-current curves for that fuse.

"C" Designation

The fuse will melt in 1000 seconds at a current value, between 1.7 and 2.4 times the C number.

If the current is higher than 2.4 times the C number, the user must consult the time-current curves for that particular fuse.

"A" Designation

Fuses that do not comply with "E", "R", or "C" designations.

Expulsion fuses can also be E-rated, K-rated and T-rated, and are also covered in the ANSI standards. The K and T ratings refer, respectively, to relatively "fast" and "slow" melting expulsion fuses. Detailed time-current tables would be needed to adequately define the ratings.

Current Limiting Fuses — Applications and Accessories

Current Limiting Fuses

Product Description



CLE and HLE Current Limiting — E-Rated



*CLPT Current Limiting E-Rated for
Potential Transformer Protection*



CLS Current Limiting for Motor Starter



*CX Current Limiting — Interchangeable
with McGraw Edison's NX Type*



*CLT Current Limiting for
Transformer Protection*

Current limiting fuses are constructed with pure silver fuse elements, high-purity silica sand filler, a specially designed core and a glass resin outer casing.

A high fault current melts the silver element almost instantly and loses energy to the surrounding sand. The sand melts and forms fulgurite, a glass-like substance.

The arc voltage rapidly increases to nearly three times the fuse voltage rating and forces the current to zero. Low fault current melts a solder drop on the silver fuse element which, in turn, melts the silver.

The element burns back until there is a sufficient internal gap to interrupt the current. This is known as the M-effect.

Cutler-Hammer Current Limiting Fuses are offered in two basic types: backup and general purpose. Backup fuses have a published minimum interrupting current and require a series device for breaking the circuit for currents below this minimum level. General purpose fuses have improved low current interruption capability and are designed to interrupt low fault currents that cause the fuse to melt in one hour or less.

General Information

Applications

Current limiting technologies can be used to meet almost every fuse application. Typical applications for utility, industrial, construction and OEM customers include:

- Feeder circuit sectionalizing.
- Power transformers.
- Substation service transformers.
- Underground distribution transformers.
- Pole-mounted transformers.
- Pad-mounted distribution transformers.
- Fused switches.
- DIP poles.
- Motor starters.
- Potential transformers.
- Substation capacitor banks.

Accessories

A wide assortment of mountings, live parts and end fittings are available to facilitate power fuse installation.

Mountings include a base, porcelain or glass polyester insulators and live parts. They help enable the fuse to be safely attached to the gear. Mountings can be either disconnect or nondisconnect.

Live Parts attach the fuse to the mountings and are considered part of the mounting. All parts above the insulators are live parts.

End Fittings are metal parts that attach to each end of the fuse at the ferrules. They are used only on disconnect fuses or when converting a non-disconnect to a disconnect fuse.



Live Parts

March 2006
Aftermarket Solutions, Ref. No. [427]

Expulsion Fuses — Applications and Accessories

Expulsion Fuses

Product Description



RBA — Refillable Boric Acid



RDB — Refillable Dropout Boric Acid



*DBU — Dropout Boric Acid —
Interchangeable with S&C's SMU - 20*

Cutler-Hammer Expulsion Fuses use boric acid as the interrupting medium. Under a fault condition, arc heat decomposes the boric acid which produces gases and boric anhydride. The water vapor blast extinguishes the arc in a deionizing action and exits from the bottom of the fuse.

Type RBA indoor expulsion fuses are fitted with a filter or condenser that moderates the discharge exhaust. The discharge filter limits the exhaust to a small and relatively inert amount of gas and lowers the noise level without affecting the fuse interrupting rating. Steam discharge, that can affect the interrupting, is fully restricted by the condenser.

Each type RDB outdoor dropout fuse includes an ejector pin which is forced through the top of the fuse. The ejector pin releases a latch on the mounting and the fuseholder is kicked outwards and swings into the dropout position, through 180° with a vertical mounting, or 90° with an underslug mounting.

Refill units can be field installed into RBA and RDB expulsion fuses. Once the old unit has been removed, the separately purchased unit can be easily installed into the fuse holder.

General Information

Applications

Expulsion technologies can be used to meet a number of fuse applications. Typical applications for utility, industrial construction and OEM customers include:

- Feeder circuit sectionalizing.
- Fused switches.
- Power transformers.
- Substation service transformers.
- DIP poles.
- Potential transformers.
- Substation capacitor banks.

Accessories

The following accessories are available for expulsion fuses:

Mountings include a base, porcelain or glass polyester insulators and live parts. They help enable the fuse to be safely attached to the gear. Mountings can be either disconnect, nondisconnect, or dropout. Fuses may be vertical or underhung.

Live Parts attach the fuse to the mountings and are considered part of the mounting. All parts above the insulators are live parts.

End Fittings must be mounted on DBU fuse units to enable them to be fitted into the mounting.

Filters and Condensers are for indoor applications of RBA expulsion fuses. They confine the arc within the fuse and substantially reduce the noise and exhaust when the fuse interrupts.

Mufflers are used with DBU fuses in indoor applications to virtually eliminate offensive noise and exhaust gases when the fuse interrupts.

Product Selection

Product Selection

Current Limiting and Expulsion Fuses

Easy to Use, Easy to Order!

Eaton's Cutler-Hammer fuse catalog numbering system makes it easy to order the right fuse. The catalog numbers are easy to remember, unique to each fuse, and are broken down in three descriptive segments: Fuse Type, Voltage Rating and Current Rating.

These Catalog Numbers can be entered directly and easily:

- No change in order processing will occur if you use either a style number or its corresponding catalog number. You will get the same fuse.
- In the back of this ordering guide is a style number to catalog number cross reference chart.

Current Limiting Fuse Examples:

5CLE-30E	5.5 max. kV, CLE fuse unit, 30E amperes
15CXN-45C	15.5 max. kV, CXN fuse unit, 45C amperes
5CLS-GDM-E	5.5 max. kV, CLS fuse unit, Glass Polyester Nondisconnect Mounting
CLE-DL-D	CLE, Disconnect Live Parts Size D

Table 18-3. Current Limiting Fuses Catalog Numbering System

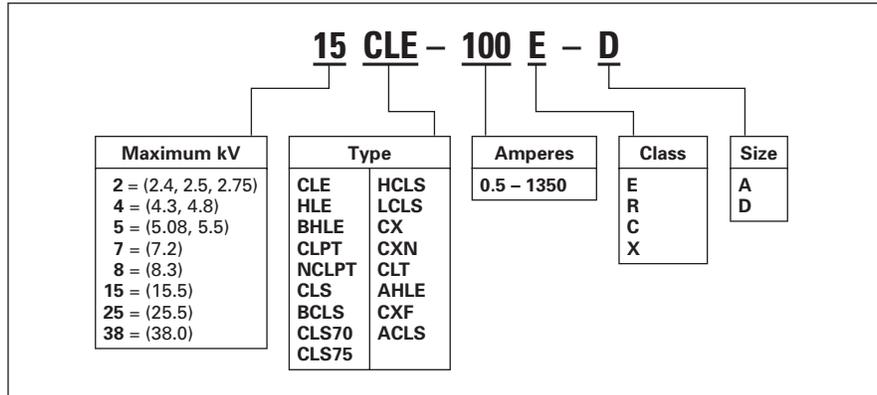
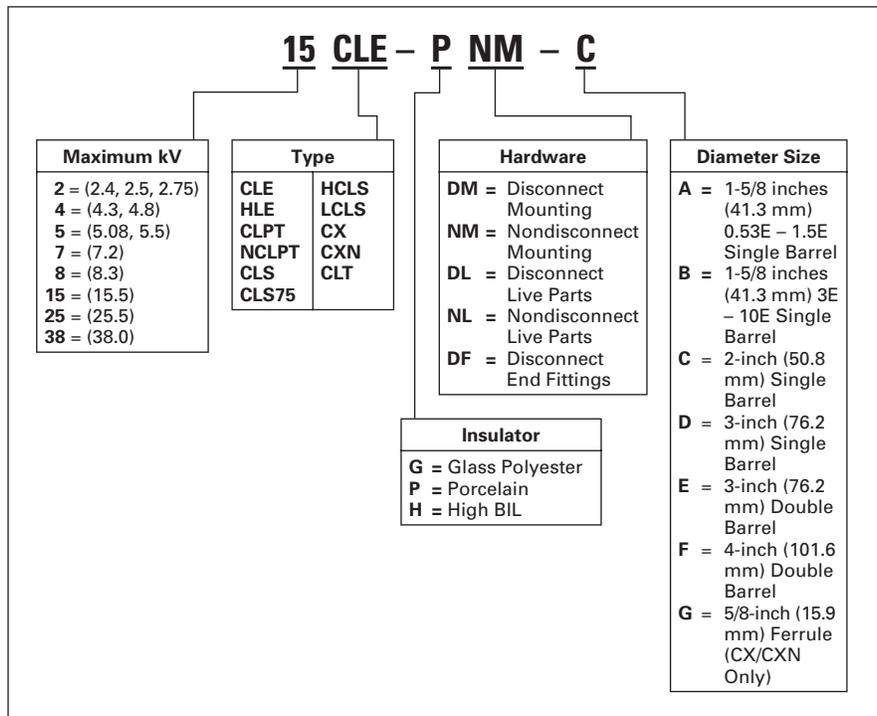


Table 18-4. Current Limiting Fuse Accessories Catalog Numbering System



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Product Selection

**Product Selection
(Continued)**

Expulsion Fuse Examples:

- 8RBA2-10E 8.3 max. kV,
RBA-200 refill,
10E amperes

- DBU17-30K 17.1 max. kV,
DBU fuse unit,
30 amperes

- 15RBA8-INH 15.5 max. kV,
RBA-800,
indicating
nondisconnect
holder

- RBA4-FLTR RBA-400 filter

Table 18-5. Expulsion Fuse Units Catalog Numbering System

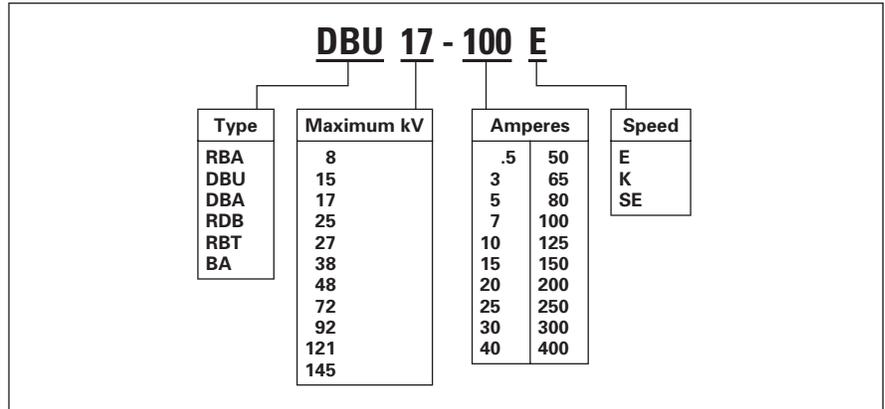
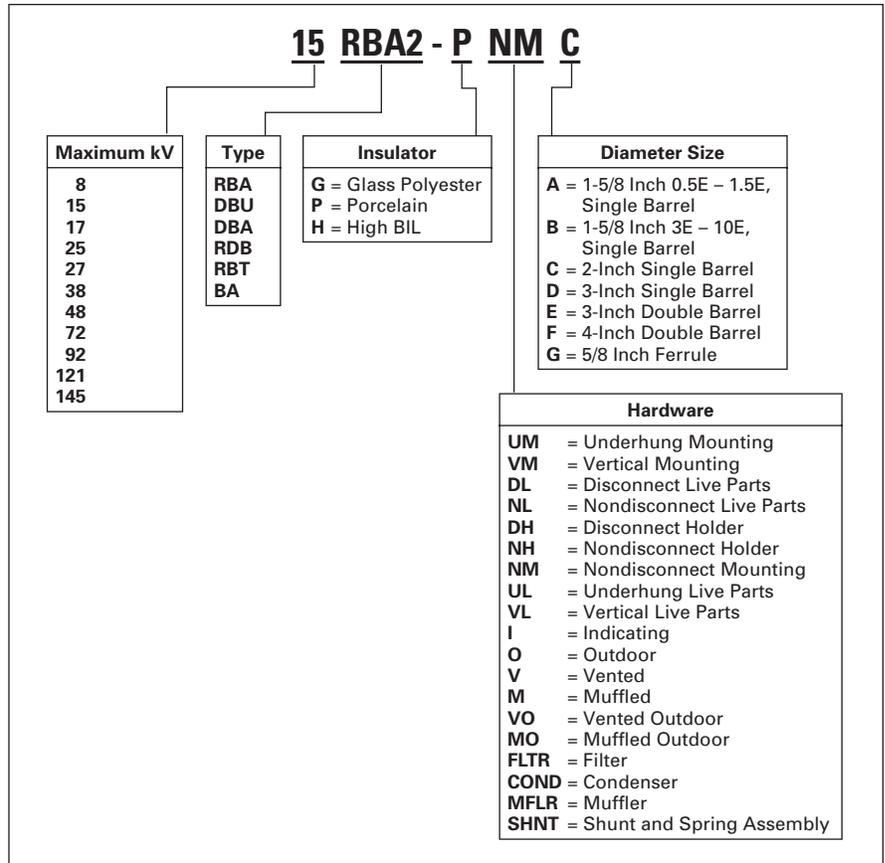


Table 18-6. Expulsion Fuse Accessories Catalog Numbering System



Further Information

Publication Number	Description
--------------------	-------------

Current-Limiting Fuses

PG01303001E	Medium Voltage Current Limiting Fuses Product Focus — Includes Technical Data, Application Information and Curves for CLE, HLE, HCL, CLS, CLPT, CX and CLT Fuses
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Expulsion Fuses

CA01303001E	Medium Voltage Expulsion Fuses Product Focus — Includes Technical Data, Application Information and Curves for RBA, RDB, DBU, DBA Fuses
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General Information

CA08101001E	<i>Electrical Distribution Products and Services Catalog, Section 13</i>
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Pricing Information

Electrical Distribution Products and Services Catalog, Section 13 — CA08101001E

Price and Availability Digest (PAD)

Vista/VISTALINE™ Discount Symbols Y1-F, Y1-FE, Y1-FH

Cutler-Hammer is a federally registered trademark of Eaton Corporation. General Electric is a federally registered trademark of General Electric Company. Gould is a federally registered trademark of Gould Electronics Inc. McGraw-Edison is a federally registered trademark of Cooper Industries Inc.

2.3

Molded Case Circuit Breakers Series C

F-Frame

2

600 Vac Maximum, 250 Vdc Maximum

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current (FLA) ①	MCP Trip Setting ②	MCP Catalog Number
0	3	A	0.69–0.91	9	HMCP003A0C
		B	0.92–1.0	12	
		C	1.1–1.2	15	
		D	1.3–1.5	18	
		E	1.6–1.7	21	
		F	1.8–1.9	24	
		G	2.0–2.2	27	
		H	2.3–2.5	30	
0	7	A	1.5–2.0	21	HMCP007C0C
		B	2.1–2.5	28	
		C	2.6–3.1	35	
		D	3.2–3.6	42	
		E	3.7–3.9	49	
		F	4.3–4.7	56	
		G	4.8–5.2	63	
		H	5.3–5.7	70	
0	15	A	3.4–4.5	45	HMCP015E0C
		B	4.6–5.6	60	
		C	5.7–6.8	75	
		D	6.9–7.9	90	
		E	8.0–9.1	105	
		F	9.2–10.3	120	
		G	10.4–11.4	135	
		H	11.5–12.6	150	
1	30	A	6.9–9.1	90	HMCP030H1C
		B	9.2–11.4	120	
		C	11.5–13.7	150	
		D	13.8–16.0	180	
		E	16.1–18.3	210	
		F	18.4–20.6	240	
		G	20.7–22.9	270	
		H	23.0–25.2	300	
2	50	A	11.5–15.2	150	HMCP050K2C
		B	15.3–19.1	200	
		C	19.2–22.9	250	
		D	23.0–26.8	300	
		E	26.9–30.6	350	
		F	30.7–4.5	400	
		G	34.6–38.3	450	
		H	38.4–42.1	500	

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current (FLA) ①	MCP Trip Setting ②	MCP Catalog Number
2	70	A	16.1–21.4	210	HMCP070M2C
		B	21.5–26.8	280	
		C	26.9–32.2	350	
		D	32.3–37.5	420	
		E	37.6–42.9	490	
		F	43.0–48.3	560	
		G	48.4–53.7	630	
		H	53.8–59.1	700	
3	100	A	23.0–30.6	300	HMCP100R3C
		B	30.7–38.3	400	
		C	38.4–46.0	500	
		D	46.1–53.7	600	
		E	53.8–61.4	700	
		F	61.5–69.1	800	
		G	69.2–76.8	900	
		H	76.9–84.5	1000	
4	150	A	34.6–46.0	450	HMCP150T4C
		B	46.1–57.5	600	
		C	57.6–69.1	750	
		D	69.2–80.6	900	
		D	69.2–80.6	900	
		E	80.7–92.2	1050	
		F	92.3–103.7	1200	
		G	103.8–115.2	1350	
4	150	A	57.0–75.0	750	HMCP150U4C
		B	76.0–95.0	1000	
		C	96.0–114.0	1250	
		D	115.0–130.7	1500	
		E	③	1750	
		F	③	2000	
		G	③	2250	
		H	③	2500	

Notes

- Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate Cam settings and/or MCP ratings should be used.
- For DC applications, actual trip levels are approximately 40% higher than values shown.
- Settings above 130 amperes are for special applications. NEC Article 430.110(a) requires the ampere rating of the disconnecting means to be not less than 115% of the motor full load ampere rating.

HMCP 3–100A come with line and load steel body terminals, 3T100FB. HMCP 150A come with line and load steel body terminals, 3T150FB.

Molded Case Circuit Breakers Series C

2.3

2

Special Low Magnetic Protection Application MCP

600 Vac Maximum, 250 Vdc Maximum

Cont. Amps	Cam Setting	MCP Trip Setting ①	MCP Catalog Number
25	A	40	HMCP025DOC
	B	43	
	D	49	
	E	52	
	F	55	
	G	58	
	H	60	
	50	A	
B		87	
C		93	
D		98	
E		103	
F		109	
G		115	
H		120	
70	A	115	HMCP070J2C
	B	122	
	C	130	
	D	139	
	E	145	
	F	153	
	G	160	
	H	170	
100	A	160	HMCP100L3C
	B	174	
	C	185	
	D	196	
	E	207	
	F	218	
	G	229	
	H	240	

Notes

① For DC applications, actual trip levels are approximately 40% higher than values shown. HMCP 25–100A come with line and load steel body terminals, 3T100FB.

2.3

Molded Case Circuit Breakers

Series C

2

MCPs for Application with Motor Starters Equipped with Electronic Overload Relays

600 Vac Maximum, 250 Vdc Maximum

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current (FLA) ^①	MCP Trip Setting ^②	MCP Catalog Number
0	3	A	0.69–0.91	9	HMCP5003A0C
		B	0.92–1.0	12	
		C	1.1–1.2	15	
		D	1.3–1.5	18	
		E	1.6–1.7	21	
		F	1.8–1.9	24	
		G	2.0–2.2	27	
		H	2.3–2.5	30	
0	7	A	1.5–2.0	21	HMCP5007C0C
		B	2.1–2.5	28	
		C	2.6–3.1	35	
		D	3.2–3.6	42	
		E	3.7–3.9	49	
		F	4.3–4.7	56	
		G	4.8–5.2	63	
		H	5.3–5.7	70	
0	15	A	3.4–4.5	45	HMCP5015E0C
		B	4.6–5.6	60	
		C	5.7–6.8	75	
		D	6.9–7.9	90	
		E	8.0–9.1	105	
		F	9.2–10.3	120	
		G	10.4–11.4	135	
		H	11.5–12.6	150	
1	30	A	6.9–9.1	90	HMCP5030H1C
		B	9.2–11.4	120	
		C	11.5–13.7	150	
		D	13.8–16.0	180	
		E	16.1–18.3	210	
		F	18.4–20.6	240	
		G	20.7–22.9	270	
		H	23.0–25.2	300	
2	50	A	11.5–15.2	150	HMCP5050K2C
		B	15.3–19.1	200	
		C	19.2–22.9	250	
		D	23.0–26.8	300	
		E	26.9–30.6	350	
		F	30.7–34.5	400	
		G	34.6–38.3	450	
		H	38.4–42.1	500	

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current (FLA) ^①	MCP Trip Setting ^②	MCP Catalog Number
3	100	A	23.0–30.6	300	HMCP5100R3C
		B	30.7–38.3	400	
		C	38.4–46.0	500	
		D	46.1–53.7	600	
		E	53.8–61.4	700	
		F	61.5–69.1	800	
		G	69.2–76.8	900	
		H	76.9–84.5	1000	
4	150	A	34.6–46.0	450	HMCP5150T4C
		B	46.1–57.5	600	
		C	57.6–69.1	750	
		D	69.2–80.6	900	
		E	80.7–92.2	1050	
		F	92.3–103.7	1200	
		G	103.8–115.2	1350	
		H	115.3–126.7	1500	
4	150	A	57.0–75.0	750	HMCP5150U4C
		B	76.0–95.0	1000	
		C	96.0–114.0	1250	
		D	115.0–130.7	1500	
		E	③	1750	
		F	③	2000	
		G	③	2250	
		H	③	2500	

Notes

- ① Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.
- ② For DC applications, actual trip levels are approximately 40% higher than values shown.
- ③ Settings above 130A are for special applications. NEC Article 430.110(a) requires the ampere rating of the disconnecting means to be not less than 115% of the motor full load ampere rating.

HMCP 25–100A come with line and load steel body terminals, 3T100FB.
 HMCP5 3–100A come with line and load steel body terminals, 3T100FB. HMCP5 150A come with line and load steel body terminals, 3T150FB.

Molded Case Circuit Breakers 2.3

Series C

J-Frame

600 Vac Maximum, 250 Vdc Maximum

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③	
4	250	A	27.0–30.7	350	HMCP250A5C	
		B	30.8–33.8	400		
		C	33.9–36.9	440		
	5	250	D	37.0–40.3	480	
			E	40.4–43.8	525	
			F	43.9–46.9	570	
			G	47.0–50.7	610	
			H	47.0–50.7	660	
			I	47.0–50.7	700	
			A	34.7–38.8	450	HMCP250C5C
			B	38.9–43.4	505	
C	43.5–47.6	565				
D	47.7–52.2	620				
E	52.3–56.5	680				
F	56.6–60.7	735				
G	60.8–64.9	790				
H	65.0–69.2	845				
I	69.3–73.5	900				
5	250	A	38.5–43.4	500	HMCP250D5C	
		B	43.5–48.0	565		
		C	48.1–53.0	625		
		D	53.1–57.6	690		
		E	57.7–62.3	750		
		F	62.4–67.3	810		
		G	67.4–71.9	875		
		H	72.0–76.9	935		
		I	77.0–81.6	1000		
		A	48.1–53.8	625	HMCP250F5C	
		B	53.9–59.9	700		
C	60.0–66.1	780				
D	66.2–72.3	860				
E	72.4–78.4	940				
F	78.5–83.8	1020				
G	83.9–89.9	1090				
H	90.0–96.1	1170				
I	96.2–102.0	1250				
5	250	A	57.7–64.6	750	HMCP250G5C	
		B	64.7–71.9	840		
		C	72.0–79.2	935		
		D	79.3–86.5	1030		
		E	86.6–93.8	1125		
		F	93.9–101.1	1220		
		G	101.2–108.4	1315		
		H	108.5–115.3	1410		
		I	115.4–122.4	1500		

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③
5	250	A	67.4–75.3	875	HMCP250J5C
		B	75.4–83.8	980	
		C	83.9–92.3	1090	
		D	92.4–100.7	1200	
		E	100.8–109.2	1310	
		F	109.3–117.6	1420	
		G	117.7–126.1	1530	
		H	126.2–134.6	1640	
		I	134.7–142.8	1750	
		A	77.0–86.6	1000	HMCP250K5C
		B	86.6–96.1	1125	
C	96.2–105.7	1250			
D	105.8–115.3	1375			
E	115.4–124.9	1500			
F	125.0–134.6	1625			
G	134.7–144.2	1750			
H	144.3–153.8	1875			
I	153.9–163.3	2000			
5	250	A	86.6–97.3	1125	HMCP250L5C
		B	97.4–108.4	1265	
		C	108.5–118.8	1410	
		D	118.9–129.9	1545	
		E	130.0–140.7	1690	
		F	140.8–151.5	1830	
		G	151.6–162.3	1970	
		H	162.4–173.0	2110	
		I	173.1–183.6	2250	
		A	96.2–108.0	1250	HMCP250M5C
		B	108.1–119.9	1405	
C	120.0–132.3	1560			
D	132.4–144.2	1720			
E	144.3–156.1	1875			
F	156.2–168.0	2030			
G	168.1–179.9	2185			
H	180.0–192.3	2340			
I	192.4–204.0	2500			

Notes

- Motor FLA ranges are typical. The corresponding trip setting is at 13 times the minimum FLA value shown. Where a 13 times setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.
- For DC applications, actual trip levels are approximately 40% higher than values shown.
- Three-pole catalog numbers shown. Two-pole catalog numbers begin with **HM2P** in place of **HMCP**.
All HMCP and HM2P 250A come with line and load steel body terminals, T250KB. (With suffix "C," without "C" comes with TA250KB.)

2.3

Molded Case Circuit Breakers Series C

K-Frame

2

600 Vac Maximum, 250 Vdc Maximum

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③	
4	400	A	27.0–30.7	350	HMCP400A5C	
		B	30.8–33.8	400		
		C	33.9–36.9	440		
5	400	D	37.0–40.3	480	HMCP400A5C	
		E	40.4–43.8	525		
		F	43.9–46.9	570		
		G	47.0–50.7	610		
		H	50.8–53.8	660		
		I	53.9–57.2	700		
5	400	A	38.5–43.4	500	HMCP400F5C	
		B	43.5–48.0	565		
		C	48.1–53.0	626		
		D	53.1–57.6	690		
		E	57.7–62.3	750		
		F	62.4–67.3	810		
		G	67.4–71.9	875		
		H	72.0–76.9	935		
		I	77.0–81.6	1000		
5	400	A	48.1–53.8	625	HMCP400F5C	
		B	53.9–59.9	700		
		C	60.0–66.1	780		
		D	66.2–72.3	860		
		E	72.4–78.4	940		
		F	78.5–83.8	1020		
		G	83.9–89.9	1090		
		H	90.0–96.1	1170		
		I	96.2–102.0	1250		
5	400	A	57.7–64.6	750	HMCP400G5C	
		B	64.7–71.9	840		
		C	72.0–79.2	935		
		D	79.3–86.5	1030		
		E	86.6–93.8	1125		
		F	93.9–101.1	1220		
		G	101.2–108.4	1315		
		H	108.5–115.3	1410		
		I	115.4–122.4	1500		
5	400	A	67.4–75.3	875	HMCP400J5C	
		B	75.4–83.8	980		
		C	83.9–92.3	1090		
		D	92.4–100.7	1200		
		E	100.8–109.2	1310		
		F	109.3–117.6	1420		
		G	117.7–126.1	1530		
		H	126.2–134.6	1640		
		I	134.7–142.8	1750		

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③	
5	400	A	77.0–86.5	1000	HMCP400K5C	
		B	86.6–96.1	1125		
		C	96.2–105.7	1250		
		D	105.8–115.3	1375		
		E	115.4–124.9	1500		
		F	125.0–134.6	1625		
		G	134.7–144.2	1750		
		H	144.3–153.8	1875		
		I	153.9–163.3	2000		
5	400	A	86.6–97.3	1125	HMCP400L5C	
		B	97.4–108.4	1265		
		C	108.5–118.8	1410		
		D	118.9–129.9	1545		
		E	130.0–140.7	1690		
		F	140.8–151.5	1830		
		G	151.6–162.3	1970		
		H	162.4–173.0	2110		
		I	173.1–183.6	2250		
5	400	A	96.2–108.0	1250	HMCP400W5C	
		B	108.1–119.9	1405		
		C	120.0–132.3	1560		
		D	132.4–144.2	1720		
		E	144.3–156.1	1875		
		F	156.2–168.0	2030		
		G	168.1–179.9	2185		
		H	180.0–192.3	2340		
		I	192.4–204.0	2500		
5	400	A	115.4–129.9	1500	HMCP400N5C	
		B	130.0–144.2	1690		
		C	144.3–158.4	1875		
		D	158.5–173.0	2060		
		E	173.1–187.6	2250		
		F	187.7–201.9	2440		
		G	202.0–216.1	2625		
		H	216.2–230.7	2810		
		I	230.8–244.9	3000		

Notes

- Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.
- For DC applications, actual trip levels are approximately 40% higher than values shown.
- Three-pole catalog numbers shown. Two-pole catalog numbers begin with **HM2P** in place of **HMCP**.

All HMCP and HM2P 400A come with aluminum body terminals, 3TA400K. Catalog numbers with suffix "C" as shown above come with copper body terminals 3T400K.

Molded Case Circuit Breakers 2.3

Series C

600 Vac Maximum, 250 Vdc Maximum, continued

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting ②	MCP Catalog Number ③		
5	400	A	134.7–151.5	1750	HMCP400R5C		
		B	151.6–168.4	1970			
		C	168.5–185.3	2190			
		D	185.4–201.9	2410			
		E	202.0–218.8	2625			
		F	218.9–235.7	2845			
		G	235.8–252.6	3065			
		H	252.7–269.2	3285			
		I	269.3–285.7	3500			
		<hr/>					
		5	400	A	153.9–173.0	2000	HMCP400X5C
B	173.1–192.3			2250			
C	192.4–211.5			2500			
D	211.6–230.7			2750			
E	230.8–249.9			3000			
F	250.0–269.2			3250			
G	269.3–288.4			3500			
H	288.5–307.6			3750			
I	307.7–326.9			4000			
<hr/>							
5	400			A	173.1–194.5	2250	HMCP400Y5C
		B	194.6–216.1	2530			
		C	216.2–237.6	2810			
		D	237.7–259.5	3090			
		E	259.6–281.1	3375			
		F	281.2–302.6	3655			
		G	302.7–324.1	3935			
		H	324.2–346.1	4215			
		I	346.2–368.1	4500			

600 Vac Maximum ④

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ①	MCP Trip Setting	MCP Catalog Number		
6	600	A	138.5–184.5	1800	HMCP600L6W		
		B	184.6–230.7	2400			
		C	230.8–276.8	3000			
		D	276.9–323.0	3600			
		E	323.1–369.1	4200			
		F	369.2–415.3	4800			
		G	415.4–461.4	5400			
		H	461.5–507.7	6000			
		<hr/>					
		6	600	A	38.5–46.1	500	HMCP600X6W
				B	46.2–61.4	600	
C	61.5–76.8			800			
D	76.9–96.1			1000			
E	96.2–115.3			1250			
F	115.4–153.7			1500			
G	153.8–192.2			2000			
H	192.3–230.7			2500			
<hr/>							
6	600			A	76.9–96.1	1000	HMCP600Y6W
				B	96.2–115.3	1250	
		C	115.4–153.7	1500			
		D	153.8–192.2	2000			
		E	192.3–230.7	2500			
		F	230.8–269.1	3000			
		G	269.2–307.6	3500			
		H	307.7–346.1	4000			

Notes

- ① Motor FLA ranges are typical. The corresponding trip setting is at 13 x the minimum FLA value shown. Where a 13 x setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.
 - ② For DC applications, actual trip levels are approximately 40% higher than values shown.
 - ③ Three-pole catalog numbers shown. Two-pole catalog numbers begin with **HM2P** in place of **HMCP**.
 - ④ Equipped with electronic trip device.
- All HMCP and HM2P 400A come with aluminum body terminals, 3TA400K. Catalog numbers with suffix "C" as shown above come with copper body terminals 3T400K. All HMCP 600A come without terminals. For terminals, see **Page V4-T2-227**.

2.3

Molded Case Circuit Breakers Series C

N-Frame

2

600 Vac Maximum ^①

NEMA Starter Size	Cont. Amps	Cam Setting	Motor Full Load Current Amperes (FLA) ^②	MCP Trip Setting	MCP Catalog Number
7	800	A	123.1–184.5	1600	HMCP800X7W
		B	184.6–246.1	2400	
		C	246.2–307.6	3200	
		D	307.7–369.1	4000	
		E	369.2–430.7	4800	
		F	430.8–492.2	5600	
		G	492.3–553.7	6400	
8	1200	A	184.6–276.8	2400	HMCP12Y8W
		B	276.9–369.1	3600	
		C	369.2–461.4	4800	
		D	461.5–553.7	6000	
		E	553.8–646.1	7200	
		F	646.2–738.4	8400	
		G	738.5–830.7	9600	

Notes

- ① Equipped with electronic trip device.
- ② Motor FLA ranges are typical. The corresponding trip setting is at 1.3X the minimum FLA value shown. Where a 1.3X setting is required for an intermediate FLA value, alternate cam settings and/or MCP ratings should be used.



Cutler-Hammer
 Westinghouse &
 Cutler-Hammer Products
 Five Parkway Center
 Pittsburgh, Pennsylvania, U.S.A. 15220

Application Data
29-167J

Page 1

December 1998
 Mailed to: E/29-100A

Time/Current Characteristic Curves for
 Westinghouse Series C® J-Frame
 Circuit Breakers

Westinghouse AB DE-ION® Circuit Breakers

Breaker Description	Curve No.	Page
Series C Types JDB, JD, HJD Equipped With Type JT Thermal-Magnetic Trip Unit	SC-4247-87C	2
Series C Types JDC Equipped With Type JT Thermal-Magnetic Trip Unit	SC-4248-87B	3

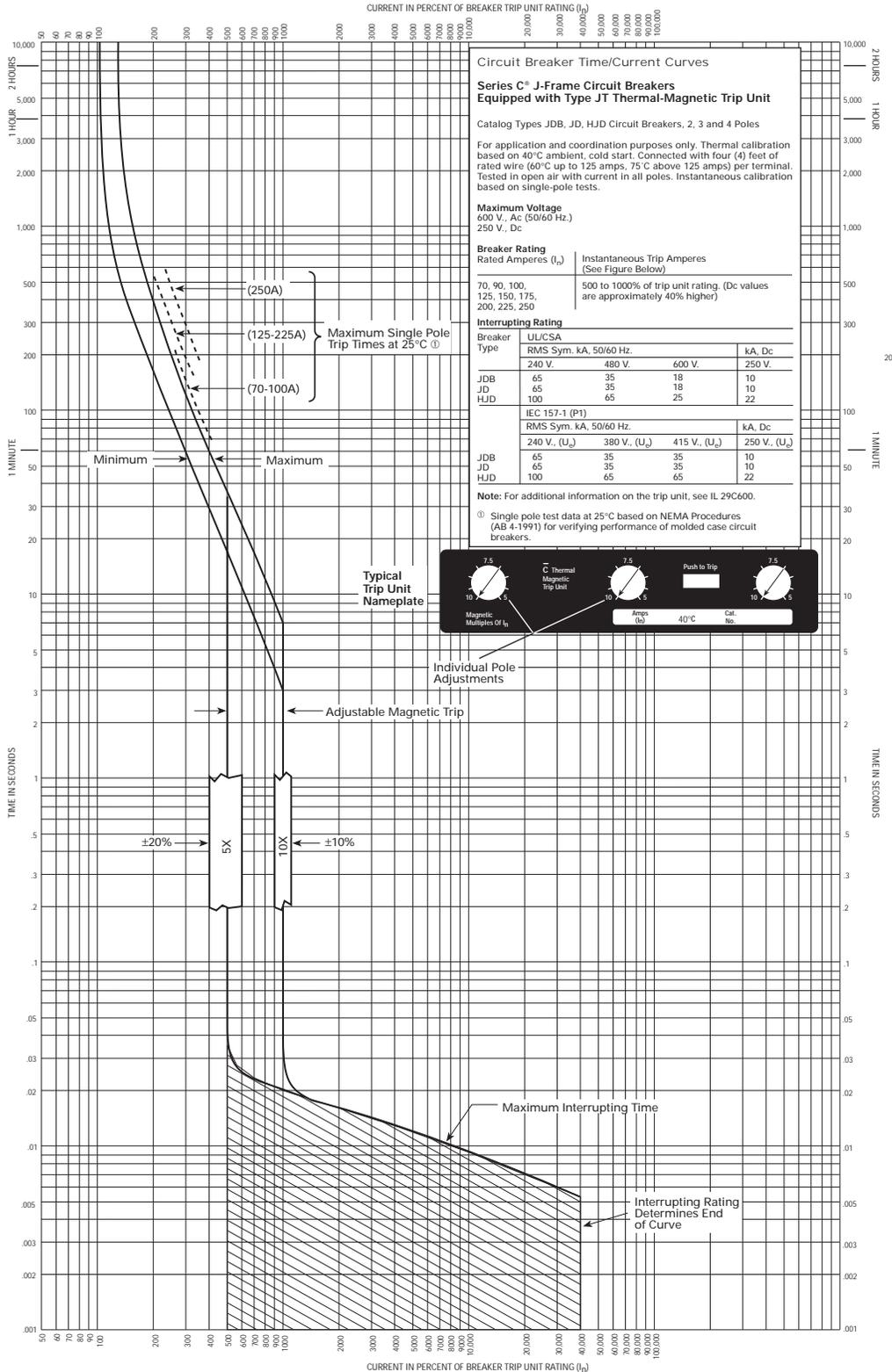
Individual oversize copies of curves listed above printed on onion-skin paper are available in limited quantity from:
 Cutler-Hammer
 Westinghouse &
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 Pittsburgh, PA 15220

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AB DE-ION Circuit Breakers

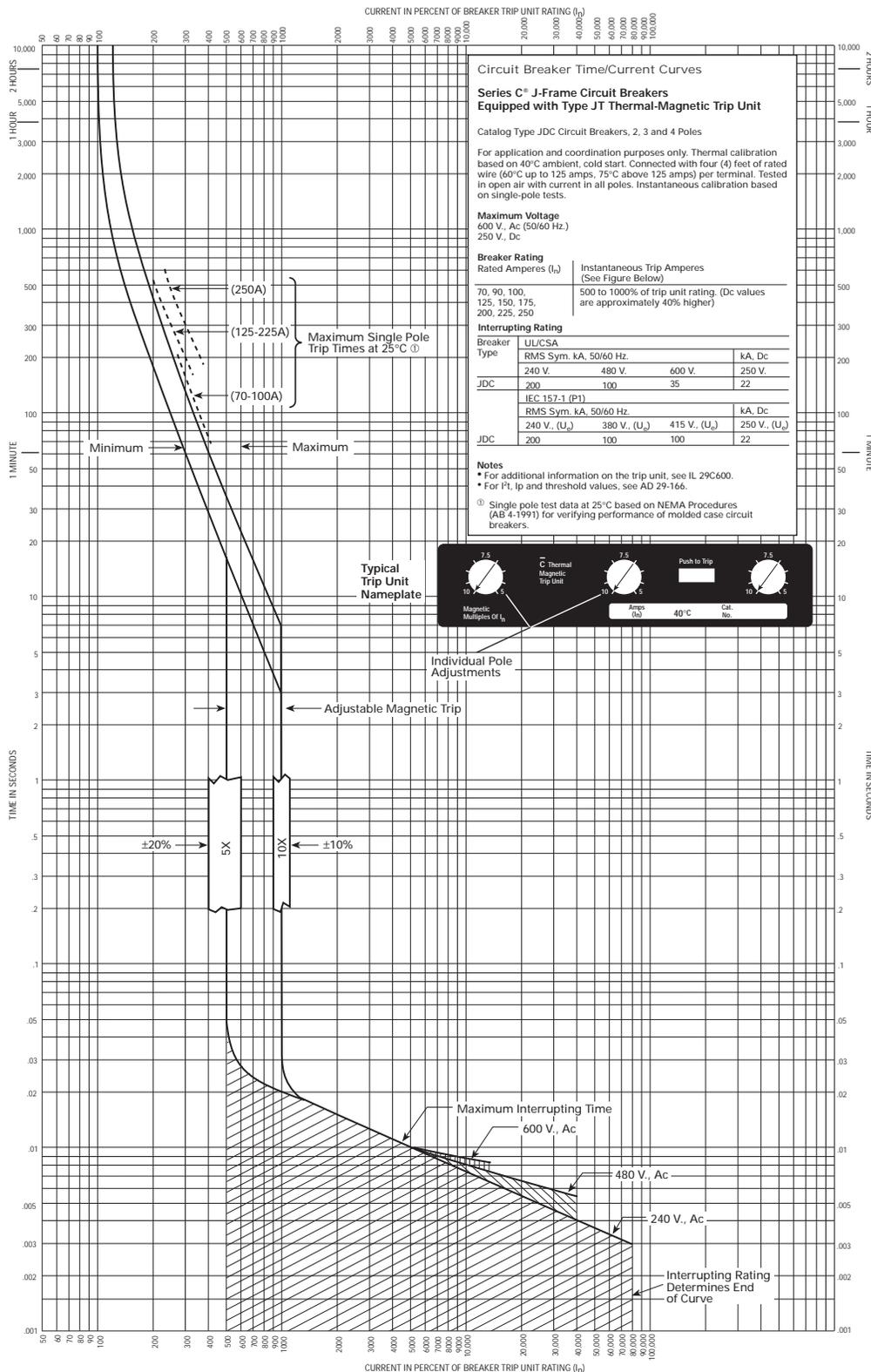
Series C Types JDB, JD, HJD Equipped With Type JT Thermal-Magnetic Trip Unit





AB DE-ION Circuit Breakers

Series C Type JDC Equipped With Type JT Thermal-Magnetic Trip Unit





May 1998

Time/Current Characteristic Curves for
Westinghouse Series C® K-Frame
Circuit Breakers

Westinghouse AB DE-ION® Circuit Breakers

Breaker Description	Curve No.	Page
Series C Type DK Circuit Breakers	SC-4117-87B	2
Series C Types KDB, KD, HKD Circuit Breakers Equipped with Type KT Thermal-Magnetic Trip Unit	SC-4118-87B	3
Series C Type KDC Circuit Breakers Equipped with Type KT Thermal-Magnetic Trip Unit	SC-4119-87B	4
Series C Types KD, CKD, HKD, CHKD Circuit Breakers Equipped with Type KES Digitrip RMS 310 Trip Units		
Types KES3400LS, KES3400LSG	SC-5638-93	5
Types KES3400LSI, KES3400LSIG	SC-5639-93	6
Types KES3250LS, KES3250LSG	SC-5640-93	7
Types KES3250LSI, KES3250LSIG	SC-5641-93	8
Types KES3125LS, KES3125LSG	SC-5642-93	9
Types KES3125LSI, KES3125LSIG	SC-5643-93	10
Series C Type KDC Circuit Breakers Equipped with Type KES Digitrip RMS 310 Trip Units		
Types KES3400LS, KES3400LSG	SC-5644-93	11
Types KES3400LSI, KES3400LSIG	SC-5645-93	12
Types KES3250LS, KES3250LSG	SC-5646-93	13
Types KES3250LSI, KES3250LSIG	SC-5647-93	14
Types KES3125LS, KES3125LSG	SC-5648-93	15
Types KES3125LSI, KES3125LSIG	SC-5649-93	16
Ground Fault Protection (KES3400LSG, KES3400LSIG)①	SC-5650-93	17
Ground Fault Protection (KES3250LSG, KES3250LSIG)②	SC-5651-93	18
Ground Fault Protection (KES3125LSG, KES3125LSIG)③	SC-5652-93	19
Series C K-Frame Circuit Breakers Equipped With Digitrip OPTIM Trip Units		
Long Delay I ² t, Short Delay I ² t	SC-6924-98	20
Long Delay I ² t, Short Delay Flat	SC-6925-98	21
Long Delay I ⁴ t, Short Delay Flat	SC-6926-98	22
Instantaneous and Override, 125 Amperes	SC-6927-98	23
Instantaneous and Override, 250 Amperes	SC-6928-98	24
Instantaneous and Override, 400 Amperes	SC-6929-98	25
Ground Fault or Ground Fault Alarm Only	SC-6930-98	26

① Use in conjunction with SC-5638-93, SC-5639-93, SC-5644-93, or SC-5645-93.
 ② Use in conjunction with SC-5640-93, SC-5641-93, SC-5646-93, or SC-5647-93.
 ③ Use in conjunction with SC-5642-93, SC-5643-93, SC-5648-93, or SC-5649-93.

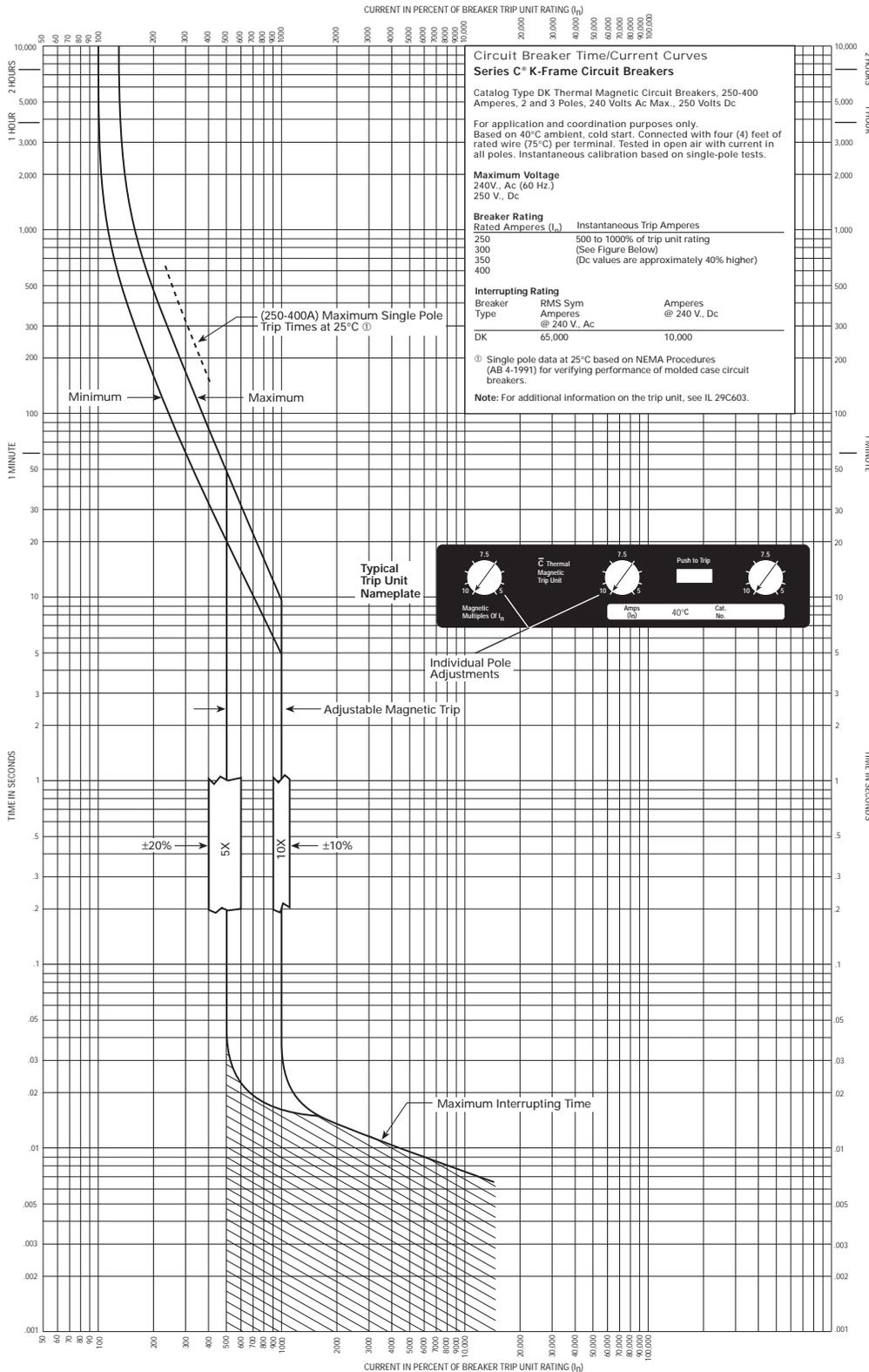
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AB DE-ION Circuit Breakers

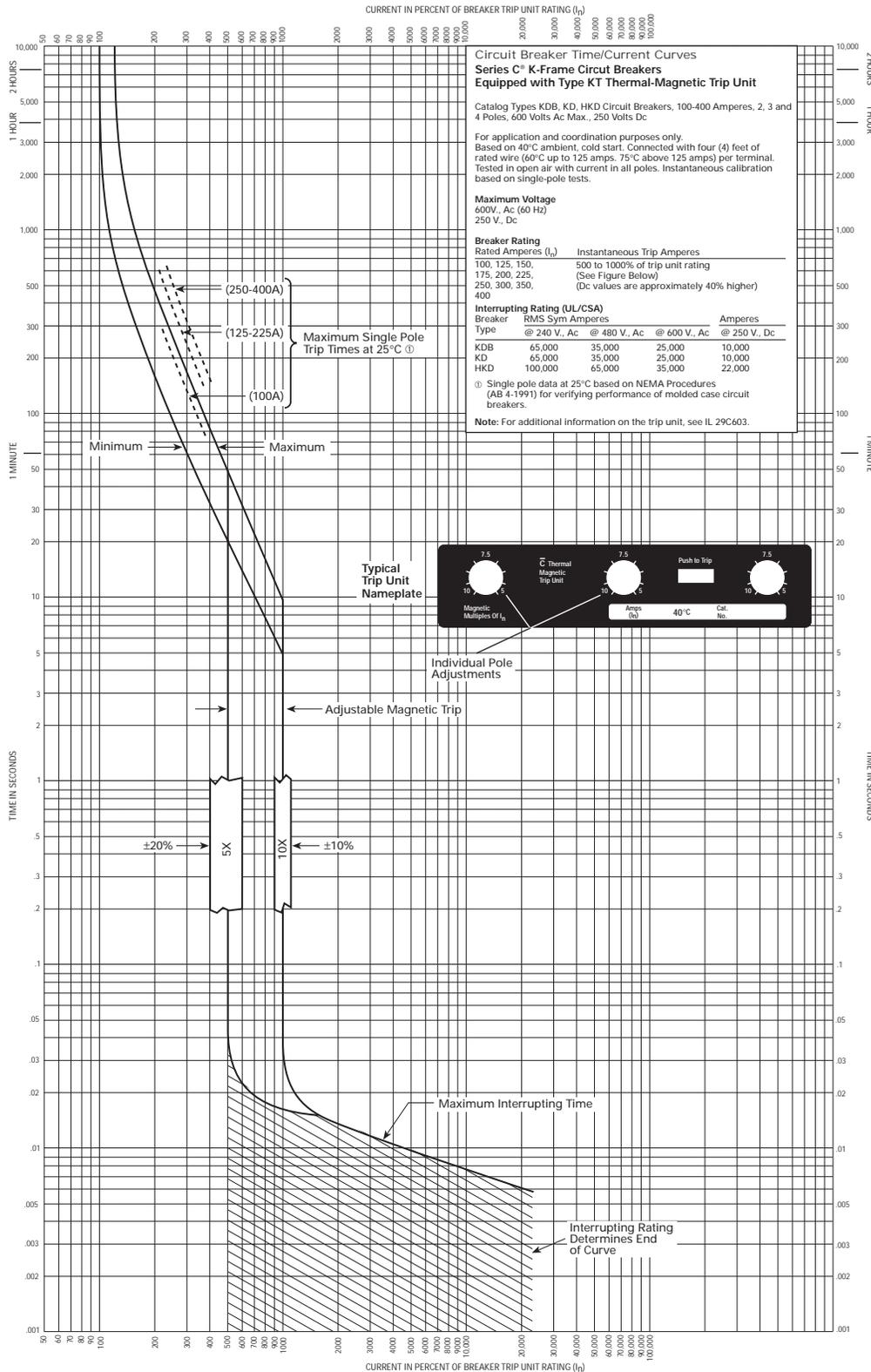
Type DK





AB DE-ION Circuit Breakers

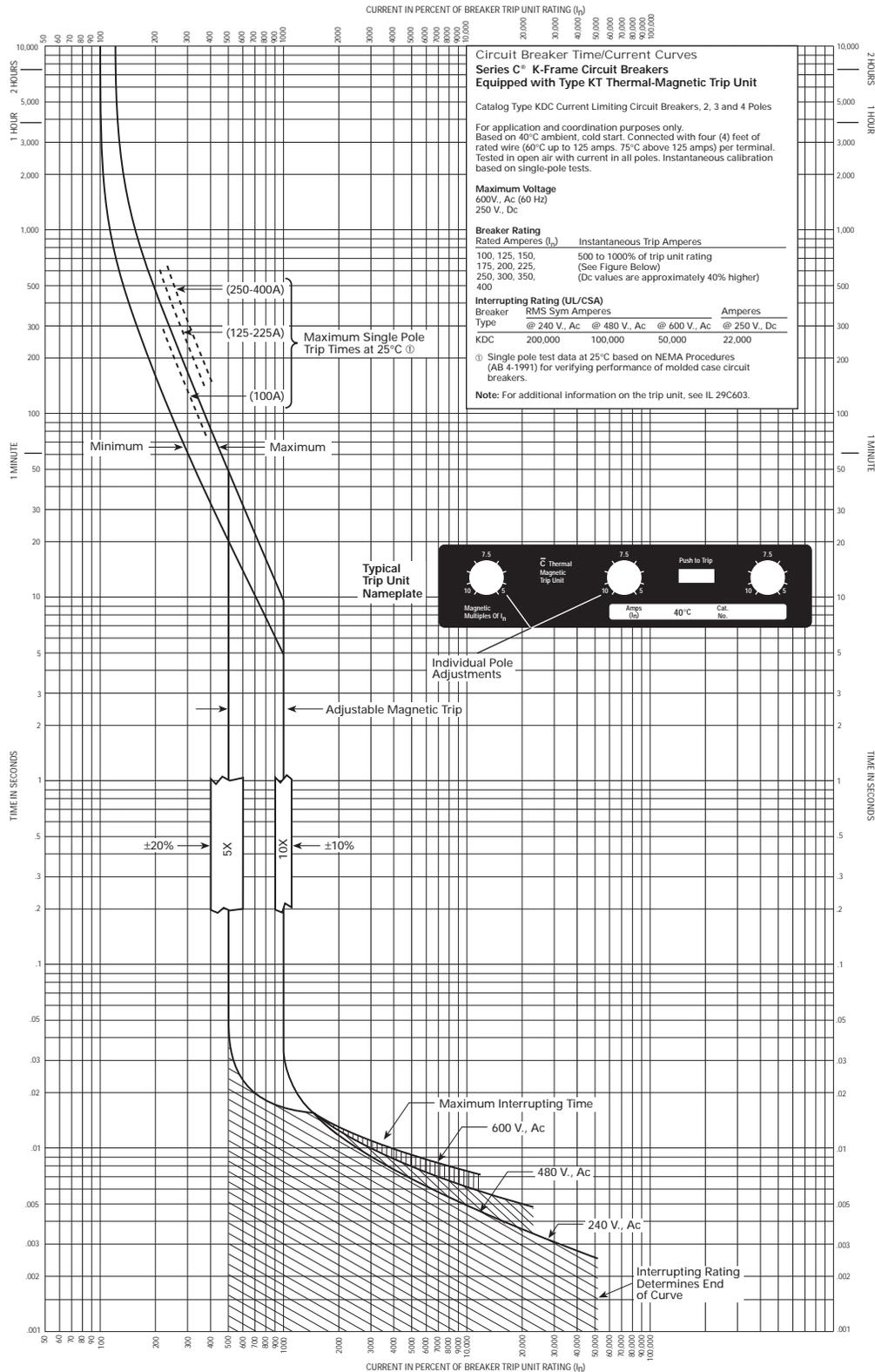
Types KDB, KD, HKD Equipped with Type KT Thermal-Magnetic Trip Unit





AB DE-ION Circuit Breakers

Type KDC Equipped with Type KT Thermal-Magnetic Trip Unit



October 1997
 Mailed to: E/29-100A

 Time/Current Characteristic Curves for
 Westinghouse Series C® L-Frame Circuit
 Breakers

Westinghouse AB DE-ION® Circuit Breakers

Breaker Description	Curve No.	Page
Series C Types LDB, LD, HLD Circuit Breakers Equipped With		
Type LT Thermal-Magnetic Trip Unit	SC-4547-89B	2
Series C Type LDC Circuit Breakers Equipped With		
Type LT Thermal-Magnetic Trip Unit	SC-5760-94	3
Series C Types LD, HLD, CLD, and CHLD Circuit Breakers		
Equipped With Type LES Digitrip RMS 310 Trip Units		
Catalog Types LES3600LS, LES3600LSG, LES4600LS, LES4600LSE, LES4600LSP	SC-5653-93	4
Catalog Types LES3600LSI, LES3600LSIG, LES4600LSI, LES4600LSIP	SC-5654-93	5
Ground Fault Protection	SC-5661-93	6
Series C Types LDC and CLDC Circuit Breakers Equipped With		
Type LES Digitrip RMS 310 Trip Units		
Catalog Types LES3600LS, LES3600LSG, LES4600LS, LES4600LSE, LES4600LSP	SC-5657-93	7
Catalog Types LES3600LSI, LES3600LSIG, LES4600LSI, LES4600LSIP	SC-5658-93	8
Ground Fault Protection	SC-5661-93	6
Series C L-Frame Circuit Breakers Equipped With Digitrip OPTIM Trip Units		
Long Delay I ² t, Short Delay I ² t	SC-6323-96	9
Long Delay I ² t, Short Delay Flat	SC-6324-96	10
Long Delay I ⁴ t, Short Delay Flat	SC-6325-96	11
Instantaneous and Override, 125 Amperes	SC-6329-96	15
Instantaneous and Override, 250 Amperes	SC-6328-96	14
Instantaneous and Override, 400 Amperes	SC-6327-96	13
Instantaneous and Override, 600 Amperes	SC-6326-96	12
Ground Fault or Ground Fault Alarm Only	SC-6330-96	16

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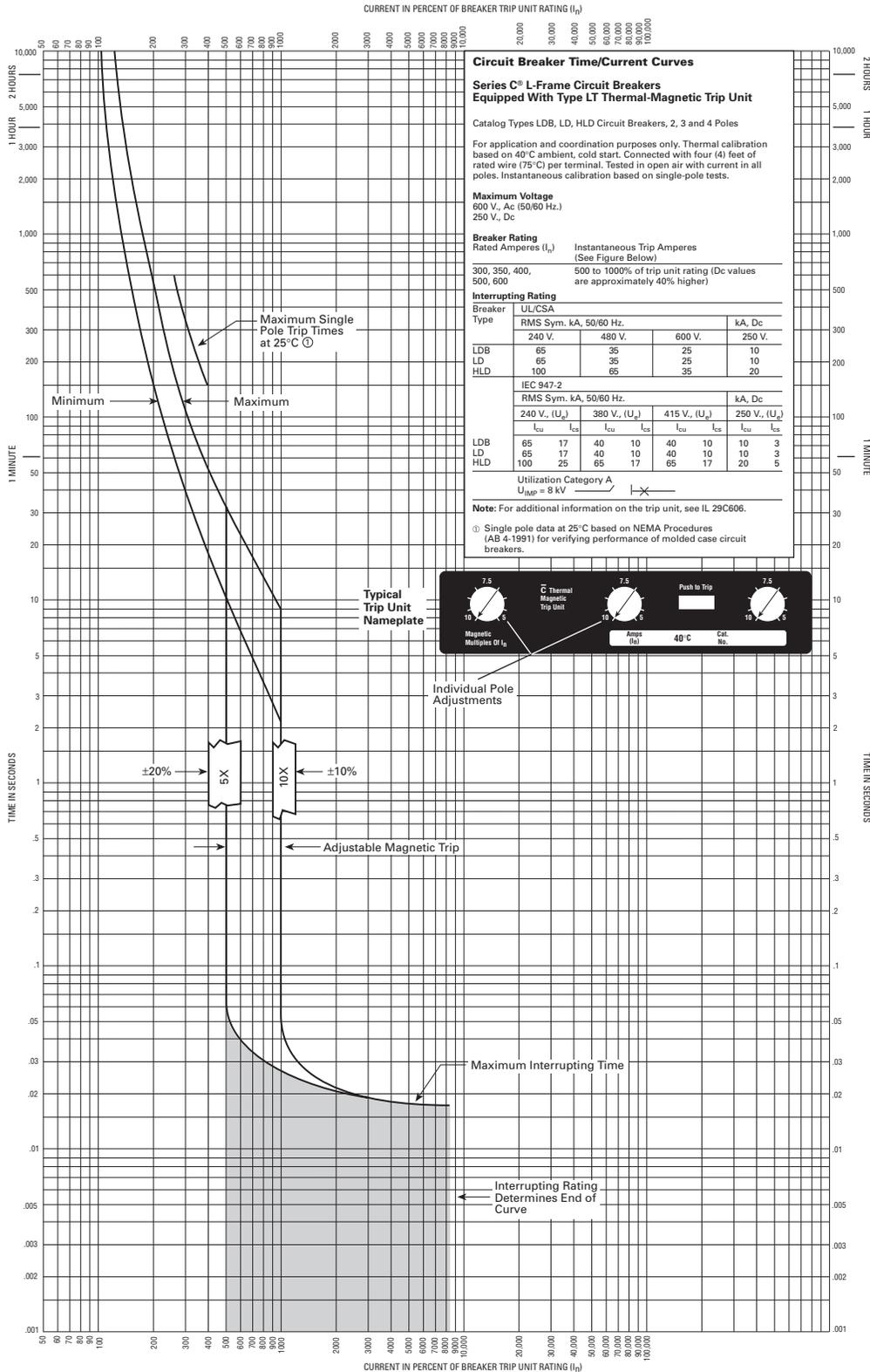
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 Pittsburgh, PA 15220

When ordering onion-skin curves, use number at bottom of page where curve appears, i.e., SC-4547-89B. **Requests for full sets of curves will not be honored.**



AB DE-ION Circuit Breakers

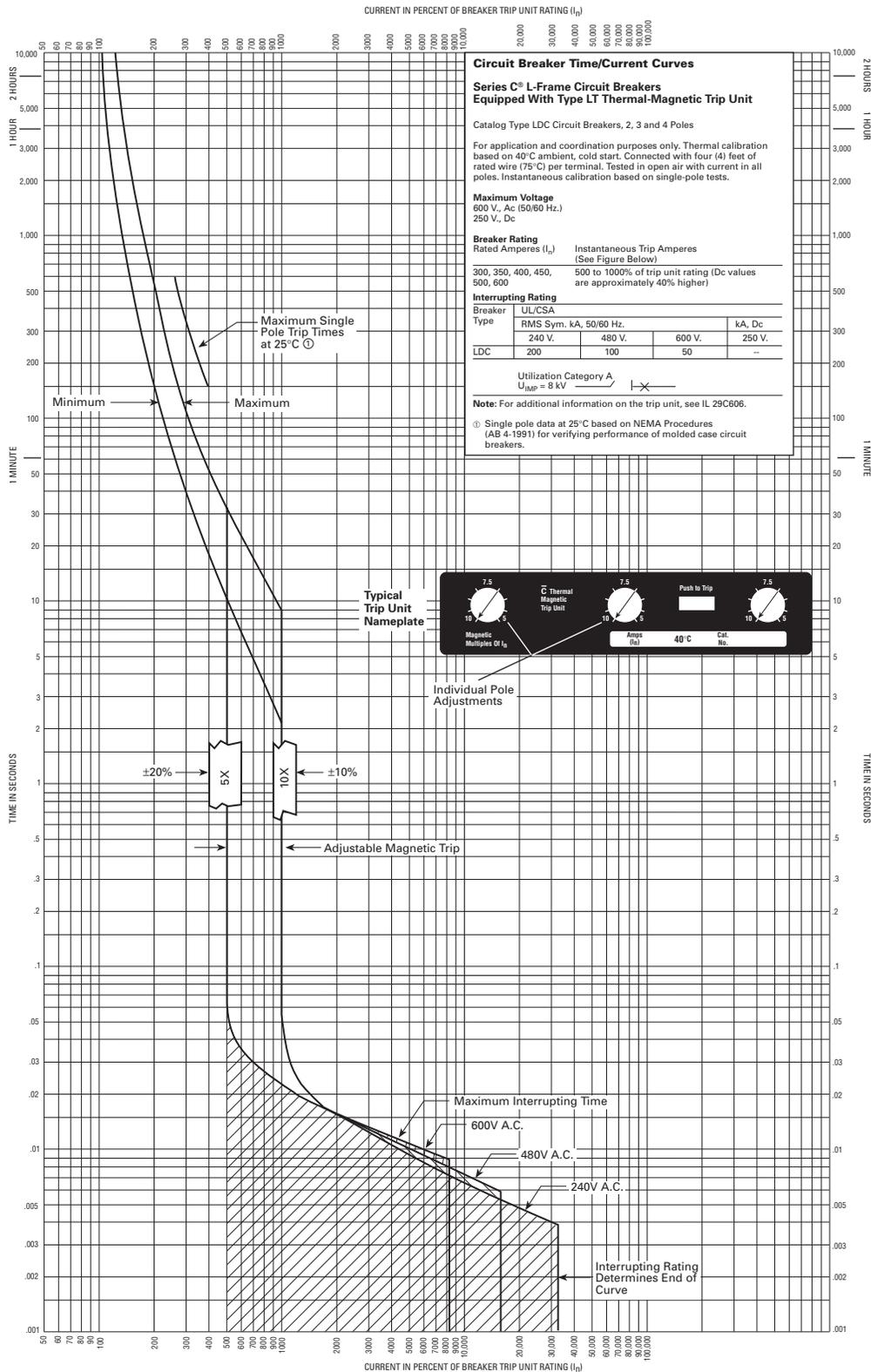
Types LDB, LD, HLD Equipped With Type LT Thermal-Magnetic Trip Unit



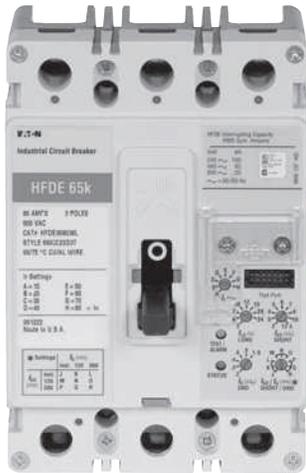


AB DE-ION Circuit Breakers

Type LDC Equipped With Type LT Thermal-Magnetic Trip Unit



F-Frame circuit breaker 10–225 amperes



Product description

- All of Eaton's F-Frame circuit breakers are HACR rated
- All F-Frame thermal-magnetic circuit breakers 10–50A are suitable for HID (high intensity discharge) use
- All F-Frame circuit breakers are suitable for reverse feed use

Table 1. Frame Trip Ratings

Frame	Ampere Rating
EDB, EDS, EDH, EDC	100–225
EHD	10–100
FDB	10–150
ED, HFD, FDC, HFDDC	15–225
FD	15–225
FDE, HFDE, FDCE [Ⓞ]	80, 160, 225

[Ⓞ] The 80A FDE, HFDE, FDCE is adjustable from 15–80A.
The 160A FDE, HFDE, FDCE is adjustable from 60–160A.
The 225A FDE, HFDE, FDCE is adjustable from 100–225A.

EATON

Powering Business Worldwide

Table 2. UL® 489 Interrupting Capacity Ratings

Circuit Breaker Type	Number of Poles	Trip Type ①	Interrupting Capacity (Symmetrical Amperes)					
			Volts AC (50/60 Hz)				Volts DC	
			240	277	480	600	125	250 ②③
EDB	2, 3	T/M N.I.T.	22,000	—	—	—	10,000	—
EDS	2, 3	T/M N.I.T.	42,000	—	—	—	10,000	—
ED	2, 3	T/M N.I.T.	65,000	—	—	—	10,000	—
EDH	2, 3	T/M N.I.T.	100,000	—	—	—	10,000	—
EDC ④	2, 3	T/M N.I.T.	200,000	—	—	—	10,000	—
EHD	1 2, 3	T/M N.I.T.	— 18,000	14,000 —	— 14,000	— —	10,000 —	— 10,000
FDB	2, 3, 4	T/M N.I.T.	18,000	—	14,000	14,000	—	10,000
FD	1 2, 3, 4	T/M N.I.T.	— 65,000	35,000 —	— 35,000	— 18,000	10,000 —	— 10,000
HFD	1 2, 3, 4	T/M N.I.T.	— 100,000	65,000 —	— 65,000	— 25,000	10,000 —	— 22,000
FDC ④	2, 3, 4	T/M N.I.T.	200,000	—	100,000	35,000	—	22,000
HFDDC ⑤	3	T/M N.I.T.	—	—	—	—	—	50,000 ⑥
FDE	3	Electronic N.I.T.	65,000	—	35,000	18,000	—	—
HFDE	3	Electronic N.I.T.	100,000	—	65,000	25,000	—	—
FDCE ④	3	Electronic N.I.T.	200,000	—	100,000	25,000	—	—

① N.I.T. is non-interchangeable trip unit. T/M is thermal-magnetic. For DC applications, magnetics are approximately 40% higher.

② Two-pole circuit breaker, or two poles of three-pole circuit breaker.

③ Time constant is 3 milliseconds minimum at 10 kA and 8 milliseconds minimum at 22 kA.

④ Current limiting.

⑤ HFDDC is UL only and is not tested to other standards.

⑥ Interrupting rating is 42,000A at 600 Vdc with three-poles in series.

Table 3. Line and Load Terminals

Maximum Breaker Amperes	Terminal Body Material ①	Wire Type	AWG Wire Range	Metric Wire Range (mm²)	Catalog Number (Package of 3 Terminals)
Standard Pressure Type Terminals					
20 (EHD)	Steel	Cu/Al	(1) #14-#10	2.5-4	3T20FB
100	Steel	Cu/Al	(1) #14-1/0	2.5-50	3T100FB
150	Aluminum	Cu/Al	(1) #4-4/0	25-95	3TA150FB
225	Aluminum	Cu/Al	(1) #4-4/0	25-95	3TA225FD
Optional Pressure Terminals					
50	Aluminum	Cu/Al	(1) #14-#4	2.5-16	3TA50FB
100	Aluminum	Cu/Al	(1) #14-1/0	2.5-50	3TA100FD
225	Aluminum	Cu/Al	(1) #6-300 kcmil	16-150	3TA225FDK ②

① UL listed for use with copper or aluminum conductors as noted.

② Use only on 175-225A. Includes terminal shield and increases height.

Table 4. Approximate Shipping Weight in Lbs (kg)

Circuit Breaker Type	Number of Poles			
	1	2	3	4
ED, EDB, EDS, EDH, EDC	—	3 (1.4)	4.5 (2.0)	—
EHD, FDB, FD, HFD, HFDDC, FDC	2 (0.9)	3 (1.4)	4.5 (2.0)	6 (2.7)
FDE, HFDE, FDCE	—	—	4.2 (1.9)	—

Table 5. Dimensions in Inches (mm)

Dimensions	Number of Poles			
	1	2	3	4
Height	6.00 (152.4)	6.00 (152.4)	6.00 (152.4)	6.00 (152.4)
Width	1.38 (34.8)	2.75 (69.9)	4.13 (104.8)	5.50 (139.7)
Depth	3.38 (85.7)	3.38 (85.7)	3.38 (85.7)	3.38 (85.7)



January 2002
Supersedes Application Data 32-870,
dated February, 2000

Characteristic Curves for Types DS/DSL and DSI I/DSLII Circuit Breakers With Digitrip RMS 510/610/810/910 Trip Units

This Application Data contains the following time-current curves:

Curve Description	Drawing No. (Curve No.)
Typical Instantaneous Time-Phase Current Characteristic Curve based on I_n , for Types DS/DSL and DSI I/DSLII Circuit Breakers	8887C00 (SC-5619)
Typical Long Delay/Short Delay Time-Phase Current Characteristic Curve based on I_r for Types DS/DSL and DSI I/DSLII Circuit Breakers.....	8887C01 (SC-5620)
Typical Ground Fault/Protection Time-Current Characteristic Curve based on I_n for Types DS/DSL and DSI I/DSLII Circuit Breakers	8887C02 (SC-5261)

Refer to Application Data 36-783 for the DSL and DSLII Limiter Time-Current Characteristic Curves.

Definitions

I_n is the maximum value of continuous current for which the trip unit can be set.

I_n is the basis (or reference) for Long Delay pickup, Instantaneous pickup and the Ground pickup protection current settings.

The value of I_n is printed on the Rating Plug.

I_r is the basis for Short Delay (if provided) protection current settings.

The value of I_r is the Long Delay pickup Current Setting x I_n .

Standard Ratings (60Hz)

Breaker Type		Frame Rating Amperes	Interrupting Capacity, RMS Symmetrical Amperes (kA) With Instantaneous Trip		
DS-	DSII-		240V	480V	600V
206	308	800A	42,000	30,000	30,000
206H	—	800A	50,000	42,000	42,000
—	508	800A	65,000	50,000	42,000
206E	—	800A	65,000	65,000	50,000
—	608	800A	65,000	65,000	50,000
416	516	1600A	65,000	50,000	42,000
416H	616	1600A	65,000	65,000	50,000
420	620	2000A	65,000	65,000	50,000
632	632	3200A	85,000	65,000	65,000
840	840	4000A	130,000	85,000	85,000
850	850	5000A	130,000	85,000	85,000

Types DSL (206, 416, 420, 632 and 840) and DSLII (308, 516, 620, 632 and 840) 200kA, 600V ac Max.

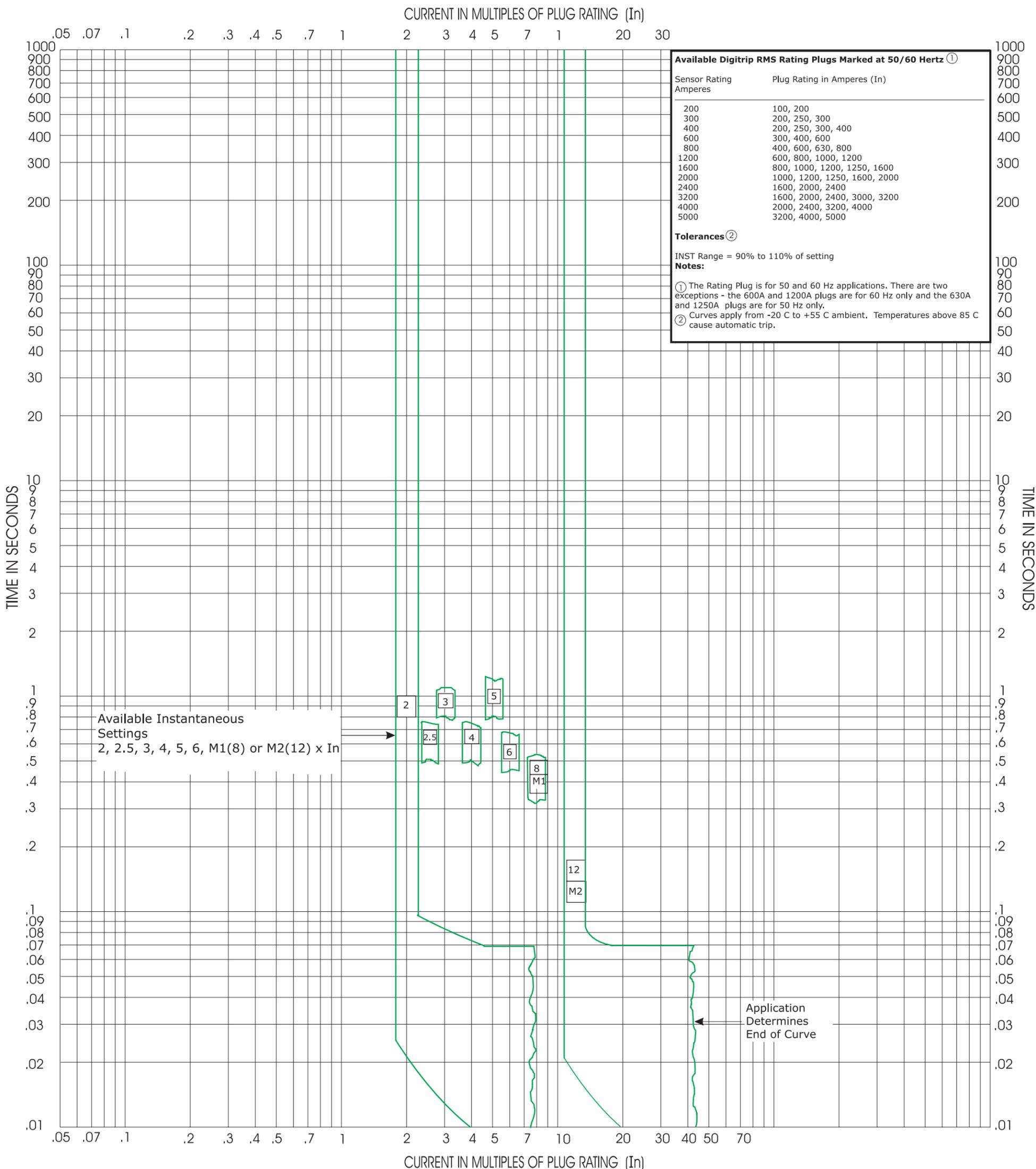
I M P O R T A N T

TRIP UNITS ARE **NOT AVAILABLE** WITH **ONLY INSTANTANEOUS** PROTECTION. **THIS CURVE MUST BE USED** in conjunction **WITH** Curve No SC-5620 for **LONG DELAY** (and, if applicable, **SHORT DELAY**) **PROTECTION** to obtain the complete time-current characteristic.

Application Data
32-870

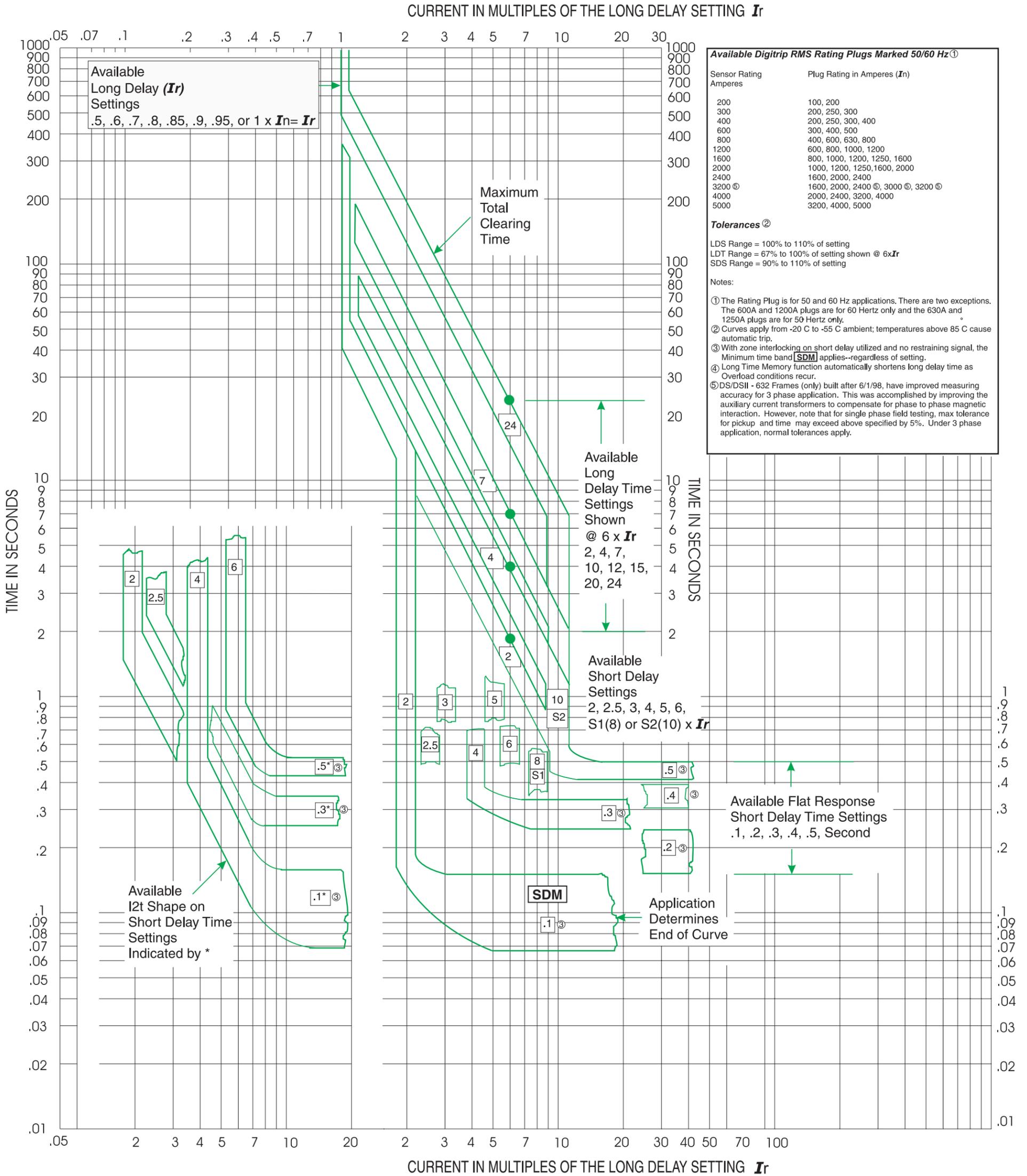
Cutler-Hammer

Types **DS/DSL** and **DSII/DSLII** Circuit Breakers **DIGITRIP RMS 510/610/810/910 Trip Units** Typical **Instantaneous** Time-Phase Current Characteristic Curve (**I**)



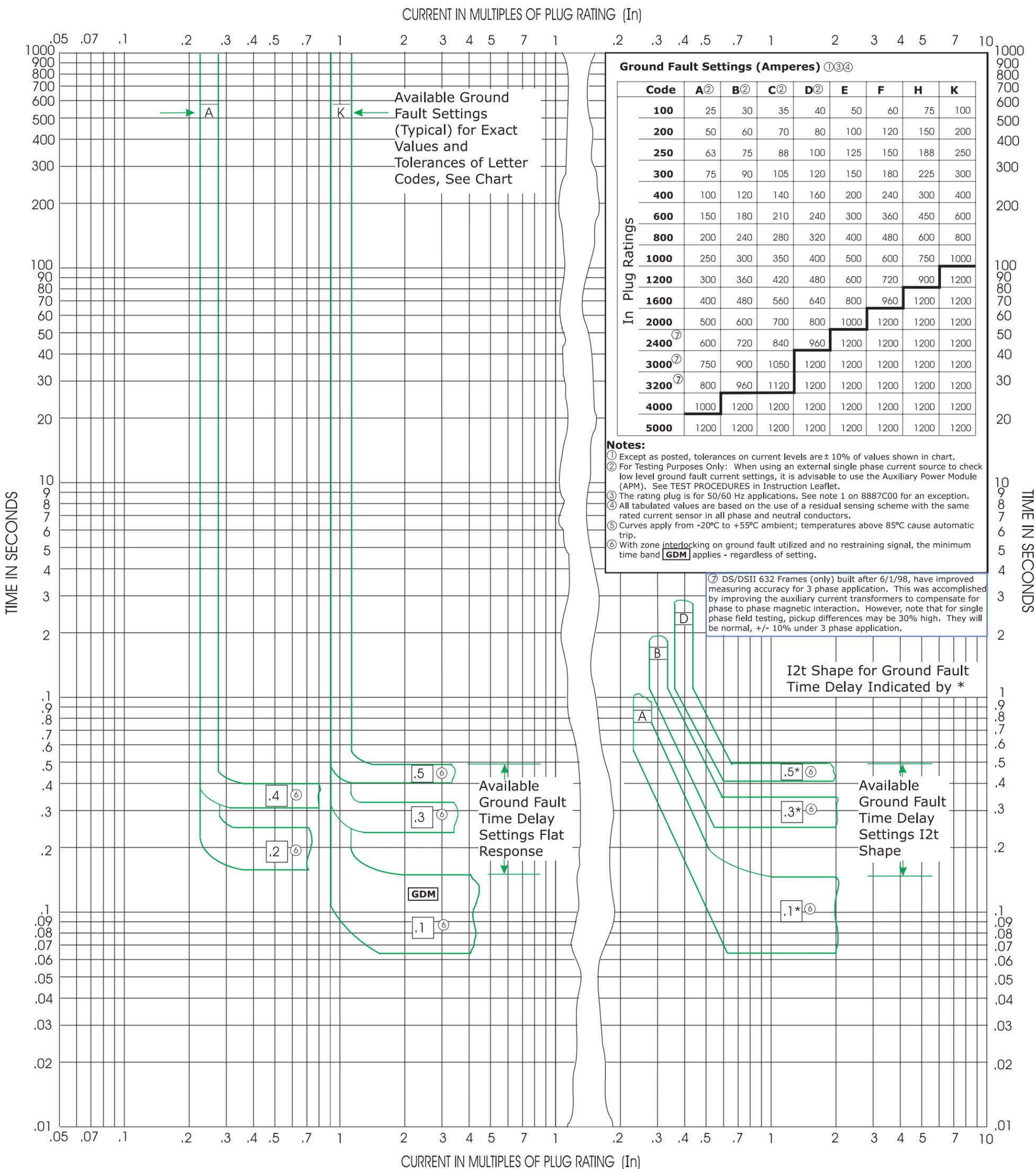
Cutler-Hammer

Types **DS/DSL** and **DS II/DSL II** Circuit Breakers with
DIGITRIP RMS 510/610/810/910 Trip Units
Typical **Long Delay** and **Short Delay**
Time-Phase Current Characteristic Curve (LS)



Cutler-Hammer

Types DS/DSL and DSII/DSLII Circuit Breakers with DIGITRIP RMS 510/610/810/910 Trip Units Typical Time-Ground Current Characteristic Curve (G)



FUSE DESCRIPTIONS

High voltage (over 34,500V)

Expulsion-Type power fuses are available for nominal voltages of 46, 69, 115, 138 and 161KV in current ratings up to 400 amperes. ANSI (American National Standards Institute) Standards are followed.

Medium Voltage (601-34,500V)

➤ **Current-Limiting or Expulsion-Type power fuses** are general purpose fuses available for nominal voltages of 2.4, 2.75, 4.16, 5.5, 7.2, 8.25, 14.4, 15.5, 23 and 34.5 KV in current ratings up to 720 amperes. ANSI and UL Standards are followed.

➤ **Current-limiting motor starter fuses** are available for nominal voltages of 2.4, 4.8 and 7.2KV in current ratings up to 36R (650A). These are special purpose R rated fuses for motor short circuit protection only (back-up fuses) and are not full-range power fuses. ANSI and UL Standards are followed.

➤ **PT Fuses** - Potential transformers require current limiting fuses or equivalent on the primary connection side. Standard PT primary voltages range from 2.4kV to 36kV. Since the power requirement is low (for relays, metering, etc.) fuses of the proper voltage are applied in the 1/2 to 5 ampere range. Several voltage ratings are available, physical sizes vary among manufacturers.

Low Voltages (600V or less)

Many types of low voltage fuses are classified and identified for use in 125, 250, 300, 480, or 600V circuits. UL/CSA/NOM standards are followed. Common types are briefly summarized below:

Summary of Low Voltage Fuses

FUSE TYPE	VOLTAGE	AMPERE RATING	INTERRUPTING RATING – kA	FS PART#	UL
Class CC	600VAC 300VDC 600VDC	0-30 0-30 0-30	200 100 100	ATDR, ATQR, ATMR ATDR, ATQR ATMR	248-4
Class G	480/600VAC	0-20/21-60	100	AG	248-5
Class H (Renewable)	250/600VAC	0-600	10	RF/RFS	248-7
Class H (Non-Renew)	250/600VAC	0-600	10	NRN, CRN/NRS, CRS	248-6
Class J	600VAC 300VDC 500VDC	0-600 0-30 0-600	200 100 100	AJT, HSJ, A4J A4J, HSJ(1-10) AJT, HSJ(15-600)	248-8
Class K-5	250/600VAC	0-600	50	OT, OTN/OTS	248-9
Class L	600VAC 500VDC	601-6000 601-3000	200 100	A4BQ, A4BY, A4BT A4BQ	248-10
Class RK1	250/600VAC 600VAC 250VDC 600VDC	0-600 70-600 0-600 0-600	200 200 100 100	A2D, A2K/A6D, A6K HSRK A2D A6D	248-12
Class RK5	250/600VAC 300/600VDC	0-600 0-30/35-400	200 20	TR/TRS TRS-RDC	248-12
Class T	300/600VAC 160/300VDC	0-1200/0-800 0-1200	200 50/100	A3T/A6T A3T/A6T	248-15
Semiconductor	130-4000VAC	0-2000	Up to 300	See Section D	248-13
Glass/Electronic	32-350VAC	0-30	Up to 10	See Section C	248-14
Midget	125/250VAC 500/600VAC	0-30 0-30	0.2-10 10,100	TRM, OTM, GFN ATQ, ATM, SBS	248-14
Plug	125VAC	0-30	10	See Section G	248-11
Cable Protector	250VAC 600VAC	1-500kcmil Cu or Al #2-1000kcmil Cu or Al	200 200	2CL CP, CPH	248-1
Capacitor	600-5500VAC	25-300	Up to 200	A100C-A550C	Other
Welder	600VAC	100-600	200	A4BX	Other

CURRENT IN AMPERES

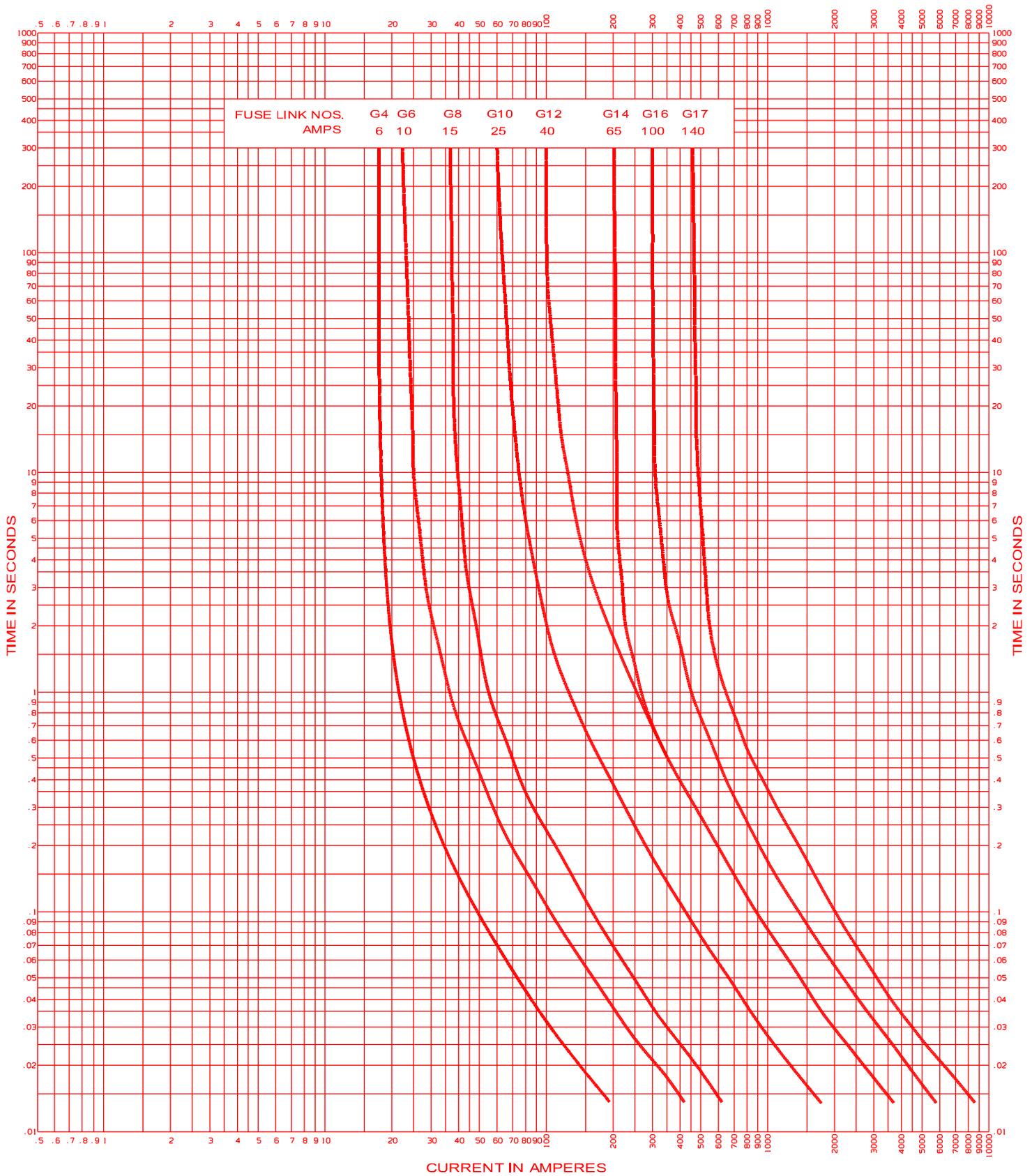


ABB POWER TRANSMISSION
 DISTRIBUTION COMPONENTS
 1128 Highway 412 South
 Alamo, TN 38001

MAXIMUM CLEARING TIME - CURRENT CHARACTERISTICS

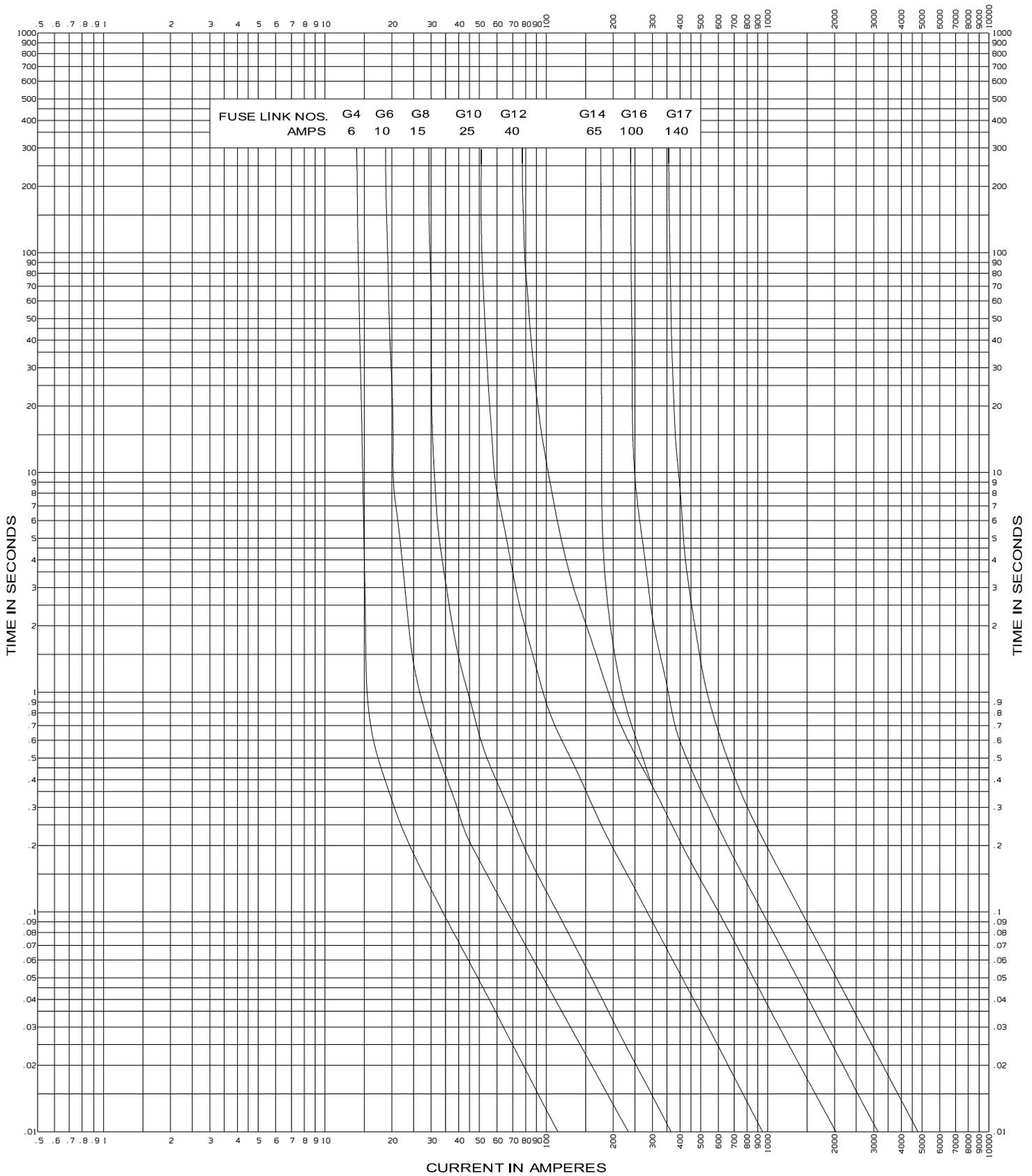
DO-II (FAULT) SENSING (143G) FUSE LINKS IN TRANSFORMER OIL
 MANUFACTURED BY ABB POWER TRANSMISSION
 (FOR MINIMUM MELT CHARACTERISTICS SEE CURVE NUMBER 1C11102)

CURVE NO. 1C11103	REVISION 1
DRWN: D. PERKINS	DATE: 12/07/00
CHKD: R. Still	DATE:
APPD: R. Eley	DATE:

CURVE NO. 1C11103

THIS DRAWING WAS CREATED ON A CAD SYSTEM, ANY MANUAL CHANGE OR REVISION WILL VOID IT.

CURRENT IN AMPERES



CURRENT IN AMPERES

ABB POWER TRANSMISSION
DISTRIBUTION COMPONENTS
1128 Highway 412 South
Alamo, TN 38001

MINIMUM MELT TIME - CURRENT CHARACTERISTICS

DO-II (FAULT) SENSING (143G) FUSE LINKS IN TRANSFORMER OIL
MANUFACTURED BY ABB POWER TRANSMISSION
(FOR CLEARING CHARACTERISTICS SEE CURVE NUMBER 1C11103)

CURVE NO. 1C11102	REVISION 1
DRWN: D. PERKINS	DATE: 12/07/00
CHKD: R. Still	DATE:
APPD: R. Eley	DATE:

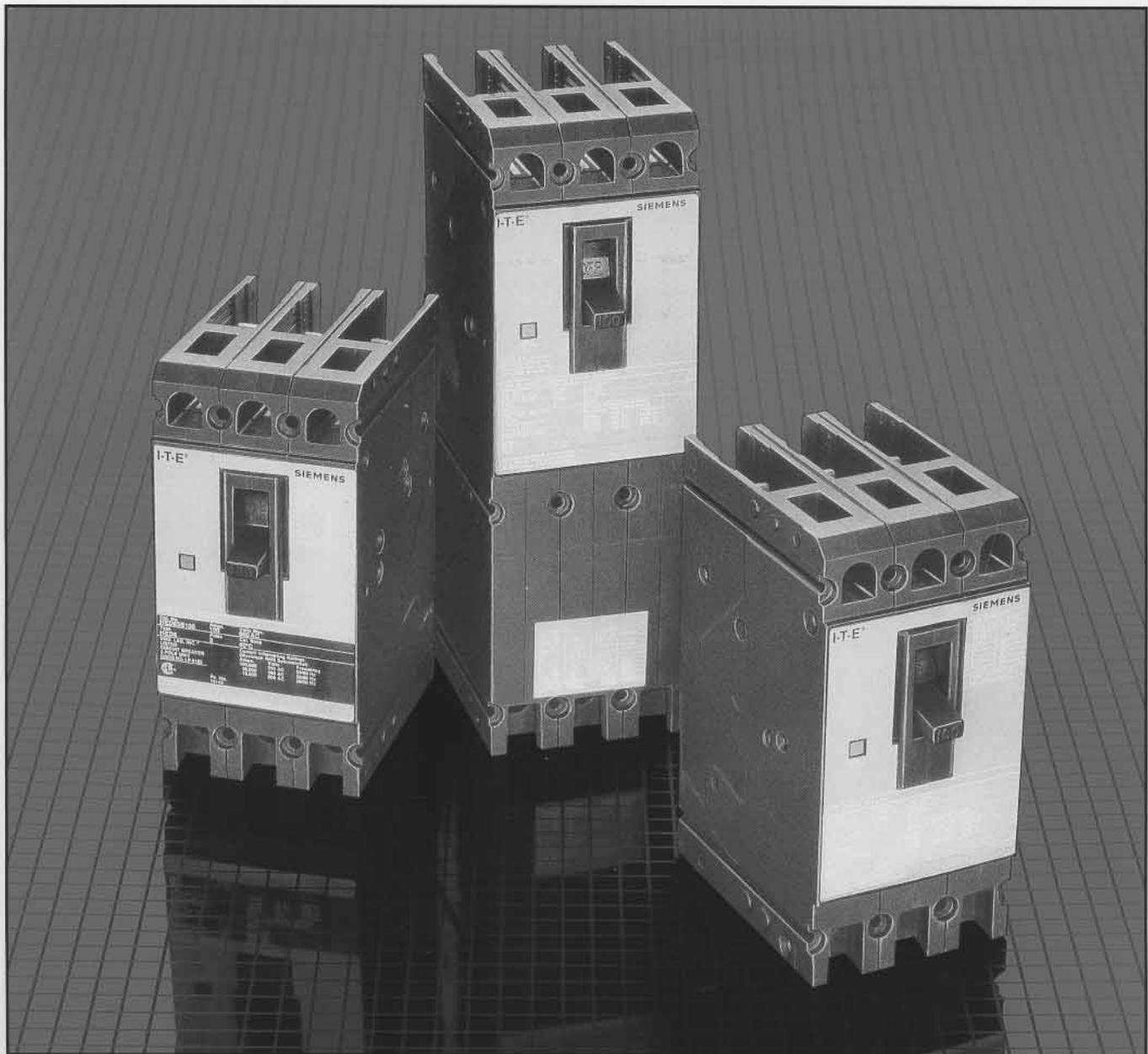
CURVE NO. 1C11102

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SIEMENS

I-T-E[®] Molded Case Circuit Breakers

ED-Frame
Information and
Instruction Guide





⚠ DANGER

Hazardous voltages are present inside the enclosures or panels in which the circuit breakers are installed. Death, serious injury, and/or equipment damage will result if circuit breakers are improperly applied or precaution is not used.

De-energize all incoming power prior to installation of circuit breakers or associated accessories.

Only qualified personnel should work on or around this equipment.

Position of circuit breaker handles shown in this booklet is for illustration purposes only. Circuit breakers are to be installed in OFF or TRIPPED position only.



I-T-E® ED-Frame Circuit Breakers 1, 2 and 3-Pole, 15-125 Amperes

Types ED2, ED4, ED6, HED4, HED6, HHED6
CED6, ED6-ETI, CED6-ETI

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NOTE: Information related to specific frame types or catalog numbers does not guarantee product availability. Technical information may change due to product revisions. Consult Siemens sales office concerning any variation of product information contained herein.

DANGER



Hazardous voltages are present in the equipment which will cause death or severe personal injury and product failure. Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which can cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

The information contained herein is general in nature and is not intended for specific application purposes nor is it intended as a training manual for unqualified personnel. Refer to Note for definition of a **qualified person**.* It does not relieve the user of responsibility to use sound practices in application, installation, operation and maintenance of the equipment purchased or in personnel safety precautions. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence. Siemens Energy & Automation, Inc. reserves the right to make changes in specifications shown herein or add improvements at any time without notice or obligation.

NOTE

***Authorized and qualified personnel—**

For the purpose of this manual a qualified person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, he has the following qualifications:

- (a) **is trained and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.
- (b) **is trained** in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety practices.
- (c) **is trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local sales office, listed on back of this instruction guide.

The contents of this instruction manual should not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens Energy & Automation, Inc. The warranty contained in the contract between the parties is the sole warranty of Siemens Energy & Automation, Inc. Any statements contained herein do not create new warranties or modify the existing warranty.

Information and Instructions

General Information

General

ED-Frame Sentron™ Series circuit breakers, as shown on pages 5-9, are for use in individual enclosures, switchboards, panelboards and load centers. They are available as thermal magnetic trip (types ED2, ED4, ED6, HED4, HED6, HHED6, CED6), current limiting (type CED6) instantaneous magnetic trip only (motor circuit protection—types ED6-ETI, CED6-ETI) and molded case switches (types ED2, ED4, ED6, HHED6, CED6).

CED6 type Sentron™ Series circuit breakers combine thermal magnetic construction for overload protection and an additional set of patented “blow-apart” contacts in conjunction with the ED-Frame’s standard patented “blow-apart” contacts. This arrangement provides for current-limiting protection under high fault interrupting conditions as outlined in the National Electric Code, Article 240-1① and UL 489② standards. CED6 type ED-Frame circuit breakers are fuseless and therefore require no blown fuses to be located and replaced should a high current fault occur. The common trip feature of the circuit breaker is completely retained so that all poles of the circuit breaker open when caused to trip due to an overload or short circuit.

Pressure wire connectors, suitable for use with aluminum or copper wire are available for all ED-Frame circuit breakers. Rear connection studs or plug-in connector assemblies are also available (1, 2 and 3-pole). The latter mounting arrangement permits removal of the circuit breaker from its leads without physically coming in contact with either the line or load terminals. Special features such as a shunt trip, auxiliary and alarm switches and undervoltage trip devices are available for field adaptation. The installation and/or removal of these devices is to be accomplished by qualified personnel only. These devices are mounted externally and Underwriters Laboratories listed, page 53. Information concerning them is found on pages 16-19 and 51.

Thermal Magnetic

ED2, ED4, ED6, HED4, HED6, HHED6, CED6 type circuit breakers provide complete overload and short circuit protection by use of a time delay thermal trip element and an instantaneous magnetic trip element. Fixed instantaneous trip values are shown in the table below:

Fixed Instantaneous Trip

Ampere Rating	Fixed Instantaneous Band
15-25	400-700
30-125	600-1000

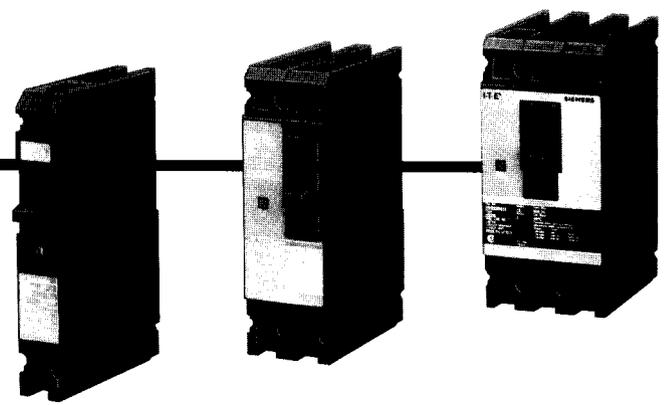
Circuit breakers are calibrated at the factory, under controlled temperature conditions for application at 40°C (104°F) ambient, to meet requirements as outlined in UL-489 standard for molded case circuit breakers. Catalog information is found on pages 48-50.

① National Electric Code (240-11)

“A current limiting overcurrent protective device, which, when interrupting currents in its current limiting range, will reduce the current flowing in the faulted circuit to a magnitude substantially less than that obtainable in the same circuit, if the device were replaced with a solid conductor having comparable impedance.”

② Underwriters Laboratories (UL 489, Par. 2.5)

“A circuit breaker that does not employ a fusible element and that when operating within its current limiting range, limits the let-through I²t to a value less than the I²t of a ½ cycle wave of the symmetrical prospective current.”



Molded Case Switch

A molded case switch is available in the ED2, ED4, ED6, HHED6, CED6 type circuit breakers. This device employs the same operating mechanism as the thermal magnetic and magnetic only units. A preset instantaneous function is factory installed to allow the switch to trip at a value over 1000A and protect itself against high fault conditions. No overload or low fault current protection is provided. This protection must be supplied by separate overcurrent devices. Catalog information is located on pages 48-51.

Interrupting Ratings—Symmetrical RMS Amperes (kA) Based on UL 489 Standards, UL File #E10848

Breaker Type	RMS Symmetrical Amperes (kA)							
	UL A.I.R.							
	AC				DC			
	120	240	277	480	600	125	250	500 ①
ED2 (1-P)	10	—	—	—	—	10	—	—
ED2 (2,3-P)	—	10	—	—	—	—	5 (2-P)	—
ED4 (1-P)	65	—	22	—	—	5	—	—
ED4 (2,3-P)	—	65	—	18	—	—	30 (2-P)	—
ED6 (2,3-P)	—	65	—	25	18	—	30 (2-P)	18 (3-P)
HED4 (1-P) (15-30 Amps)	100	—	65	—	—	10	—	—
HED4 (1-P) (35-110 Amps)	100	—	25	—	—	10	—	—
HED4 (2,3-P)	—	100	—	42	—	—	30 (2-P)	—
HED6 (2,3-P)	—	100	—	30	18	—	30 (2-P)	25 (3-P)
HHED6 (2,3-P)	—	100	—	65	25	—	—	—
CED6 (2,3-P)	—	200	—	200	100	—	30 (2-P)	50 (3-P)

① For 500VDC applications the customer’s power supply and load must be wired as shown in Figure 1 on page 4.

Breaker Type	RMS Symmetrical Amperes (kA)			
	IEC A.I.R. (157-P1)			
	Volts AC (50/60 Hz)			
	220/240	380/415	500	
ED4 (3-P)	65	18	NA	NA
HED4 (3-P)	100	42	NA	NA
HED6 (3-P)	100	30	NA	NA
CED6 (3-P)	200	200	NA	NA

Breaker Type	IEC A.I.R. (947-2)					
	(lcu)	(lcs)	(lcu)	(lcs)	(lcu)	(lcs)
ED6 (3-P)	65	17	35	9	18	5

Instantaneous Trip

ETI motor circuit interrupters, types ED6-ETI, CED6-ETI (adjustable instantaneous magnetic trip only) are designed for use in welding circuits, motor circuits and combination starters where short circuit protection only is required. When used in combination starters, they serve in conjunction with motor protective relays to offer the best available protection. The relays guard against motor overloads and the circuit breaker provides short circuit protection. Catalog information is located on page 50.

Information and Instructions

Operation and Maintenance

Instantaneous Trip Adjustments

Motor Full Load Amperes	ETI Trip Setting ^①		Breaker Ampere Rating
	Adjustment	Amperes	
.20 - .33	Low	2.6	1
.34 - .45	2	4.5	
.46 - .56	3	6	
.57 - .68	4	7.5	
.69 - .81	High	9	
.53 - .83	Low	7	2
.84 - 1.14	2	11	
1.15 - 1.45	3	15	
1.46 - 1.68	4	19	
1.69 - 2.00	High	22	
.76 - 1.29	Low	10	3
1.30 - 1.75	2	17	
1.76 - 2.29	3	23	
2.30 - 2.68	4	30	
2.69 - 3.18	High	35	
1.23 - 1.99	Low	16	5
2.00 - 2.75	2	26	
2.76 - 3.52	3	36	
3.53 - 4.14	4	46	
4.15 - 4.90	High	54	
2.30 - 3.83	Low	30	10
3.84 - 5.37	2	50	
5.38 - 6.52	3	70	
6.53 - 7.68	4	85	
7.69 - 9.10	High	100	
4.23 - 6.91	Low	55	25
6.92 - 9.61	2	90	
9.62 - 11.91	3	125	
11.92 - 13.83	4	155	
13.84 - 16.40	High	180	
6.15 - 10.37	Low	80	30
10.38 - 14.22	2	135	
14.23 - 18.06	3	185	
18.07 - 20.75	4	235	
20.76 - 24.50	High	270	
8.84 - 14.22	Low	115	40
14.23 - 19.60	2	185	
19.61 - 24.99	3	255	
25.00 - 28.83	4	325	
28.84 - 34.00	High	375	
13.84 - 23.06	Low	180	50
23.07 - 31.52	2	300	
31.53 - 39.99	3	410	
40.00 - 46.14	4	520	
46.15 - 54.50	High	600	
24.23 - 41.52	Low	315	100
41.53 - 56.91	2	540	
56.92 - 68.45	3	740	
68.46 - 76.91	4	890	
76.92 - 90.90	High	1000	
38.46 - 55.37	Low	500	125
55.38 - 70.75	2	720	
70.76 - 84.60	3	920	
84.61 - 96.14	4	1100	
96.15 - 113.60	High	1250	

① All values calibrated within guidelines of UL 489.

Circuit Breaker Operation

With the mechanism latched and the contacts open, the operating handle will be in the OFF position. Moving the handle to the ON position closes the contacts and establishes a circuit through the breaker. Under overload or short circuit conditions sufficient to automatically trip or open the breaker, the operating handle moves to a position between ON and OFF. To relatch the circuit breaker after automatic operation, move the operating handle to the extreme OFF position. The circuit breaker is now ready for reclosing.

The overcenter toggle mechanism is trip free of the operating handle. The circuit breaker, therefore, cannot be held closed by means of the handle should a tripping condition exist. After automatic operation, the handle assumes an intermediate position between ON and OFF, thus displaying a clear indication of tripping.

Maintenance

Experience has shown that properly applied molded case circuit breakers normally do not require maintenance. However, some industrial users may choose to establish an inspection and maintenance procedure to be carried out on a regular basis. For detailed information, consult applicable NEMA publications or your local Siemens sales office.

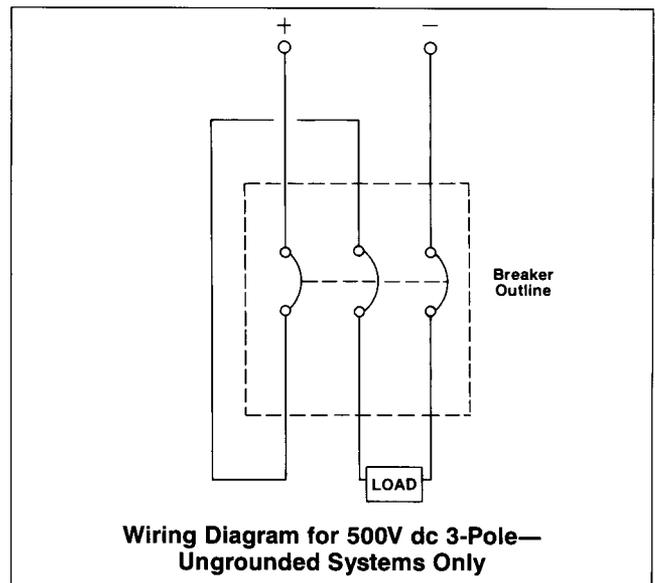
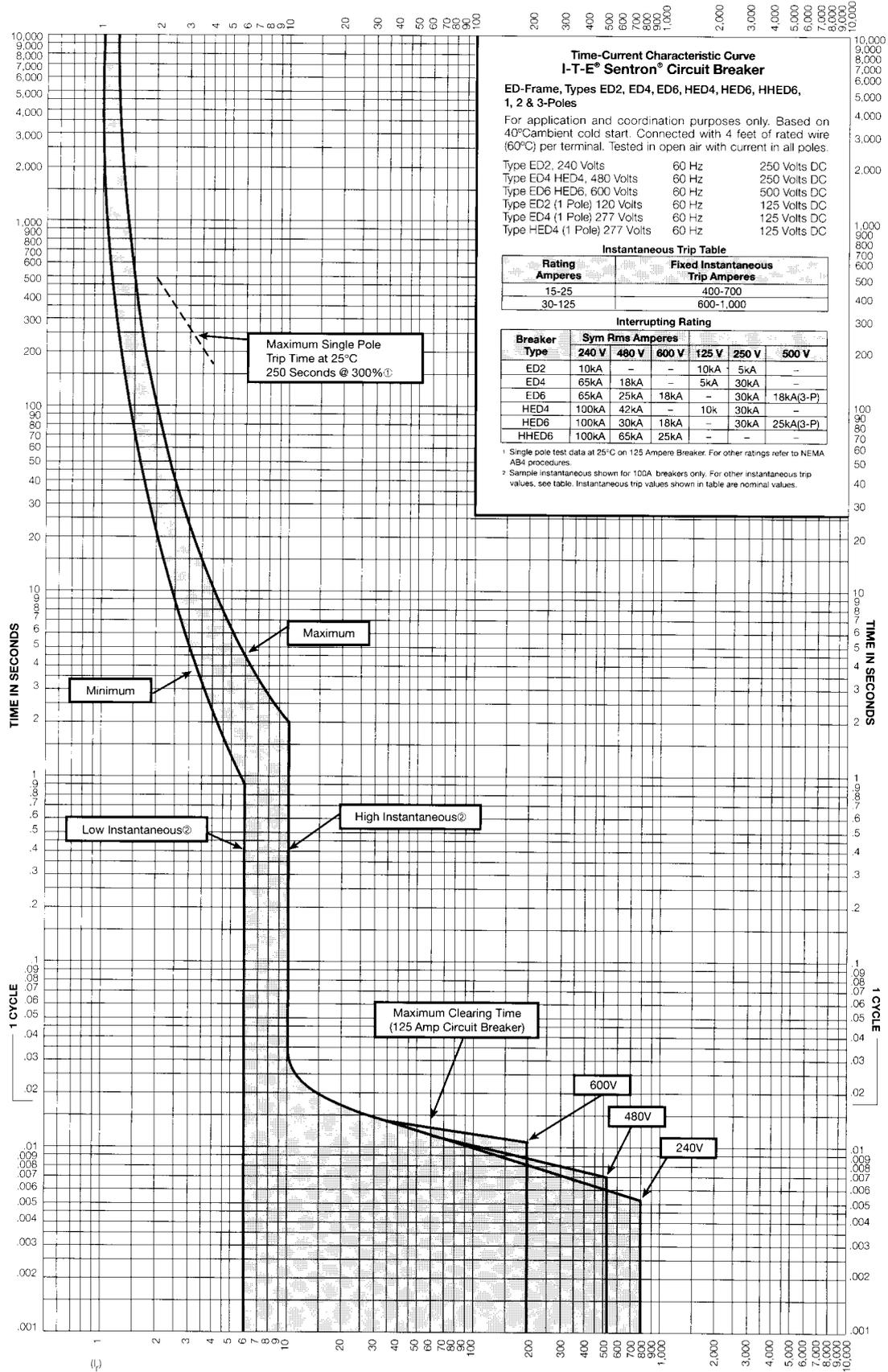


Figure 1

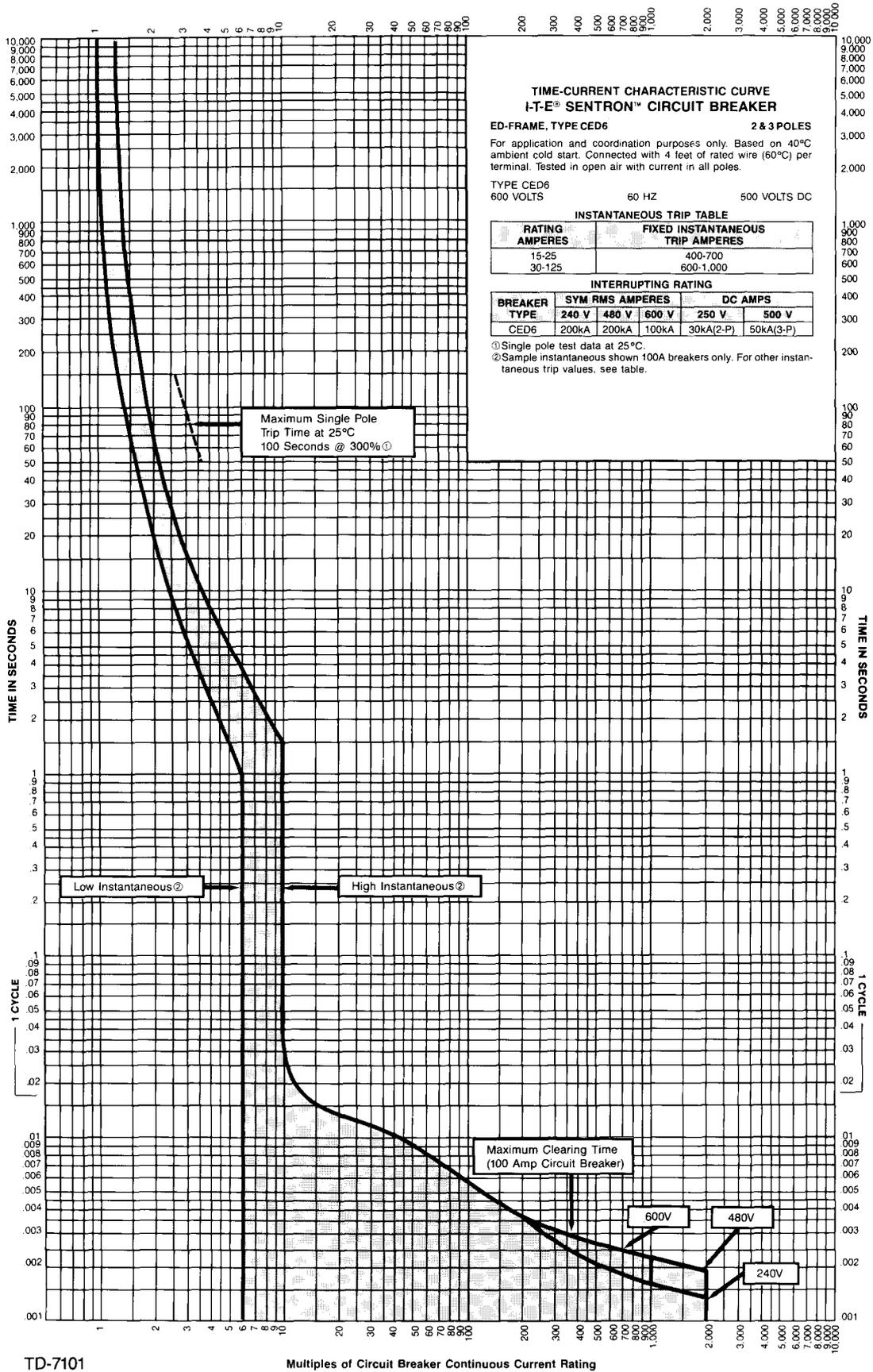
ED-Frame Time Current Curve

Types ED2, ED4, ED6, HED4, HED6, HHED6



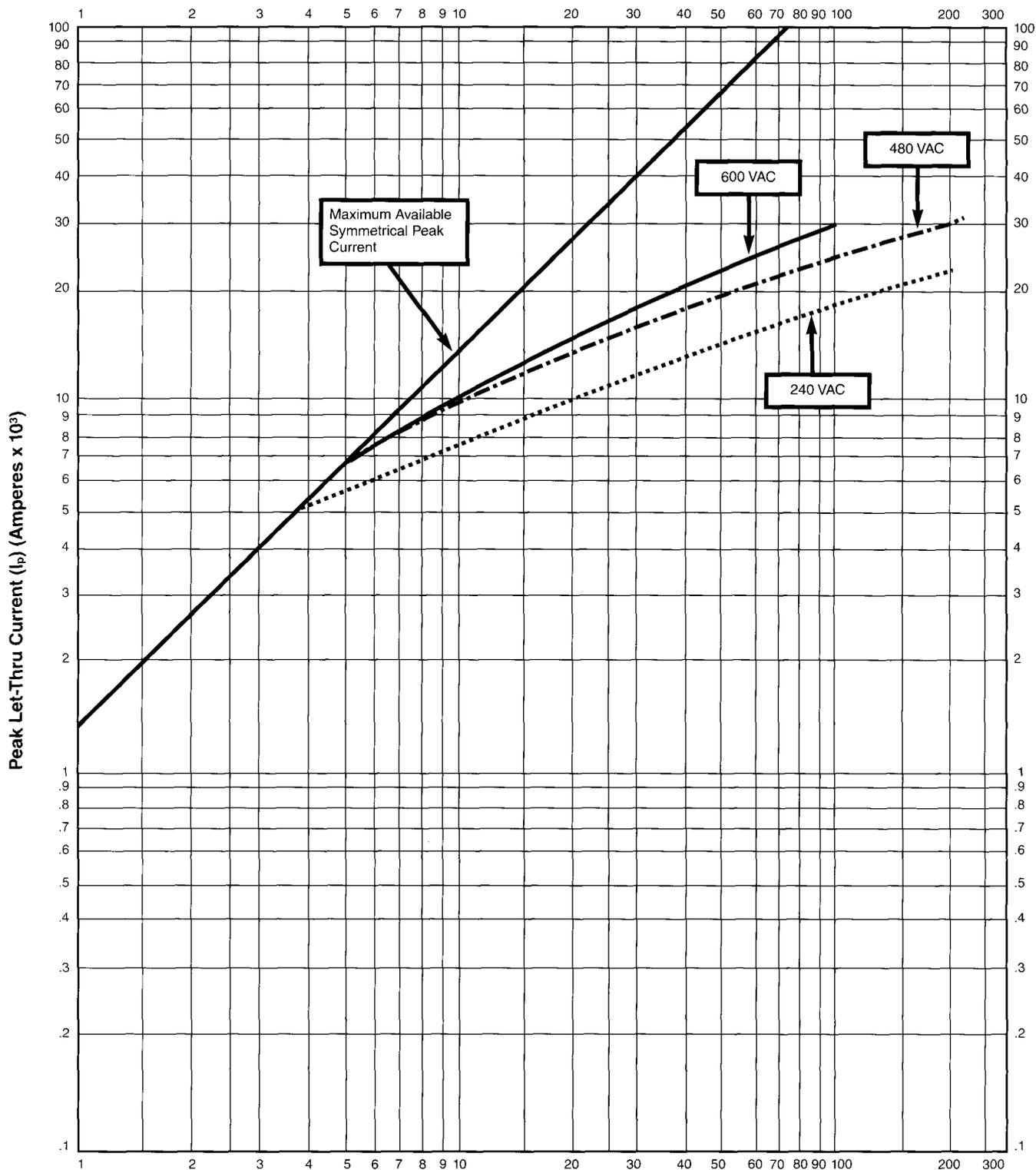
ED-Frame Time Current Curve

Type CED6



ED-Frame Peak Let-Thru Current (I_p) Curve

Type CED6

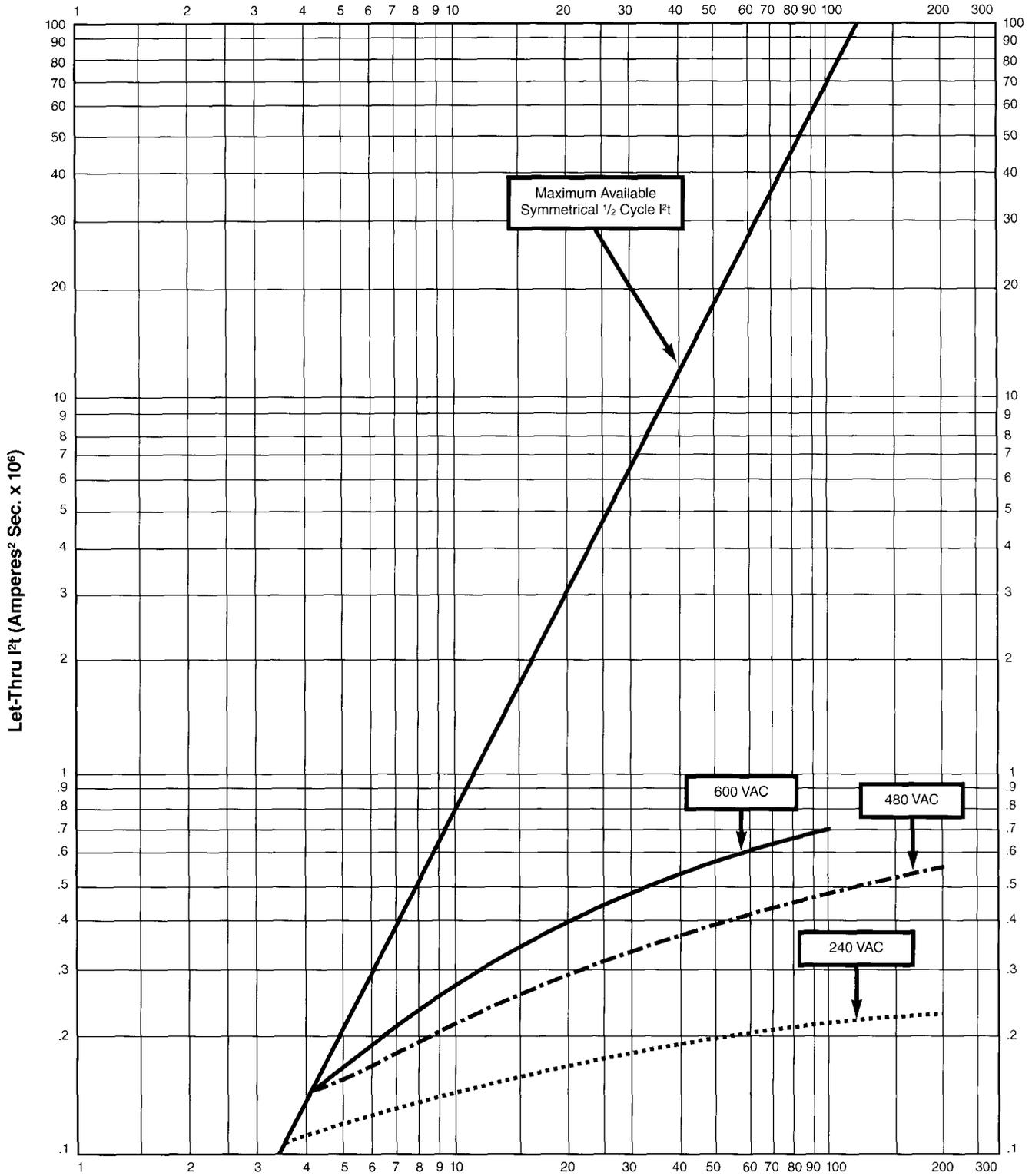


TD-7101-A (REV. 2)

Available Short Circuit Current
(RMS Symmetrical Amperes $\times 10^3$)

ED-Frame Let-Thru I²t Curve

Type CED6



TD-7101-B (REV. 2)

Available Short Circuit Current
(RMS Symmetrical Amperes x 10³)



MULTIPLES OF RATED CURRENT

**FA/FH/FC FAMILY MOLDED CASE CIRCUIT BREAKERS
CHARACTERISTIC TRIP CURVE NO. 650-4**

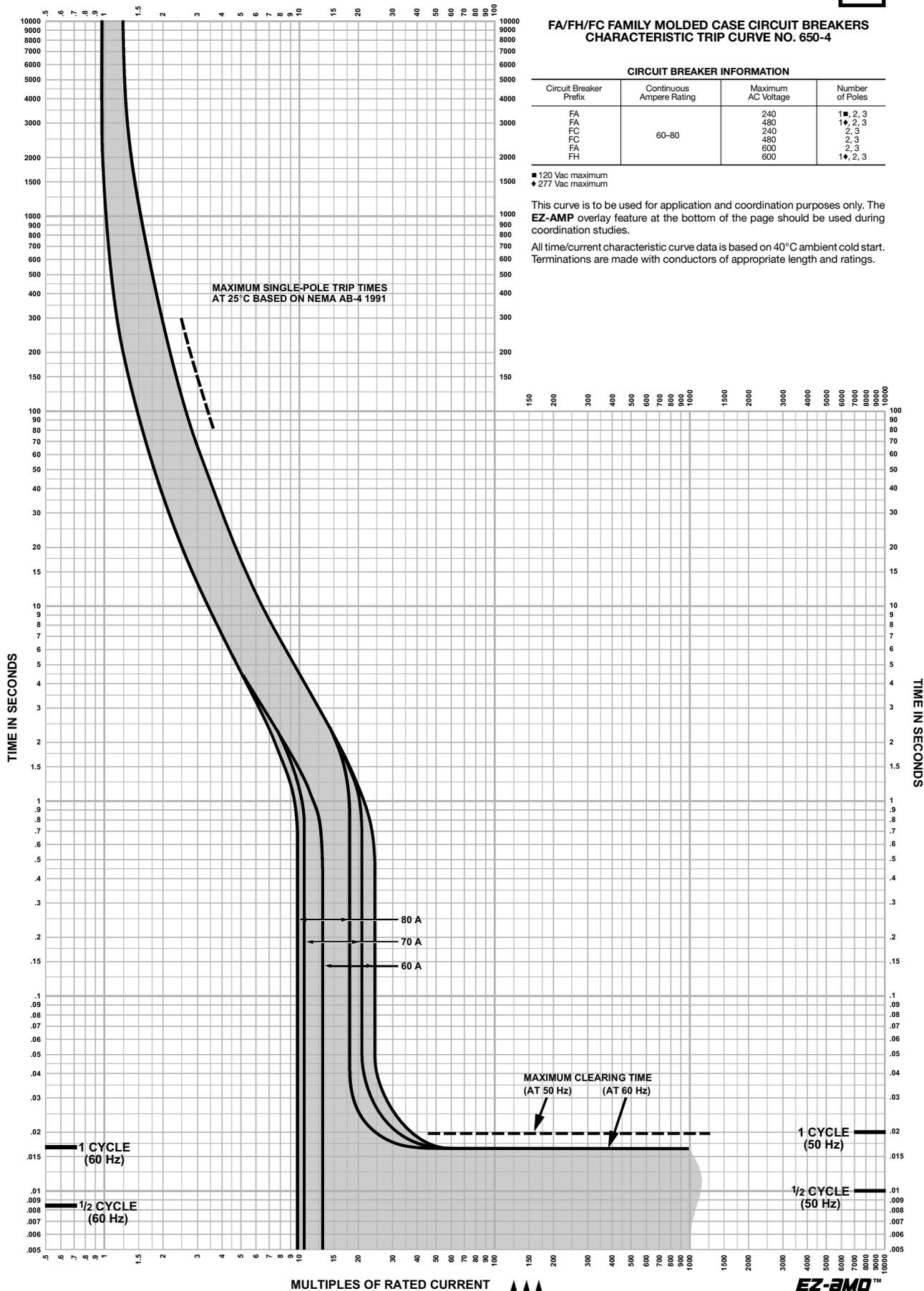
CIRCUIT BREAKER INFORMATION

Circuit Breaker Prefix	Continuous Ampere Rating	Maximum AC Voltage	Number of Poles
FA	60-80	240	1, 2, 3
FA		480	1, 2, 3
FC		240	2, 3
FC		480	2, 3
FH		600	1, 2, 3

■ 120 Vac maximum
◆ 277 Vac maximum

This curve is to be used for application and coordination purposes only. The **EZ-AMP** overlay feature at the bottom of the page should be used during coordination studies.

All time/current characteristic curve data is based on 40°C ambient cold start. Terminations are made with conductors of appropriate length and ratings.



APPENDIX 4:SHORT CIRCUIT FAULT ANALYSIS OUTPUT REPORT



Electrical Reliability Services, Inc.

CLIENT: PSW Electric

PROJECT: Central Kitsap WWTP

JOB#: 3130462

Appendix 4

Summary of Calculated Short Circuit Values

		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 1	2960 MAIN A	480.0	27.887	3.800	26.311	3.211								
Case 2	2960 MAIN A	480.0	31.689	4.146	28.466	3.310								
Case 1	2960 MAIN B	480.0	28.695	4.118	30.655	4.452								
Case 2	2960 MAIN B	480.0	31.677	4.141	28.438	3.299								
Case 1	ACTIV SLUDGE MIXER 2	480.0	1.030	0.130	0.603	0.089								
Case 2	ACTIV SLUDGE MIXER 2	480.0	1.032	0.126	0.602	0.090								
Case 1	ACTIV SLUDGE MIXER 4	480.0	1.356	0.138	0.796	0.095								
Case 2	ACTIV SLUDGE MIXER 4	480.0	1.358	0.132	0.794	0.096								
Case 1	ACTIVATED SLUDGE MIXER 1	480.0	1.127	0.132	0.660	0.093								
Case 2	ACTIVATED SLUDGE MIXER 1	480.0	1.130	0.127	0.660	0.091								
Case 1	ACTIVATED SLUDGE MIXER 3	480.0	1.354	0.138	0.793	0.098								
Case 2	ACTIVATED SLUDGE MIXER 3	480.0	1.358	0.132	0.794	0.096								
Case 1	AER BLWR 1 VLVS	480.0	2.590	0.140	1.536	0.095								
Case 2	AER BLWR 1 VLVS	480.0	2.599	0.130	1.531	0.097								
Case 1	AER BLWR 3 VLVS	480.0	2.200	0.127	1.298	0.092								
Case 2	AER BLWR 3 VLVS	480.0	2.212	0.118	1.300	0.088								
Case 1	AERATED GRIT TANK BLOWER	480.0	6.936	0.923	4.633	0.728								
Case 2	AERATED GRIT TANK BLOWER	480.0	7.154	0.892	4.694	0.716								
Case 1	AERATION BLOWER 1	480.0	25.471	3.211	25.028	2.588								
Case 2	AERATION BLOWER 1	480.0	27.728	3.125	23.336	2.228								
Case 1	AERATION BLOWER 2	480.0	25.471	3.211	25.028	2.588								
Case 2	AERATION BLOWER 2	480.0	27.728	3.125	23.336	2.228								
Case 1	AERATION BLOWER 3	480.0	24.796	3.068	21.899	2.254								
Case 2	AERATION BLOWER 3	480.0	27.737	3.127	23.357	2.232								
Case 1	AGITATION AIR BLOWER	480.0	9.061	1.491	6.423	1.274								



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Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	AGITATION AIR BLOWER	480.0	9.471	1.463	6.556	1.259								
Case 1	AHU1281 DISC	480.0	3.097	0.312	1.892	0.250								
Case 2	AHU1281 DISC	480.0	3.130	0.298	1.900	0.245								
Case 1	AHU1285 DISC	480.0	4.373	0.462	2.746	0.374								
Case 2	AHU1285 DISC	480.0	4.446	0.444	2.764	0.367								
Case 1	ALUM METE PMPS	480.0	1.755	0.145	1.444	0.157								
Case 2	ALUM METE PMPS	480.0	1.762	0.139	1.447	0.153								
Case 1	B1061 VFD	480.0	11.069	1.911	8.725	2.150								
Case 2	B1061 VFD	480.0	12.069	2.203	8.722	2.239								
Case 1	B1276 VFD	480.0	11.322	2.132	8.415	2.150								
Case 2	B1276 VFD	480.0	11.990	2.143	8.655	2.156								
Case 1	B1277 VFD	480.0	8.830	1.248	6.587	1.191								
Case 2	B1277 VFD	480.0	9.460	1.311	6.579	1.212								
Case 1	B1278 VFD	480.0	11.394	2.195	8.480	2.233								
Case 2	B1278 VFD	480.0	12.071	2.211	8.722	2.242								
Case 1	B7192 VFD	480.0	16.137	1.994	12.330	1.535								
Case 2	B7192 VFD	480.0	17.265	1.946	12.748	1.507								
Case 1	BIO FILTER BLOWER	480.0	1.385	0.313	0.796	0.154								
Case 2	BIO FILTER BLOWER	480.0	1.388	0.303	0.797	0.151								
Case 1	BL BLDG ELEC RM AHU-2901	480.0	3.140	0.179	1.869	0.113								
Case 2	BL BLDG ELEC RM AHU-2901	480.0	3.157	0.165	1.863	0.113								
Case 1	BLWR RM EXH FN 1	480.0	1.810	0.135	1.065	0.085								
Case 2	BLWR RM EXH FN 1	480.0	1.814	0.126	1.062	0.085								
Case 1	BLWR RM EXH FN 2	480.0	2.054	0.130	1.212	0.087								
Case 2	BLWR RM EXH FN 2	480.0	2.061	0.121	1.210	0.087								
Case 1	BLWR ROOM AHU2910	480.0	2.005	0.151	1.178	0.094								



Electrical Reliability Services, Inc.

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Appendix 4

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Case	Location	Volts	LOW VOLTAGE LOCATION RESULTS				>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
			3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	BLWR ROOM AHU2910	480.0	2.014	0.141	1.179	0.091								
Case 1	CENT 1 CAKE CONV	480.0	1.656	0.155	0.972	0.111								
Case 2	CENT 1 CAKE CONV	480.0	1.663	0.147	0.973	0.108								
Case 1	CENT 1 CONV DR VLV	480.0	1.692	0.151	0.993	0.110								
Case 2	CENT 1 CONV DR VLV	480.0	1.699	0.144	0.995	0.108								
Case 1	CENT 1 FLUSH VLV	480.0	1.835	0.149	1.080	0.113								
Case 2	CENT 1 FLUSH VLV	480.0	1.844	0.142	1.081	0.111								
Case 1	CENT 1 MOTOR	480.0	11.698	1.674	8.436	1.298								
Case 2	CENT 1 MOTOR	480.0	12.344	1.655	8.650	1.284								
Case 1	CENT 1 SLDG GRIND BYP VLV	480.0	2.909	0.210	1.725	0.157								
Case 2	CENT 1 SLDG GRIND BYP VLV	480.0	2.932	0.199	1.730	0.152								
Case 1	CENT 1 SLUDGE FEED PMP	480.0	6.087	0.670	3.727	0.408								
Case 2	CENT 1 SLUDGE FEED PMP	480.0	6.212	0.638	3.755	0.397								
Case 1	CENT 1 SLUDGE GRIND	480.0	1.990	0.183	1.169	0.126								
Case 2	CENT 1 SLUDGE GRIND	480.0	2.000	0.174	1.171	0.123								
Case 1	CENT 1 SLUDGE INLET VLV	480.0	2.908	0.208	1.725	0.156								
Case 2	CENT 1 SLUDGE INLET VLV	480.0	2.931	0.197	1.730	0.152								
Case 1	CENT CONR AREA ACU	480.0	7.168	0.709	5.612	0.650								
Case 2	CENT CONR AREA ACU	480.0	7.331	0.676	5.679	0.635								
Case 1	CENT RM HOIST	480.0	2.693	0.252	2.190	0.251								
Case 2	CENT RM HOIST	480.0	2.709	0.240	2.197	0.245								
Case 1	CENTRATE PMP 1	480.0	2.549	0.244	2.075	0.244								
Case 2	CENTRATE PMP 1	480.0	2.563	0.233	2.081	0.238								
Case 1	CENTRATE PMP 2	480.0	2.541	0.247	2.090	0.238								
Case 2	CENTRATE PMP 2	480.0	2.555	0.236	2.078	0.239								
Case 1	CHAN 2 AIR BLWR	480.0	3.005	0.232	1.783	0.136								



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Case	Location	Volts	LOW VOLTAGE LOCATION RESULTS				>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
			3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	CHAN 2 AIR BLWR	480.0	3.017	0.217	1.775	0.138								
Case 1	CHANNEL AIR BLOWER 1	480.0	3.016	0.236	1.777	0.131								
Case 2	CHANNEL AIR BLOWER 1	480.0	3.036	0.219	1.781	0.126								
Case 1	-2002AER BLW 2 IN SURGE VL	480.0	2.206	0.126	1.304	0.087								
Case 2	-2002AER BLW 2 IN SURGE VL	480.0	2.212	0.118	1.300	0.088								
Case 1	CV-21XX AER TNK CNTR VLV 1,	480.0	26.660	3.517	27.172	3.281								
Case 2	CV-21XX AER TNK CNTR VLV 1,	480.0	29.668	3.488	25.845	2.827								
Case 1	CVS5011	480.0	0.792	0.133	0.468	0.110								
Case 2	CVS5011	480.0	0.795	0.128	0.468	0.109								
Case 1	DECANT FACILITY	480.0	1.768	0.283	1.050	0.231								
Case 2	DECANT FACILITY	480.0	1.777	0.276	1.052	0.228								
Case 1	DEWAT POL-AGE TANK 2 MIX	480.0	2.069	0.170	1.711	0.172								
Case 2	DEWAT POL-AGE TANK 2 MIX	480.0	2.078	0.161	1.703	0.173								
Case 1	DEWATER FOUL AIR BLWR	480.0	0.000	0.000	0.000	0.000								
Case 2	DEWATER FOUL AIR BLWR	480.0	0.000	0.000	0.000	0.000								
Case 1	DIG WITH VLV 1	480.0	1.563	0.144	0.912	0.109								
Case 2	DIG WITH VLV 1	480.0	1.567	0.138	0.913	0.107								
Case 1	DIG WITH VLV 2	480.0	7.389	0.805	4.615	0.576								
Case 2	DIG WITH VLV 2	480.0	7.569	0.774	4.657	0.564								
Case 1	DIG WITH PMP 1	480.0	7.478	0.988	4.644	0.616								
Case 2	DIG WITH PMP 1	480.0	7.659	0.949	4.685	0.603								
Case 1	DIG WITH PMP 2	480.0	7.478	0.988	4.644	0.616								
Case 2	DIG WITH PMP 2	480.0	7.659	0.949	4.685	0.603								
Case 1	DUPLEX SEAL WATER PMP 1	480.0	2.230	0.176	1.826	0.184								
Case 2	DUPLEX SEAL WATER PMP 1	480.0	2.240	0.167	1.831	0.180								
Case 1	DUPLEX SEAL WATER UNIT PMP	480.0	1.675	0.149	1.387	0.152								



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Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	JPLEX SEAL WATER UNIT PMP	480.0	1.680	0.142	1.381	0.153								
Case 1	DW POL AGE TANK	480.0	1.858	0.150	1.093	0.114								
Case 2	DW POL AGE TANK	480.0	1.867	0.143	1.095	0.111								
Case 1	DW POLY 2 PMP	480.0	1.805	0.186	1.490	0.173								
Case 2	DW POLY 2 PMP	480.0	1.812	0.177	1.484	0.174								
Case 1	DW POLY AGE TANK VLVS	480.0	2.220	0.169	1.836	0.174								
Case 2	DW POLY AGE TANK VLVS	480.0	2.231	0.160	1.827	0.176								
Case 1	DW POLY AGE TNK MIX	480.0	2.126	0.174	1.252	0.127								
Case 2	DW POLY AGE TNK MIX	480.0	2.138	0.165	1.255	0.124								
Case 1	DW POLY FEED PMP	480.0	1.848	0.189	1.083	0.124								
Case 2	DW POLY FEED PMP	480.0	1.856	0.180	1.085	0.120								
Case 1	EAST CLARIFIER THKNR	480.0	0.860	0.104	0.501	0.077								
Case 2	EAST CLARIFIER THKNR	480.0	0.861	0.100	0.501	0.075								
Case 1	EAST PRIMARY CLARIFIER	480.0	0.453	0.070	0.264	0.054								
Case 2	EAST PRIMARY CLARIFIER	480.0	0.454	0.068	0.264	0.053								
Case 1	ELEC RM COND UNIT	480.0	6.151	0.355	3.756	0.235								
Case 2	ELEC RM COND UNIT	480.0	6.260	0.330	3.780	0.225								
Case 1	ELEC RM RET FAN	480.0	3.128	0.165	1.856	0.114								
Case 2	ELEC RM RET FAN	480.0	3.151	0.153	1.861	0.110								
Case 1	EQUIP GALL SUMP P1	480.0	0.905	0.238	0.528	0.138								
Case 2	EQUIP GALL SUMP P1	480.0	0.907	0.231	0.528	0.136								
Case 1	EQUIP GALL SUMP P2	480.0	0.905	0.238	0.528	0.138								
Case 2	EQUIP GALL SUMP P2	480.0	0.907	0.231	0.528	0.136								
Case 1	F2015 UNIDOR VENT	480.0	1.238	0.213	0.719	0.106								
Case 2	F2015 UNIDOR VENT	480.0	1.239	0.204	0.718	0.107								
Case 1	FILT FEED PMP 1	480.0	3.785	0.397	3.036	0.348								



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Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	FILT FEED PMP 1	480.0	3.819	0.377	3.050	0.340								
Case 1	GEN-2995 STBY GEN 1 JACKET	480.0	3.976	0.216	2.393	0.147								
Case 2	GEN-2995 STBY GEN 1 JACKET	480.0	4.007	0.200	2.383	0.148								
Case 1	GENERATOR 2994	480.0	0.000	0.000	0.000	0.000								
Case 2	GENERATOR 2994	480.0	0.000	0.000	0.000	0.000								
Case 1	GENERATOR 2995	480.0	0.000	0.000	0.000	0.000								
Case 2	GENERATOR 2995	480.0	0.000	0.000	0.000	0.000								
Case 1	GRIFT PUMP 1	480.0	1.239	0.286	0.728	0.180								
Case 2	GRIFT PUMP 1	480.0	1.243	0.278	0.729	0.177								
Case 1	GRIFT PUMP 2	480.0	1.177	0.285	0.691	0.176								
Case 2	GRIFT PUMP 2	480.0	1.181	0.277	0.692	0.174								
Case 1	GRINDER	480.0	0.380	0.097	0.220	0.059								
Case 2	GRINDER	480.0	0.380	0.094	0.220	0.058								
Case 1	GRINDER #1	480.0	1.918	0.210	1.119	0.147								
Case 2	GRINDER #1	480.0	1.925	0.201	1.120	0.145								
Case 1	GRINDER #2	480.0	1.918	0.210	1.119	0.147								
Case 2	GRINDER #2	480.0	1.925	0.201	1.120	0.145								
Case 1	GRIT PUMP-3	480.0	1.084	0.285	0.638	0.170								
Case 2	GRIT PUMP-3	480.0	1.090	0.275	0.637	0.169								
Case 1	GRIT PUMP-4	480.0	1.036	0.285	0.609	0.167								
Case 2	GRIT PUMP-4	480.0	1.042	0.274	0.608	0.166								
Case 1	HC1281 DISC	480.0	4.361	0.432	2.742	0.364								
Case 2	HC1281 DISC	480.0	4.434	0.415	2.761	0.357								
Case 1	HC1285 DISC	480.0	9.047	1.334	6.444	1.224								
Case 2	HC1285 DISC	480.0	9.460	1.311	6.579	1.212								
Case 1	HC1303 DISC	480.0	1.535	0.250	0.924	0.208								



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			3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	HC1303 DISC	480.0	1.549	0.243	0.924	0.208								
Case 1	-2903 ELECT RM AHU HEAT CO	480.0	1.993	0.119	1.174	0.087								
Case 2	-2903 ELECT RM AHU HEAT CO	480.0	2.002	0.112	1.176	0.084								
Case 1	HEADWORKS FOUL AIR BLWR	480.0	0.000	0.000	0.000	0.000								
Case 2	HEADWORKS FOUL AIR BLWR	480.0	0.000	0.000	0.000	0.000								
Case 1	HOIST	480.0	2.557	0.270	1.645	0.226								
Case 2	HOIST	480.0	2.575	0.260	1.650	0.222								
Case 1	HYPO CIRC PMP 1	480.0	2.126	0.174	1.252	0.127								
Case 2	HYPO CIRC PMP 1	480.0	2.138	0.165	1.255	0.124								
Case 1	HYPO REC PMP 2	480.0	2.620	0.196	2.139	0.205								
Case 2	HYPO REC PMP 2	480.0	2.635	0.186	2.146	0.200								
Case 1	LAB ATS NORMAL TERM	277.2	9.646	3.859	9.895	3.947								
Case 2	LAB ATS NORMAL TERM	277.2	9.638	3.816	9.889	3.916								
Case 1	LV LAB XFMR SEC	277.2	0.998	0.404	1.409	0.489								
Case 2	LV LAB XFMR SEC	277.2	0.999	0.402	1.411	0.487								
Case 1	LV TFR LAB PRI	480.0	0.644	0.219	0.379	0.183								
Case 2	LV TFR LAB PRI	480.0	0.645	0.217	0.379	0.184								
Case 1	MCC 2971	480.0	26.423	3.511	24.340	3.042								
Case 2	MCC 2971	480.0	29.896	3.769	26.214	3.120								
Case 1	MCC 2972	480.0	26.831	3.768	27.471	3.681								
Case 2	MCC 2972	480.0	29.887	3.767	26.150	3.108								
Case 1	MCC 2983	480.0	16.980	2.536	13.023	1.814								
Case 2	MCC 2983	480.0	18.243	2.509	13.497	1.787								
Case 1	MCC-2	480.0	12.297	1.827	8.416	1.122								
Case 2	MCC-2	480.0	12.893	1.765	8.587	1.097								
Case 1	MCC-2971	480.0	26.423	3.511	24.340	3.042								



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Summary of Calculated Short Circuit Values

		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	MCC-2971	480.0	29.896	3.769	26.214	3.120								
Case 1	MCC-2972	480.0	26.831	3.768	27.471	3.681								
Case 2	MCC-2972	480.0	29.887	3.767	26.150	3.108								
Case 1	MCC-2973	480.0	26.343	3.490	24.294	3.034								
Case 2	MCC-2973	480.0	29.726	3.725	26.126	3.103								
Case 1	MCC-2974	480.0	26.295	3.668	26.698	3.529								
Case 2	MCC-2974	480.0	29.717	3.722	26.062	3.091								
Case 1	MCC-2975	480.0	11.461	2.227	8.539	2.283								
Case 2	MCC-2975	480.0	12.147	2.247	8.785	2.295								
Case 1	MCC-2976	480.0	11.135	1.940	8.788	2.201								
Case 2	MCC-2976	480.0	12.147	2.247	8.785	2.295								
Case 1	MCC-2981	480.0	16.488	2.328	12.820	1.760								
Case 2	MCC-2981	480.0	17.812	2.353	13.332	1.749								
Case 1	MCC-2982	480.0	16.572	2.272	13.758	1.807								
Case 2	MCC-2982	480.0	17.812	2.353	13.332	1.749								
Case 1	MCC-2983	480.0	16.980	2.536	13.023	1.814								
Case 2	MCC-2983	480.0	18.243	2.509	13.497	1.787								
Case 1	MCC-2984	480.0	16.383	2.375	12.428	1.701								
Case 2	MCC-2984	480.0	17.553	2.339	12.856	1.674								
Case 1	MCC4 PANEL	480.0	7.078	0.811	5.671	0.897								
Case 2	MCC4 PANEL	480.0	7.275	0.786	5.756	0.885								
Case 1	MEE1100	208.0	1.578	1.317	1.729	1.537								
Case 2	MEE1100	208.0	1.586	1.322	1.735	1.542								
Case 1	MEE1100 480V	480.0	2.044	0.290	1.244	0.241								
Case 2	MEE1100 480V	480.0	2.069	0.281	1.243	0.241								
Case 1	MEE5012 SEPTAGE PANEL	277.2	1.340	0.591	1.716	0.765								



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Summary of Calculated Short Circuit Values

Case	Location	Volts	LOW VOLTAGE LOCATION RESULTS				>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
			3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	MEE5012 SEPTAGE PANEL	277.2	1.344	0.588	1.721	0.762								
Case 1	MEE7110 VFD PNL	480.0	13.709	1.904	10.197	1.459								
Case 2	MEE7110 VFD PNL	480.0	14.609	1.894	10.514	1.444								
Case 1	NALGEAR PMP	480.0	1.028	0.123	0.849	0.128								
Case 2	NALGEAR PMP	480.0	1.030	0.119	0.850	0.126								
Case 1	NORTH TRAILER	277.2	1.676	1.100	1.402	0.815								
Case 2	NORTH TRAILER	277.2	1.682	1.097	1.405	0.813								
Case 1	OFFICE LAB SWITCHES	277.2	9.646	3.859	9.895	3.947								
Case 2	OFFICE LAB SWITCHES	277.2	9.638	3.816	9.889	3.916								
Case 1	P1001 VFD	480.0	23.852	1.936	20.481	1.442								
Case 2	P1001 VFD	480.0	26.651	1.900	21.768	1.404								
Case 1	P2514 VFD	480.0	24.930	2.208	23.975	1.671								
Case 2	P2514 VFD	480.0	27.458	2.103	22.760	1.569								
Case 1	P2515 VFD	480.0	24.930	2.208	23.975	1.671								
Case 2	P2515 VFD	480.0	27.458	2.103	22.760	1.569								
Case 1	P7112 VFD	480.0	15.667	1.946	11.891	1.443								
Case 2	P7112 VFD	480.0	16.852	1.934	12.324	1.424								
Case 1	P7241 VFD	480.0	15.590	1.824	11.778	1.360								
Case 2	P7241 VFD	480.0	16.762	1.806	12.201	1.341								
Case 1	PANEL 1990	277.2	3.769	2.349	0.000	1.000								
Case 2	PANEL 1990	277.2	3.805	2.350	0.000	1.000								
Case 1	PANEL A	277.2	7.998	2.835	7.541	2.885								
Case 2	PANEL A	277.2	7.992	2.815	7.538	2.873								
Case 1	PANEL B	277.2	6.802	2.369	6.071	2.461								
Case 2	PANEL B	277.2	6.798	2.358	6.069	2.453								
Case 1	PANEL MP	208.0	2.103	1.008	2.461	1.230								



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		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	PANEL MP	208.0	2.111	1.006	2.469	1.228								
Case 1	PLATE DEWATER PRESS	480.0	2.677	0.211	2.183	0.229								
Case 2	PLATE DEWATER PRESS	480.0	2.694	0.202	2.191	0.224								
Case 1	PNL 1021	480.0	3.095	0.287	2.544	0.331								
Case 2	PNL 1021	480.0	3.128	0.275	2.559	0.325								
Case 1	PNL 1023	480.0	2.180	0.220	1.324	0.178								
Case 2	PNL 1023	480.0	2.208	0.209	1.323	0.178								
Case 1	PNL 1025	480.0	3.095	0.287	2.544	0.331								
Case 2	PNL 1025	480.0	3.128	0.275	2.559	0.325								
Case 1	PNL 1026	480.0	1.913	0.195	1.146	0.162								
Case 2	PNL 1026	480.0	1.924	0.188	1.148	0.159								
Case 1	PNL 1027	480.0	1.696	0.178	1.012	0.148								
Case 2	PNL 1027	480.0	1.704	0.171	1.014	0.145								
Case 1	PNL 1028	480.0	1.790	0.188	1.078	0.152								
Case 2	PNL 1028	480.0	1.807	0.179	1.077	0.152								
Case 1	PNL 1070	480.0	0.508	0.110	0.298	0.093								
Case 2	PNL 1070	480.0	0.509	0.108	0.298	0.092								
Case 1	PNL 1250	480.0	0.963	0.247	0.562	0.144								
Case 2	PNL 1250	480.0	0.965	0.240	0.562	0.142								
Case 1	PNL 2958	208.0	3.133	2.287	3.196	2.304								
Case 2	PNL 2958	208.0	3.151	2.283	3.209	2.301								
Case 1	PNL 2973	208.0	3.133	2.283	3.196	2.301								
Case 2	PNL 2973	208.0	3.151	2.283	3.209	2.301								
Case 1	PNL 2975	208.0	2.676	2.669	2.768	2.686								
Case 2	PNL 2975	208.0	2.691	2.674	2.779	2.690								
Case 1	PNL 2976	208.0	0.893	2.448	0.904	2.455								



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		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	PNL 2976	208.0	0.896	2.462	0.905	2.465								
Case 1	PNL 2981	208.0	2.244	2.861	2.289	2.874								
Case 2	PNL 2981	208.0	2.254	2.866	2.296	2.877								
Case 1	PNL 2982	208.0	1.320	2.707	1.336	2.713								
Case 2	PNL 2982	208.0	1.324	2.712	1.338	2.716								
Case 1	PNL 5010	480.0	1.731	0.266	1.046	0.221								
Case 2	PNL 5010	480.0	1.749	0.257	1.046	0.221								
Case 1	PNL 5020	480.0	1.073	0.191	0.637	0.149								
Case 2	PNL 5020	480.0	1.079	0.184	0.637	0.149								
Case 1	PNL 7225 DEWAT POL DIST PNL	480.0	1.564	0.133	0.919	0.102								
Case 2	PNL 7225 DEWAT POL DIST PNL	480.0	1.570	0.127	0.920	0.100								
Case 1	PNL C	277.2	1.607	2.737	1.627	2.733								
Case 2	PNL C	277.2	1.613	2.739	1.631	2.735								
Case 1	PNL-1090 PLANT WW SMP PNL	480.0	7.721	0.490	4.875	0.360								
Case 2	PNL-1090 PLANT WW SMP PNL	480.0	7.924	0.462	4.923	0.348								
Case 1	PRESS PRES WASH	480.0	1.871	0.190	1.097	0.124								
Case 2	PRESS PRES WASH	480.0	1.879	0.181	1.098	0.121								
Case 1	PRI SLUDGE PMP 1	480.0	0.000	0.000	0.000	0.000								
Case 2	PRI SLUDGE PMP 1	480.0	0.000	0.000	0.000	0.000								
Case 1	PRIMARY GALLERY EXH FAN	480.0	0.513	0.094	0.301	0.074								
Case 2	PRIMARY GALLERY EXH FAN	480.0	0.514	0.091	0.301	0.074								
Case 1	PRIMARY GALLERY SUP FAN	480.0	0.455	0.103	0.266	0.074								
Case 2	PRIMARY GALLERY SUP FAN	480.0	0.456	0.099	0.266	0.074								
Case 1	PRIMARY SLUDGE PMP 2	480.0	0.000	0.000	0.000	0.000								
Case 2	PRIMARY SLUDGE PMP 2	480.0	0.000	0.000	0.000	0.000								
Case 1	PROCESS WATER PUMP 1	480.0	2.123	0.610	1.224	0.273								



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		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	PROCESS WATER PUMP 1	480.0	2.133	0.592	1.226	0.269								
Case 1	PROCESS WATER PUMP 3	480.0	2.223	0.602	1.285	0.274								
Case 2	PROCESS WATER PUMP 3	480.0	2.234	0.584	1.287	0.270								
Case 1	PROCESS WTR PMP 2	480.0	2.059	0.616	1.189	0.267								
Case 2	PROCESS WTR PMP 2	480.0	2.064	0.599	1.184	0.268								
Case 1	RET ACT SLUDGE PMP 1	480.0	0.376	0.150	0.216	0.065								
Case 2	RET ACT SLUDGE PMP 1	480.0	0.376	0.147	0.216	0.064								
Case 1	RET ACT SLUDGE PMP 2	480.0	0.383	0.149	0.220	0.065								
Case 2	RET ACT SLUDGE PMP 2	480.0	0.383	0.145	0.220	0.064								
Case 1	RET ACT SLUDGE PMP 3	480.0	0.390	0.148	0.224	0.064								
Case 2	RET ACT SLUDGE PMP 3	480.0	0.390	0.144	0.224	0.064								
Case 1	RETURN AC SLUD PMP 4	480.0	0.000	0.000	0.000	0.000								
Case 2	RETURN AC SLUD PMP 4	480.0	0.000	0.000	0.000	0.000								
Case 1	RETURN AC SLUD PMP 5	480.0	0.000	0.000	0.000	0.000								
Case 2	RETURN AC SLUD PMP 5	480.0	0.000	0.000	0.000	0.000								
Case 1	S101 PANEL	480.0	7.145	0.819	5.722	0.906								
Case 2	S101 PANEL	480.0	7.346	0.794	5.810	0.893								
Case 1	S102 PANEL	277.2	3.817	2.030	4.204	2.289								
Case 2	S102 PANEL	277.2	3.853	2.027	4.234	2.289								
Case 1	SAN DRAIN PMP 1	480.0	0.985	0.127	0.574	0.071								
Case 2	SAN DRAIN PMP 1	480.0	0.986	0.122	0.573	0.072								
Case 1	SAN DRAIN PMP 2	480.0	0.985	0.127	0.574	0.071								
Case 2	SAN DRAIN PMP 2	480.0	0.986	0.122	0.573	0.072								
Case 1	SCUM PUMP	480.0	0.415	0.145	0.239	0.065								
Case 2	SCUM PUMP	480.0	0.415	0.141	0.239	0.065								
Case 1	SCUM PUMP 1	480.0	0.376	0.150	0.216	0.064								



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 Short Circuit Values**

		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	SCUM PUMP 1	480.0	0.376	0.147	0.216	0.064								
Case 1	SEAL WATER	480.0	2.391	0.211	1.401	0.163								
Case 2	SEAL WATER	480.0	2.402	0.202	1.404	0.160								
Case 1	SEC CLAR COLL 2	480.0	0.383	0.071	0.224	0.052								
Case 2	SEC CLAR COLL 2	480.0	0.384	0.069	0.223	0.053								
Case 1	SECONDARY CLAR COLL 1	480.0	0.496	0.099	0.289	0.076								
Case 2	SECONDARY CLAR COLL 1	480.0	0.496	0.097	0.289	0.076								
Case 1	SEPTAGE PMP 1	480.0	2.319	0.275	1.885	0.250								
Case 2	SEPTAGE PMP 1	480.0	2.330	0.263	1.890	0.245								
Case 1	SEPTAGE PMP 2	480.0	1.615	0.255	1.316	0.221								
Case 2	SEPTAGE PMP 2	480.0	1.620	0.245	1.318	0.217								
Case 1	SEPTAGE PWR CENTER	480.0	1.059	0.141	0.880	0.169								
Case 2	SEPTAGE PWR CENTER	480.0	1.062	0.137	0.882	0.166								
Case 1	SERV AIR CMP 2 PNL	480.0	3.565	0.393	2.853	0.343								
Case 2	SERV AIR CMP 2 PNL	480.0	3.594	0.374	2.866	0.334								
Case 1	SERV AIR COMP 1 PNL	480.0	2.436	0.280	1.979	0.256								
Case 2	SERV AIR COMP 1 PNL	480.0	2.448	0.267	1.984	0.250								
Case 1	SHOP HEAT 1	480.0	4.068	0.427	2.813	0.390								
Case 2	SHOP HEAT 1	480.0	4.121	0.412	2.829	0.384								
Case 1	SHOP HEAT 2	480.0	2.786	0.304	1.816	0.266								
Case 2	SHOP HEAT 2	480.0	2.809	0.294	1.822	0.261								
Case 1	SLDG BLDG HT WT PMP	480.0	2.713	0.197	2.214	0.207								
Case 2	SLDG BLDG HT WT PMP	480.0	2.729	0.187	2.221	0.202								
Case 1	SLUDGE BLD LAB AREA EXH FA	480.0	2.131	0.163	1.748	0.175								
Case 2	SLUDGE BLD LAB AREA EXH FA	480.0	2.141	0.155	1.752	0.171								
Case 1	SLUDGE BLDG AHU-1	480.0	1.038	0.153	0.855	0.141								



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		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	SLUDGE BLDG AHU-1	480.0	1.040	0.147	0.856	0.139								
Case 1	SLUDGE BLDG AHU-2	480.0	16.920	2.488	12.973	1.790								
Case 2	SLUDGE BLDG AHU-2	480.0	18.174	2.458	13.443	1.763								
Case 1	SLUDGE BLDG ELEC RM ACU	480.0	1.502	0.213	1.229	0.179								
Case 2	SLUDGE BLDG ELEC RM ACU	480.0	1.506	0.204	1.230	0.175								
Case 1	SLUDGE BLDG RM EXH FAN	480.0	16.889	2.458	12.947	1.776								
Case 2	SLUDGE BLDG RM EXH FAN	480.0	18.138	2.427	13.414	1.748								
Case 1	SLUDGE CHEM RM SUP FAN	480.0	2.487	0.184	2.034	0.195								
Case 2	SLUDGE CHEM RM SUP FAN	480.0	2.501	0.175	2.040	0.190								
Case 1	SLUDGE MIXING P1	480.0	3.024	0.336	1.768	0.213								
Case 2	SLUDGE MIXING P1	480.0	3.042	0.322	1.772	0.209								
Case 1	SLUDGE MIXING P2	480.0	3.024	0.336	1.768	0.213								
Case 2	SLUDGE MIXING P2	480.0	3.042	0.322	1.772	0.209								
Case 1	SLUDGE RECIRC P1	480.0	2.042	0.211	1.190	0.141								
Case 2	SLUDGE RECIRC P1	480.0	2.050	0.202	1.191	0.138								
Case 1	SLUDGE RECIRC P2	480.0	2.042	0.211	1.190	0.141								
Case 2	SLUDGE RECIRC P2	480.0	2.050	0.202	1.191	0.138								
Case 1	SOUTH TRAILER	277.2	1.904	1.349	1.719	1.051								
Case 2	SOUTH TRAILER	277.2	1.913	1.346	1.724	1.049								
Case 1	STANDBY AIR BLOWER	480.0	0.000	0.000	0.000	0.000								
Case 2	STANDBY AIR BLOWER	480.0	0.000	0.000	0.000	0.000								
Case 1	SWBD 1	480.0	24.998	3.095	22.730	2.746								
Case 2	SWBD 1	480.0	28.027	3.220	24.326	2.780								
Case 1	SWGR 1	12470.0					2.437	1.502	1.720	2.408	2.570	1.694	2.779	2.621
Case 2	SWGR 1	12470.0					2.436	1.490	1.720	2.396	2.557	1.642	2.839	2.568
Case 1	SWGR 2950 LINE	12470.0					2.414	1.495	1.705	2.387	2.545	1.690	2.821	2.600



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		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	SWGR 2950 LINE	12470.0					2.413	1.484	1.705	2.374	2.533	1.638	2.882	2.547
Case 1	TANK DRAIN PUMP	480.0	0.575	0.147	0.335	0.090								
Case 2	TANK DRAIN PUMP	480.0	0.576	0.143	0.335	0.089								
Case 1	TFR 1990 PRI	480.0	7.356	1.204	4.987	0.977								
Case 2	TFR 1990 PRI	480.0	7.593	1.181	5.056	0.966								
Case 1	TFR 2951 PRI	12470.0					2.410	1.491	1.703	2.378	2.541	1.685	2.834	2.589
Case 2	TFR 2951 PRI	12470.0					2.409	1.480	1.703	2.366	2.528	1.635	2.893	2.539
Case 1	TFR 2951 SEC	480.0	31.641	3.915	34.277	4.518								
Case 2	TFR 2951 SEC	480.0	34.942	3.744	36.784	4.405								
Case 1	TFR 2952 PRI	12470.0					2.411	1.494	1.704	2.383	2.542	1.689	2.827	2.596
Case 2	TFR 2952 PRI	12470.0					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Case 1	TFR 2952 SEC	480.0	29.383	4.136	32.125	4.709								
Case 2	TFR 2952 SEC	480.0	0.000	0.000	0.000	0.000								
Case 1	TFR-2957 PRI	480.0	22.438	1.587	18.563	1.150								
Case 2	TFR-2957 PRI	480.0	24.815	1.529	19.562	1.110								
Case 1	TFR-2958 PRI	480.0	22.508	1.631	20.084	1.152								
Case 2	TFR-2958 PRI	480.0	24.809	1.528	19.523	1.110								
Case 1	THKND SLUDGE PMP #1	480.0	2.406	0.255	1.405	0.174								
Case 2	THKND SLUDGE PMP #1	480.0	2.417	0.245	1.407	0.171								
Case 1	THKND SLUDGE PMP #2	480.0	2.248	0.245	1.312	0.167								
Case 2	THKND SLUDGE PMP #2	480.0	2.257	0.235	1.314	0.163								
Case 1	TX PANEL 3100	440.0	4.441	2.690	4.955	2.927								
Case 2	TX PANEL 3100	440.0	4.521	2.698	5.021	2.937								
Case 1	TX PANEL 3200	440.0	4.204	2.847	4.753	3.052								
Case 2	TX PANEL 3200	440.0	4.276	2.840	4.815	3.049								
Case 1	TX TRAIL SEC	277.2	2.379	2.414	2.520	2.646								



Electrical Reliability Services, Inc.

CLIENT: PSW Electric

PROJECT: Central Kitsap WWTP

JOB#: 3130462

Appendix 4

Summary of Calculated Short Circuit Values

		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	TX TRAIL SEC	277.2	2.394	2.414	2.530	2.647								
Case 1	UTIL INTERFACE	12470.0					2.489	1.547	1.748	2.518	2.629	1.732	2.645	2.730
Case 2	UTIL INTERFACE	12470.0					2.488	1.536	1.748	2.505	2.616	1.682	2.700	2.678
Case 1	UV PWR DIST CHAN 2	480.0	10.932	1.835	8.228	1.484								
Case 2	UV PWR DIST CHAN 2	480.0	11.462	1.789	8.142	1.456								
Case 1	UV PWR DIST CHNL 1	480.0	12.675	1.510	10.190	1.595								
Case 2	UV PWR DIST CHNL 1	480.0	13.400	1.477	10.496	1.579								
Case 1	UVB-3110	440.0	4.201	2.558	4.514	2.607								
Case 2	UVB-3110	440.0	4.273	2.563	4.569	2.611								
Case 1	UVB-3120	440.0	4.201	2.558	4.514	2.607								
Case 2	UVB-3120	440.0	4.273	2.563	4.569	2.611								
Case 1	UVB-3121	440.0	3.989	2.701	4.348	2.711								
Case 2	UVB-3121	440.0	4.054	2.693	4.399	2.705								
Case 1	UVB-3210	440.0	3.989	2.701	4.348	2.711								
Case 2	UVB-3210	440.0	4.054	2.693	4.399	2.705								
Case 1	VFD P1002	480.0	25.612	2.611	25.270	2.097								
Case 2	VFD P1002	480.0	28.331	2.517	23.992	1.924								
Case 1	VFD P2531	480.0	22.405	1.529	18.405	1.099								
Case 2	VFD P2531	480.0	24.817	1.468	19.400	1.059								
Case 1	WAS PUMP 2	480.0	0.367	0.121	0.212	0.061								
Case 2	WAS PUMP 2	480.0	0.367	0.118	0.212	0.061								
Case 1	WAS PUMP 1	480.0	0.000	0.000	0.000	0.000								
Case 2	WAS PUMP 1	480.0	0.000	0.000	0.000	0.000								
Case 1	WEST CLARIFIER THKNR	480.0	0.860	0.104	0.501	0.077								
Case 2	WEST CLARIFIER THKNR	480.0	0.861	0.100	0.501	0.075								
Case 1	WEST PRI CLAR	480.0	0.281	0.066	0.164	0.050								



Electrical Reliability Services, Inc.

CLIENT: PSW Electric

PROJECT: Central Kitsap WWTP

JOB#: 3130462

**Appendix 4
Summary of Calculated
Short Circuit Values**

		LOW VOLTAGE LOCATION RESULTS					>1000V LOCATION INTERRUPTING				>1000V LOCATION MOMENTARY			
Case	Location	Volts	3ph (KA)	3ph X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R	3PH (KA)	3PH X/R	SLG (KA)	SLG X/R
Case 2	WEST PRI CLAR	480.0	0.282	0.065	0.164	0.050								
Case 1	WIREWAY CLOR BLDG	480.0	7.178	0.823	5.748	0.911								
Case 2	WIREWAY CLOR BLDG	480.0	7.382	0.799	5.837	0.898								

APPENDIX 5:DEVICE EVALUATION REPORT

Device Evaluation

ERS # 3162884

Client: PFW Electric
Project: Central Kitsap WWTP

Bus Name	Voltage (V)	Device Type	Interrupt Rating (kA)	Series Rating (kA)	C&L Rating (kA)	Calculated Interrupt (kA)	Calculated Momentary (kA)	Interrupt Rating (%)	C&L Rating (%)	Evaluation	Possible Corrective Action
2960 MAIN A	480	Cutler-Hammer SPB-50	50	0	0	31.69	0	63 %	0 %	Pass	
	480	Cutler-Hammer SPB-65	65	0	0	31.69	0	49 %	0 %	Pass	
	480	Cutler-Hammer SPB-100	100	0	0	31.69	0	32 %	0 %	Pass	
2960 MAIN B	480	Cutler-Hammer SPB-50	50	0	0	30.66	0	61 %	0 %	Pass	
	480	Cutler-Hammer SPB-65	65	0	0	31.68	0	49 %	0 %	Pass	
	480	Cutler-Hammer SPB-100, SPB-100M	100	0	0	31.68	0	32 %	0 %	Pass	
ACTIV SLUDGE MIXER 2	480	Cutler-Hammer DH	10	0	0	1.03	0	10 %	0 %	Pass	
ACTIV SLUDGE MIXER 4	480	Cutler-Hammer DH	10	0	0	1.36	0	14 %	0 %	Pass	
ACTIVATED SLUDGE MIXER 1	480	Cutler-Hammer DH	10	0	0	1.13	0	11 %	0 %	Pass	
ACTIVATED SLUDGE MIXER 3	480	Cutler-Hammer DH	10	0	0	1.36	0	14 %	0 %	Pass	
AER BLWR 1 VLVS	480	Cutler-Hammer DH	10	0	0	2.6	0	26 %	0 %	Pass	
AHU1281 DISC	480	Bussmann FRS-R	100+	0	0	3.13	0	2 %	0 %	Pass	
AHU1285 DISC	480	Bussmann FRS-R	100+	0	0	4.45	0	2 %	0 %	Pass	
ALUM METE PMPS	480	UI 98 DS	10	0	0	1.76	0	18 %	0 %	Pass	
BIO FILTER BLOWER	480	Cutler-Hammer DH	10	0	0	1.39	0	14 %	0 %	Pass	
BL BLDG ELEC RM AHU-2901	480	Cutler-Hammer DH	10	0	0	3.16	0	32 %	0 %	Pass	
BLWR RM EXH FN 1	480	Cutler-Hammer DH	10	0	0	1.81	0	18 %	0 %	Pass	
BLWR ROOM AHU2910	480	UI 98 DS	10	0	0	2.01	0	20 %	0 %	Pass	
CENT 1 CAKE CONV	480	Cutler-Hammer DH	10	0	0	1.66	0	17 %	0 %	Pass	
CENT 1 CONV DR VLV	480	Cutler-Hammer DH	10	0	0	1.7	0	17 %	0 %	Pass	
CENT 1 SLUDGE FEED PMP	480	Cutler-Hammer DH	10	0	0	6.21	0	62 %	0 %	Pass	
CENT 1 SLUDGE GRIND	480	Cutler-Hammer DH	10	0	0	2	0	20 %	0 %	Pass	
CENT 1 SLUDGE INLET VLV	480	Cutler-Hammer DH	10	0	0	2.93	0	29 %	0 %	Pass	
CENT CONR AREA ACU	480	Cutler-Hammer DH	10	0	0	7.33	0	73 %	0 %	Pass	
CENT RM HOIST	480	Cutler-Hammer DH	10	0	0	2.71	0	27 %	0 %	Pass	
CENTRATE PMP 1	480	Cutler-Hammer DH	10	0	0	2.56	0	26 %	0 %	Pass	
CENTRATE PMP 2	480	Cutler-Hammer DH	10	0	0	2.55	0	26 %	0 %	Pass	
CHAN 2 AIR BLWR	480	Cutler-Hammer DH	10	0	0	3.02	0	30 %	0 %	Pass	
DECANT FACILITY	480	Siemens ED4	18	0	0	1.78	0	10 %	0 %	Pass	
DEWAT P0L-AGE TANK 2 MIX	480	Cutler-Hammer DH	10	0	0	2.08	0	21 %	0 %	Pass	
DUPLEX SEAL WATER PMP 1	480	UI 98 DS	10	0	0	2.24	0	22 %	0 %	Pass	
DW POLY 2 PMP	480	Cutler-Hammer DH	10	0	0	1.81	0	18 %	0 %	Pass	
DW POLY AGE TANK VLVS	480	Cutler-Hammer DH	10	0	0	2.23	0	22 %	0 %	Pass	
DW POLY AGE TNK MIX	480	Cutler-Hammer DH	10	0	0	2.14	0	21 %	0 %	Pass	
ELEC RM COND UNIT	480	UI 98 DS	10	0	0	6.26	0	63 %	0 %	Pass	
ELEC RM RET FAN	480	UI 98 DS	10	0	0	3.15	0	32 %	0 %	Pass	
F2015 UNIDOR VENT	480	Cutler-Hammer DH	10	0	0	1.24	0	12 %	0 %	Pass	
FILT FEED PMP 1	480	Cutler-Hammer DH	10	0	0	3.82	0	38 %	0 %	Pass	
GENERATOR 2994	480	GE THKR	50	0	0	0	0	0 %	0 %	Pass	
GENERATOR 2995	480	Merlin Gerin CM1600HH	85	0	0	0	0	0 %	0 %	Pass	
GRIFT PUMP 1	480	UI 98 DS	10	0	0	1.24	0	12 %	0 %	Pass	
GRIFT PUMP 2	480	UI 98 DS	10	0	0	1.18	0	12 %	0 %	Pass	
GRIT PUMP-3	480	UI 98 DS	10	0	0	1.09	0	11 %	0 %	Pass	
GRIT PUMP-4	480	UI 98 DS	10	0	0	1.04	0	10 %	0 %	Pass	
HC1281 DISC	480	UI 98 DS	10	0	0	4.43	0	44 %	0 %	Pass	
HC1285 DISC	480	UI 98 DS	10	0	0	9.46	0	95 %	0 %	Pass	
HC1303 DISC	480	Bussmann FRS-R	100+	0	0	1.55	0	1 %	0 %	Pass	
HC-2903 ELECT RM AHU HEAT COIL	480	UI 98 DS	10	0	0	2	0	20 %	0 %	Pass	
HYP0 REC PMP 2	480	Cutler-Hammer DH	10	0	0	2.64	0	26 %	0 %	Pass	
MCC 2971	480	Cutler-Hammer HFD, HLD	65	0	0	29.9	0	46 %	0 %	Pass	
MCC 2972	480	Cutler-Hammer HFD, HMCP	65	0	0	29.89	0	46 %	0 %	Pass	
MCC 2983	480	Cutler-Hammer HFD, HMCP	65	0	0	18.24	0	28 %	0 %	Pass	
MCC-2	480	GE TECL	100	0	0	12.89	0	13 %	0 %	Pass	
	480	Bussmann FRS-R, Gould Shawmut TRS	100+	0	0	12.89	0	6 %	0 %	Pass	
MCC-2971	480	Cutler-Hammer HFD, HJD	65	0	0	29.9	0	46 %	0 %	Pass	
MCC-2972	480	Cutler-Hammer HFD, HMCP	65	0	0	29.89	0	46 %	0 %	Pass	
MCC-2973	480	Cutler-Hammer HFD, HKD	65	0	0	29.73	0	46 %	0 %	Pass	
MCC-2974	480	Cutler-Hammer HFD, HKD	65	0	0	29.72	0	46 %	0 %	Pass	
MCC-2975	480	Allen-Bradley 140M-I, Cutler-Hammer HFD	65	0	0	12.15	0	19 %	0 %	Pass	
MCC-2976	480	Allen-Bradley 140M-I, Cutler-Hammer HFD	65	0	0	12.15	0	19 %	0 %	Pass	
MCC-2981	480	Cutler-Hammer HFD, HKD	65	0	0	17.81	0	27 %	0 %	Pass	
MCC-2982	480	Cutler-Hammer HFD, HLD	65	0	0	17.81	0	27 %	0 %	Pass	
MCC-2983	480	Cutler-Hammer HFD, HKD	65	0	0	18.24	0	28 %	0 %	Pass	
MCC-2984	480	Cutler-Hammer HFD, HMCP	65	0	0	17.55	0	27 %	0 %	Pass	
MCC4 PANEL	480	Panel Rating	5	0	0	7.27	0	145 %	0 %	Fail	Increase panel rating
NALGEAR PMP	480	Cutler-Hammer DH	10	0	0	1.03	0	10 %	0 %	Pass	

Device Evaluation

ERS # 3162884

Client: PFW Electric
Project: Central Kitsap WWTP

Bus Name	Voltage (V)	Device Type	Interrupt Rating (kA)	Series Rating (kA)	C&L Rating (kA)	Calculated Interrupt (kA)	Calculated Momentary (kA)	Interrupt Rating (%)	C&L Rating (%)	Evaluation	Possible Corrective Action
OFFICE LAB SWITCHES	277	UI 98 DS	10	0	0	12.31	0	123 %	0 %	Fail	Replace UI 98 DS breakers
	277	Gould Shawmut OT	50	0	0	9.89	0	20 %	0 %	Pass	
PANEL 1990	277	Cutler-Hammer BAB	10	0	0	4.12	0	41 %	0 %	Pass	
	277	Cutler-Hammer HFD	100	0	0	3.81	0	4 %	0 %	Pass	
PLATE DEWATER PRESS	480	Panel Rating	2.5	0	0	2.69	0	108 %	0 %	Fail	Increase panel rating
PNL 1025	480	Square D GJL	65	0	0	3.13	0	5 %	0 %	Pass	
PNL 1250	480	Square D HD	18	0	0	0.96	0	5 %	0 %	Pass	
	208	Cutler-Hammer BAB	10	0	0	3.45	0	35 %	0 %	Pass	
PNL 2958	208	Cutler-Hammer FD	25	0	0	3.21	0	13 %	0 %	Pass	
PNL 2973	208	Cutler-Hammer HFD	65	0	0	3.21	0	5 %	0 %	Pass	
PNL 2975	208	Cutler-Hammer QBHW	22	0	0	2.78	0	13 %	0 %	Pass	
PNL 2976	208	Cutler-Hammer QBHW	22	0	0	0.91	0	4 %	0 %	Pass	
PNL 2981	208	Cutler-Hammer HFD	100	0	0	2.3	0	2 %	0 %	Pass	
PNL 2982	208	Cutler-Hammer HFD	100	0	0	1.34	0	1 %	0 %	Pass	
PNL C	277	GE THQB	10	0	0	1.84	0	18 %	0 %	Pass	
PNL-1090 PLANT WW SMP PNL	480	Panel Rating	5	0	0	7.92	0	158 %	0 %	Fail	Increase panel rating
PRESS PRES WASH	480	Cutler-Hammer DH	10	0	0	1.88	0	19 %	0 %	Pass	
PRIMARY GALLERY EXH FAN	480	UI 98 DS	10	0	0	0.51	0	5 %	0 %	Pass	
PRIMARY GALLERY SUP FAN	480	UI 98 DS	10	0	0	0.46	0	5 %	0 %	Pass	
PROCESS WATER PUMP 1	480	Cutler-Hammer DH	10	0	0	2.13	0	21 %	0 %	Pass	
PROCESS WATER PUMP 3	480	Cutler-Hammer HFD	22	0	0	2.23	0	10 %	0 %	Pass	
PROCESS WTR PMP 2	480	Cutler-Hammer DH	10	0	0	2.06	0	21 %	0 %	Pass	
RET ACT SLUDGE PMP 1	480	Cutler-Hammer DH	10	0	0	0.38	0	4 %	0 %	Pass	
RET ACT SLUDGE PMP 2	480	Cutler-Hammer DH	10	0	0	0.38	0	4 %	0 %	Pass	
RET ACT SLUDGE PMP 3	480	Cutler-Hammer DH	10	0	0	0.39	0	4 %	0 %	Pass	
S101 PANEL	480	Panel Rating	5	0	0	7.35	0	147 %	0 %	Fail	Increase panel rating
	480	GE TED	14	0	0	7.35	0	53 %	0 %	Pass	
S102 PANEL	277	GE THQB	10	0	0	4.55	0	46 %	0 %	Pass	
SAN DRAIN PMP 1	480	Cutler-Hammer DH	10	0	0	0.99	0	10 %	0 %	Pass	
SAN DRAIN PMP 2	480	Cutler-Hammer DH	10	0	0	0.99	0	10 %	0 %	Pass	
SCUM PUMP	480	Cutler-Hammer DH	10	0	0	0.42	0	4 %	0 %	Pass	
SCUM PUMP 1	480	Cutler-Hammer DH	10	0	0	0.38	0	4 %	0 %	Pass	
SEC CLAR COLL 2	480	Cutler-Hammer DH	10	0	0	0.38	0	4 %	0 %	Pass	
SECONDARY CLAR COLL 1	480	Cutler-Hammer DH	10	0	0	0.5	0	5 %	0 %	Pass	
SEPTAGE PMP 1	480	Cutler-Hammer DH	10	0	0	2.33	0	23 %	0 %	Pass	
SEPTAGE PMP 2	480	Cutler-Hammer DH	10	0	0	1.62	0	16 %	0 %	Pass	
SEPTAGE PWR CENTER	480	Square D FA	14	0	0	1.06	0	8 %	0 %	Pass	
SHOP HEAT 1	480	UI 98 DS	10	0	0	4.12	0	41 %	0 %	Pass	
SHOP HEAT 2	480	UI 98 DS	10	0	0	2.81	0	28 %	0 %	Pass	
SLDG BLDG HT WT PMP	480	UI 98 DS	10	0	0	2.73	0	27 %	0 %	Pass	
SLUDGE BLD LAB AREA EXH FAN	480	UI 98 DS	10	0	0	2.14	0	21 %	0 %	Pass	
SLUDGE BLDG AHU-1	480	UI 98 DS	10	0	0	1.04	0	10 %	0 %	Pass	
SLUDGE BLDG AHU-2	480	UI 98 DS	10	0	0	19.93	0	199 %	0 %	Fail	Replace UI 98 DS breakers
SLUDGE BLDG ELEC RM ACU	480	Cutler-Hammer DH	10	0	0	1.51	0	15 %	0 %	Pass	
SLUDGE BLDG RM EXH FAN	480	UI 98 DS	10	0	0	19.82	0	198 %	0 %	Fail	Replace UI 98 DS breakers
SLUDGE CHEM RM SUP FAN	480	UI 98 DS	10	0	0	2.5	0	25 %	0 %	Pass	
SOUTH TRAILER	277	UI 98 DS	10	0	0	1.91	0	19 %	0 %	Pass	
SWBD 1	480	Bussmann FRS-R, KRP-C	100+	0	0	28.03	0	14 %	0 %	Pass	
SWGR 1	12,470	Cutler-Hammer CLE, 300E, Hi-Tech Trans-Guard EX	50	0	80	2.51	2.57	5 %	3 %	Pass	
	12470	Cutler-Hammer WLI	38	0	61	2.49	2.55	7 %	4 %	Pass	
SWGR 2950 LINE	12470	Cutler-Hammer CLE, 150E	50	0	80	2.49	2.55	5 %	3 %	Pass	
TANK DRAIN PUMP	480	Cutler-Hammer DH	10	0	0	0.58	0	6 %	0 %	Pass	
UV PWR DIST CHAN 2	480	Cutler-Hammer HKD	65	0	0	11.46	0	18 %	0 %	Pass	
UV PWR DIST CHNL 1	480	Cutler-Hammer HKD	65	0	0	13.4	0	21 %	0 %	Pass	
WAS PUMP 2	480	Cutler-Hammer DH	10	0	0	0.37	0	4 %	0 %	Pass	
WEST PRI CLAR	480	Cutler-Hammer DH	10	0	0	0.28	0	3 %	0 %	Pass	

APPENDIX 6:RECOMMENDED DEVICE SETTINGS



Electrical Reliability Services, Inc.

PSW Electric

Central Kitsap WWTP

3130462

**APPENDIX 6
RECOMMENDED
CIRCUIT BREAKER SETTINGS**

Device Location	Device Name in Model /Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
2960 MAIN A	CB 2960 A1 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-100	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (400A)	LTPU (0.5-1.0 x P) 1 (400A)
				400.0A	LTD (2-24 Sec.) 15	LTD (2-24 Sec.) 15
					STPU (2-8 x LTPU) S2(8) (3200A)	STPU (2-8 x LTPU) 6 (2400A)
					STD (0.1-0.5 Sec.) 0.1 (I ² t Out)	STD (0.1-0.5 Sec.) 0.1 (I ² t Out)
					OVERRIDE (1 x ST) Fixed (25000A)	OVERRIDE (1 x ST) Fixed (25000A)
					GROUND	GROUND
2960 MAIN A	CB 2960 A2 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-65	1200.0A	Phase	Phase
				1200.0A	LTPU (0.5-1.0 x P) 1 (1000A)	LTPU (0.5-1.0 x P) 1 (1000A)
				1000.0A	LTD (2-24 Sec.) 2	LTD (2-24 Sec.) 7
					STPU (2-8 x LTPU) 3 (3000A)	STPU (2-8 x LTPU) 2 (2000A)
					STD (0.1-0.5 Sec.) 0.1 (I ² t In)	STD (0.1-0.5 Sec.) 0.1 (I ² t Out)
					OVERRIDE (1 x ST) Fixed (35000A)	OVERRIDE (1 x ST) Fixed (35000A)
					GROUND	GROUND
2960 MAIN A	CB 2960 A3 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LSI, 400-3000AF	SPB-100	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (600A)	LTPU (0.5-1.0 x P) 1 (600A)
				600.0A	LTD (2-24 Sec.) 4	LTD (2-24 Sec.) 24
					STPU (2-8 x LTPU) S2(8) (4800A)	STPU (2-8 x LTPU) 3 (1800A)
					STD (0.1-0.5 Sec.) 0.3 (I ² t Out)	STD (0.1-0.5 Sec.) 0.2 (I ² t Out)
					INST (2-10 x P) 4 (2400A)	INST (2-10 x P) M2(10) (6000A)
					OVERRIDE (1 x ST) Fixed (25000A)	OVERRIDE (1 x ST) Fixed (25000A)
	Ground	Ground				
	GFPU (100-1200A Plug) B (180A)	GFPU (100-1200A Plug) D (240A)				
	GFD (0.1-0.5 Sec.) 0.3 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)				



Electrical Reliability Services, Inc.

PSW Electric

Central Kitsap WWTP

3130462

**APPENDIX 6
RECOMMENDED
CIRCUIT BREAKER SETTINGS**

Device Location	Device Name in Model /Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
2960 MAIN A	CB 2960 A4 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-65	1200.0A	Phase	Phase
				1200.0A	LTPU (0.5-1.0 x P) 1 (1000A)	LTPU (0.5-1.0 x P) 1 (1000A)
				1000.0A	LTD (2-24 Sec.) 7	LTD (2-24 Sec.) 7
					STPU (2-8 x LTPU) 4 (4000A)	STPU (2-8 x LTPU) 2.5 (2500A)
					STD (0.1-0.5 Sec.) 0.1 (I ² t Out)	STD (0.1-0.5 Sec.) 0.2 (I ² t Out)
					OVERRIDE (1 x ST) Fixed (35000A)	OVERRIDE (1 x ST) Fixed (35000A)
					GROUND	GROUND
	GFPU (100-1200A Plug) H (750A)	GFPU (100-1200A Plug) H (750A)				
	GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)				
2960 MAIN A	CB 2960 A5 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LSI, 400-3000AF	SPB-50	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (600A)	LTPU (0.5-1.0 x P) 1 (600A)
				600.0A	LTD (2-24 Sec.) 24	LTD (2-24 Sec.) 24
					STPU (2-8 x LTPU) 6 (3600A)	STPU (2-8 x LTPU) 3 (1800A)
					STD (0.1-0.5 Sec.) 0.3 (I ² t Out)	STD (0.1-0.5 Sec.) 0.3 (I ² t Out)
					INST (2-10 x P) 6 (3600A)	INST (2-10 x P) 6 (3600A)
					OVERRIDE (1 x ST) Fixed (25000A)	OVERRIDE (1 x ST) Fixed (25000A)
	Ground	Ground				
	GFPU (100-1200A Plug) D (240A)	GFPU (100-1200A Plug) D (240A)				
	GFD (0.1-0.5 Sec.) 0.3 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)				
2960 MAIN A	CB 2960 A6 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LSI, 400-3000AF	SPB-50	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (600A)	LTPU (0.5-1.0 x P) 1 (600A)
				600.0A	LTD (2-24 Sec.) 24	LTD (2-24 Sec.) 24
					STPU (2-8 x LTPU) 6 (3600A)	STPU (2-8 x LTPU) 6 (3600A)
					STD (0.1-0.5 Sec.) 0.3 (I ² t Out)	STD (0.1-0.5 Sec.) 0.3 (I ² t Out)
					INST (2-10 x P) 6 (3600A)	INST (2-10 x P) 6 (3600A)
					OVERRIDE (1 x ST) Fixed (25000A)	OVERRIDE (1 x ST) Fixed (25000A)
	Ground	Ground				
	GFPU (100-1200A Plug) D (240A)	GFPU (100-1200A Plug) D (240A)				
	GFD (0.1-0.5 Sec.) 0.3 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)				



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Device Location	Device Name in Model /Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
2960 MAIN A	CB 2960 A7 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-100	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 0.7 (420A)	LTPU (0.5-1.0 x P) 0.7 (420A)
				600.0A	LTD (2-24 Sec.) 24	LTD (2-24 Sec.) 24
					STPU (2-8 x LTPU) S2(8) (3360A)	STPU (2-8 x LTPU) S2(8) (3360A)
					STD (0.1-0.5 Sec.) 0.2 (I^2t Out)	STD (0.1-0.5 Sec.) 0.2 (I^2t Out)
					OVERRIDE (1 x ST) Fixed (25000A)	OVERRIDE (1 x ST) Fixed (25000A)
					Ground	Ground
		GFPU (100-1200A Plug) K (600A)	GFPU (100-1200A Plug) D (240A)			
		GFD (0.1-0.5 Sec.) 0.4 Sec. (I^2t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I^2t Out)			
2960 MAIN A	CB 2960 A9 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LSI, 400-3000AF	SPB-100	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (600A)	LTPU (0.5-1.0 x P) 1 (600A)
				600.0A	LTD (2-24 Sec.) 24	LTD (2-24 Sec.) 24
					STPU (2-8 x LTPU) 6 (3600A)	STPU (2-8 x LTPU) S1(7) (4200A)
					STD (0.1-0.5 Sec.) 0.3 (I^2t Out)	STD (0.1-0.5 Sec.) 0.2 (I^2t Out)
					INST (2-10 x P) 6 (3600A)	INST (2-10 x P) M2(10) (6000A)
					OVERRIDE (1 x ST) Fixed (25000A)	OVERRIDE (1 x ST) Fixed (25000A)
	Ground	Ground				
		GFPU (100-1200A Plug) D (240A)	GFPU (100-1200A Plug) D (240A)			
		GFD (0.1-0.5 Sec.) 0.3 Sec. (I^2t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I^2t Out)			
2960 MAIN A	CB 2960 TIE Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-100	3000.0A	Phase	Phase
				3000.0A	LTPU (0.5-1.0 x P) 0.8 (2400A)	LTPU (0.5-1.0 x P) 0.6 (1800A)
				3000.0A	LTD (2-24 Sec.) 4	LTD (2-24 Sec.) 4
					STPU (2-8 x LTPU) 2 (4800A)	STPU (2-8 x LTPU) 3 (5400A)
					STD (0.1-0.5 Sec.) 0.4 (I^2t Out)	STD (0.1-0.5 Sec.) 0.3 (I^2t Out)
					OVERRIDE (1 x ST) Fixed (35000A)	OVERRIDE (1 x ST) Fixed (35000A)
					ground	ground
		GFPU (100-1200A Plug) C (1050A)	GFPU (100-1200A Plug) A (750A)			
		GFD (0.1-0.5 Sec.) 0.5 Sec. (I^2t Out)	GFD (0.1-0.5 Sec.) 0.3 Sec. (I^2t Out)			



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Device Location	Device Name in Model / Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
2960 MAIN A	CB 2960-A MAIN Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LI, 400-3000AF	SPB-100	3000.0A	Phase	Phase
				3000.0A	LTPU (0.5-1.0 x P) 0.6 (1200A)	LTPU (0.5-1.0 x P) 1 (2000A)
				2000.0A	LTD (2-24 Sec.) 10	LTD (2-24 Sec.) 10
					INST (2-10 x P) 4 (8000A)	INST (2-10 x P) 4 (8000A)
					OVERRIDE (1 x ST) Fixed (35000A) ground	OVERRIDE (1 x ST) Fixed (35000A) ground
					GFPU (100-1200A Plug) E (1000A)	GFPU (100-1200A Plug) E (1000A)
					GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)
2960 MAIN A	CB 2960-G1 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LI, 400-3000AF	SPB-100	3000.0A	Phase	Phase
				3000.0A	LTPU (0.5-1.0 x P) 0.5 (800A)	LTPU (0.5-1.0 x P) 0.5 (800A)
				1600.0A	LTD (2-24 Sec.) 2	LTD (2-24 Sec.) 2
					INST (2-10 x P) M2(10) (16000A)	INST (2-10 x P) M2(10) (16000A)
					OVERRIDE (1 x ST) Fixed (35000A) GROUND	OVERRIDE (1 x ST) Fixed (35000A) GROUND
					GFPU (100-1200A Plug) F (960A)	GFPU (100-1200A Plug) F (960A)
					GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)
2960 MAIN B	CB 2960 B1 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-100	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (400A)	LTPU (0.5-1.0 x P) 1 (400A)
				400.0A	LTD (2-24 Sec.) 15	LTD (2-24 Sec.) 15
					STPU (2-8 x LTPU) S2(8) (3200A)	STPU (2-8 x LTPU) 6 (2400A)
					STD (0.1-0.5 Sec.) 0.1 (I ² t Out)	STD (0.1-0.5 Sec.) 0.1 (I ² t Out)
					OVERRIDE (1 x ST) Fixed (25000A) GROUND	OVERRIDE (1 x ST) Fixed (25000A) GROUND
					GFPU (100-1200A Plug) E (200A)	GFPU (100-1200A Plug) E (200A)
	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)				



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Device Location	Device Name in Model / Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
2960 MAIN B	CB 2960 B2 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-65	1200.0A	Phase	Phase
				1200.0A	LTPU (0.5-1.0 x P) 1 (1000A)	LTPU (0.5-1.0 x P) 1 (1000A)
				1000.0A	LTD (2-24 Sec.) 2	LTD (2-24 Sec.) 7
					STPU (2-8 x LTPU) 3 (3000A)	STPU (2-8 x LTPU) 3 (3000A)
					STD (0.1-0.5 Sec.) 0.1 (I ² t Out)	STD (0.1-0.5 Sec.) 0.1 (I ² t Out)
					OVERRIDE (1 x ST) Fixed (35000A)	OVERRIDE (1 x ST) Fixed (35000A)
					GROUND	GROUND
2960 MAIN B	CB 2960 B3 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-100	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (400A)	LTPU (0.5-1.0 x P) 1 (400A)
				400.0A	LTD (2-24 Sec.) 15	LTD (2-24 Sec.) 15
					STPU (2-8 x LTPU) S2(8) (3200A)	STPU (2-8 x LTPU) 6 (2400A)
					STD (0.1-0.5 Sec.) 0.1 (I ² t Out)	STD (0.1-0.5 Sec.) 0.1 (I ² t Out)
					OVERRIDE (1 x ST) Fixed (25000A)	OVERRIDE (1 x ST) Fixed (25000A)
					GROUND	GROUND
2960 MAIN B	CB 2960 B4 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-65	1200.0A	Phase	Phase
				1200.0A	LTPU (0.5-1.0 x P) 1 (1000A)	LTPU (0.5-1.0 x P) 1 (1000A)
				1000.0A	LTD (2-24 Sec.) 7	LTD (2-24 Sec.) 7
					STPU (2-8 x LTPU) 4 (4000A)	STPU (2-8 x LTPU) 2.5 (2500A)
					STD (0.1-0.5 Sec.) 0.1 (I ² t Out)	STD (0.1-0.5 Sec.) 0.2 (I ² t Out)
					OVERRIDE (1 x ST) Fixed (35000A)	OVERRIDE (1 x ST) Fixed (35000A)
					GROUND	GROUND
	GFP (100-1200A Plug) H (750A)	GFP (100-1200A Plug) H (750A)				
	GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)				



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Device Location	Device Name in Model / Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
2960 MAIN B	CB 2960 B6 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LI, 400-3000AF	SPB-65	1600.0A	Phase	Phase
				1600.0A	LTPU (0.5-1.0 x P) 0.6 (960A)	LTPU (0.5-1.0 x P) 0.6 (960A)
				1600.0A	LTD (2-24 Sec.) 20	LTD (2-24 Sec.) 20
					INST (2-10 x P) M2(10) (16000A)	INST (2-10 x P) M2(10) (16000A)
					OVERRIDE (1 x ST) Fixed (35000A)	OVERRIDE (1 x ST) Fixed (35000A)
					GROUND	GROUND
					GFPU (1600A Plug) F (960A)	GFPU (1600A Plug) F (960A)
2960 MAIN B	CB 2960 B7 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LI, 400-3000AF	SPB-65	1600.0A	Phase	Phase
				1600.0A	LTPU (0.5-1.0 x P) 0.5 (800A)	LTPU (0.5-1.0 x P) 0.5 (800A)
				1600.0A	LTD (2-24 Sec.) 20	LTD (2-24 Sec.) 20
					INST (2-10 x P) M2(10) (16000A)	INST (2-10 x P) M2(10) (16000A)
					OVERRIDE (1 x ST) Fixed (35000A)	OVERRIDE (1 x ST) Fixed (35000A)
					GROUND	GROUND
					GFPU (1600A Plug) F (960A)	GFPU (1600A Plug) F (960A)
2960 MAIN B	CB 2960 B8 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LSI, 400-3000AF	SPB-50	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (600A)	LTPU (0.5-1.0 x P) 1 (600A)
				600.0A	LTD (2-24 Sec.) 4	LTD (2-24 Sec.) 24
					STPU (2-8 x LTPU) S2(8) (4800A)	STPU (2-8 x LTPU) 3 (1800A)
					STD (0.1-0.5 Sec.) 0.3 (I ² t Out)	STD (0.1-0.5 Sec.) 0.3 (I ² t Out)
					INST (2-10 x P) 4 (2400A)	INST (2-10 x P) 6 (3600A)
					OVERRIDE (1 x ST) Fixed (25000A)	OVERRIDE (1 x ST) Fixed (25000A)
	GROUND	Ground				
	GFPU (100-1200A Plug) B (180A)	GFPU (100-1200A Plug) D (240A)				
	GFD (0.1-0.5 Sec.) 0.3 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)				



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Device Location	Device Name in Model /Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
2960 MAIN B	CB 2960 B9 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LSI, 400-3000AF	SPB-50	800.0A	Phase	Phase
				800.0A	LTPU (0.5-1.0 x P) 1 (600A)	LTPU (0.5-1.0 x P) 1 (600A)
				600.0A	LTD (2-24 Sec.) 24	LTD (2-24 Sec.) 24
					STPU (2-8 x LTPU) 6 (3600A)	STPU (2-8 x LTPU) 3 (1800A)
					STD (0.1-0.5 Sec.) 0.3 (I ² t Out)	STD (0.1-0.5 Sec.) 0.3 (I ² t Out)
					INST (2-10 x P) 6 (3600A)	INST (2-10 x P) 6 (3600A)
					OVERVERRIDE (1 x ST) Fixed (25000A)	OVERVERRIDE (1 x ST) Fixed (25000A)
	GROUND	Ground				
	GFPFU (100-1200A Plug) D (240A)	GFPFU (100-1200A Plug) D (240A)				
	GFD (0.1-0.5 Sec.) 0.3 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)				
2960 MAIN B	CB 2960-B MAIN Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LI, 400-3000AF	SPB-100M	3000.0A	Phase	Phase
				3000.0A	LTPU (0.5-1.0 x P) 0.8 (2400A)	LTPU (0.5-1.0 x P) 0.8 (2400A)
				3000.0A	LTD (2-24 Sec.) 4	LTD (2-24 Sec.) 4
					INST (2-10 x P) 4 (12000A)	INST (2-10 x P) 4 (12000A)
					OVERVERRIDE (1 x ST) Fixed (51000A)	OVERVERRIDE (1 x ST) Fixed (51000A)
					ground	ground
					GFPFU (100-1200A Plug) C (1050A)	GFPFU (100-1200A Plug) C (1050A)
	GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)				
2960 MAIN B	CB 2960-G2 Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LI, 400-3000AF	SPB-100	3000.0A	Phase	Phase
				3000.0A	LTPU (0.5-1.0 x P) 0.6 (960A)	LTPU (0.5-1.0 x P) 0.6 (960A)
				1600.0A	LTD (2-24 Sec.) 4	LTD (2-24 Sec.) 4
					INST (2-10 x P) M2(10) (16000A)	INST (2-10 x P) M2(10) (16000A)
					OVERVERRIDE (1 x ST) Fixed (35000A)	OVERVERRIDE (1 x ST) Fixed (35000A)
					GROUND	GROUND
					GFPFU (100-1200A Plug) F (960A)	GFPFU (100-1200A Plug) F (960A)
	GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)	GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)				
DECANT FACILITY	CB PNL MP Thermal Magnetic	SIEMENS ED4 Sentron, 2 & 3-Pole 15-125A	ED4	125.0A	Thermal Curve (Fixed)	Thermal Curve (Fixed)
				60.0A	INST Fixed (800A)	INST Fixed (800A)



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Device Location	Device Name in Model /Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
GENERATOR 2994	CB GEN 2994 Static Trip	GE TKR & THKR, SelecTrip GF, 400-1200A	THKR	1200.0A 1000.0A	Ground GFPU (0.3 x S) 0.3 (300A)	Ground GFPU (0.3 x S) 0.3 (300A)
GENERATOR 2995	CB GEN 2995 Static Trip	MERLIN GERIN Compact CM, ST 206D LI, 1250-2500A	CM1600HH	1600.0A 1600.0A	LTPU (0.5-1.0 x S) 0.6 (960A) LTD (Fixed) Fixed INST (3-6 x LTPU) 5 (4800A)	LTPU (0.5-1.0 x S) 0.6 (960A) LTD (Fixed) Fixed INST (3-6 x LTPU) 5 (4800A)
MCC 2971	CB 2971-2972 TIE Static Trip	CUTLER-HAMMER HLD, RMS 310 LS, 300-600A Fixed Plug	HLD	600.0A 600.0A 600.0A	LTPU (1.0 x P) Fixed (600A) LTD (Fixed) Fixed STPU (2-8 x P) 8 (4800A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)	LTPU (1.0 x P) Fixed (600A) LTD (Fixed) Fixed STPU (2-8 x P) 3 (1800A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)
MCC-2971	CB MCC-2971 MAIN Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-65	1200.0A 1200.0A 1000.0A	Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 2 STPU (2-8 x LTPU) 3 (3000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)	Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 2 (2000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)
MCC-2971	CB MCC-2971 TFR-1990 Thermal Magnetic	CUTLER-HAMMER HJD 70-250A	HJD	250.0A 250.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 7.5 (1875A)	Thermal Curve (Fixed) INST (5-10 x Trip) 7.5 (1875A)



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MCC-2972	CB MCC-2972 MAIN Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-65	1200.0A 1200.0A 1000.0A	Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 2 STPU (2-8 x LTPU) 3 (3000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)	Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 3 (3000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)
MCC-2973	CB 2973-2974 TIE Static Trip	CUTLER-HAMMER HLD, RMS 310 LS, 300-600A Fixed Plug	HLD	600.0A 600.0A 600.0A	LTPU (1.0 x P) Fixed (600A) LTD (Fixed) Fixed STPU (2-8 x P) 8 (4800A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)	LTPU (1.0 x P) Fixed (600A) LTD (Fixed) Fixed STPU (2-8 x P) 8 (4800A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)
MCC-2973	CB MCC-2973 MAIN Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-65	1200.0A 1200.0A 1000.0A	Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 4 (4000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)	Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 4 (4000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)
MCC-2973	CB MCC-2973 PNL3100 Thermal Magnetic	CUTLER-HAMMER HKD 100-400A	HKD	300.0A 300.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (3000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (3000A)



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Device Location	Device Name in Model /Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings (Range) Setting	Recommended Settings (Range) Setting
MCC-2974	CB MCC-2974 MAIN Static Trip	CUTLER-HAMMER SPB, RMS 510/610/810/910 LS, 400-3000AF	SPB-65	1200.0A 1200.0A 1000.0A	Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 4 (4000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)	Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 4 (4000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)
MCC-2974	CB MCC-2974 PNL3200 Thermal Magnetic	CUTLER-HAMMER HKD 100-400A	HKD	300.0A 300.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (3000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (3000A)
MCC-2975	CB MCC 2975/2976 TIE Thermal Magnetic	CUTLER-HAMMER HLD 300-600A	HLD	600.0A 600.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 5 (3000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 5 (3000A)
MCC-2975	CB MCC-2975 Thermal Magnetic	CUTLER-HAMMER HLD 300-600A	HLD	600.0A 600.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 5 (3000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 5 (3000A)
MCC-2976	CB MCC-2976 MAIN Thermal Magnetic	CUTLER-HAMMER HLD 300-600A	HLD	600.0A 600.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 5 (3000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 5 (3000A)
MCC-2981	CB MCC 2981/2982 TIE Thermal Magnetic	CUTLER-HAMMER HKD 100-400A	HKD	400.0A 400.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (4000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 5 (2000A)



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**APPENDIX 6
RECOMMENDED
CIRCUIT BREAKER SETTINGS**

Device Location	Device Name in Model /Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings Settings (Range) Setting	Recommended Settings Settings (Range) Setting
MCC-2981	CB MCC-2981 MAIN Static Trip	CUTLER-HAMMER HLD, RMS 310 LS, 300-600A Adj Plug	HLD	600.0A 600.0A 600.0A	Plug Adj (300-600A) 600A (600A) LTD (Fixed) Fixed STPU (2-8 x LTPU) 6 (3600A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)	Plug Adj (300-600A) 600A (600A) LTD (Fixed) Fixed STPU (2-8 x LTPU) 6 (3600A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)
MCC-2981	CB MCC-2981 MEE7110 Thermal Magnetic	CUTLER-HAMMER HKD 100-400A	HKD	400.0A 400.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (4000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 5 (2000A)
MCC-2982	CB MCC-2982 MAIN Static Trip	CUTLER-HAMMER HLD, RMS 310 LS, 300-600A Adj Plug	HLD	600.0A 600.0A 600.0A	Plug Adj (300-600A) 600A (600A) LTD (Fixed) Fixed STPU (2-8 x LTPU) 8 (4800A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)	Plug Adj (300-600A) 600A (600A) LTD (Fixed) Fixed STPU (2-8 x LTPU) 6 (3600A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)
MCC-2983	CB MCC-2982/2983 TIE Thermal Magnetic	CUTLER-HAMMER HKD 100-400A	HKD	400.0A 400.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (4000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (4000A)
MCC-2983	CB MCC-2983 Thermal Magnetic	CUTLER-HAMMER HLD 300-600A	HLD	600.0A 600.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (6000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (6000A)
MCC-2983	CB MCC-2983/2984 MAIN Thermal Magnetic	CUTLER-HAMMER HKD 100-400A	HKD	400.0A 400.0A	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (4000A)	Thermal Curve (Fixed) INST (5-10 x Trip) 10 (4000A)



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**APPENDIX 6
RECOMMENDED
CIRCUIT BREAKER SETTINGS**

Device Location	Device Name in Model /Trip Type	Device Description	Frame/ Model	Frame (A) Trip (A)	Existing Settings		Recommended Settings	
					Settings (Range)	Setting	Settings (Range)	Setting
UV PWR DIST CHAN 2	CB UV PWR DIST 2 Thermal Magnetic	CUTLER-HAMMER	HKD	400.0A	Thermal Curve (Fixed)		Thermal Curve (Fixed)	
		HKD 100-400A		400.0A	INST (5-10 x Trip) 10 (4000A)		INST (5-10 x Trip) 10 (4000A)	
UV PWR DIST CHNL 1	CB UV PWR DIST 1 Thermal Magnetic	CUTLER-HAMMER	HKD	400.0A	Thermal Curve (Fixed)		Thermal Curve (Fixed)	
		HKD 100-400A		400.0A	INST (5-10 x Trip) 10 (4000A)		INST (5-10 x Trip) 10 (4000A)	



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 Project:Central Kitsap WWTP
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**APPENDIX 6
 EXISTING AND RECOMMENDED
 FUSE INFORMATION**

Device Location	Device Name in Model /Low or High Voltage	Device Description	Model	Existing Cartridge/Fuse Sizes	Recommended Cartridge/Fuse Size
SWGR 2950 LINE	FS TFR2951 High Voltage	CUTLER-HAMMER CLE, 15.5kV E-Rated 20E-300E	CLE, 100E	100.0A 100.0A	150.0A 150.0A
SWGR 2950 LINE	FS TFR2952 High Voltage	CUTLER-HAMMER CLE, 15.5kV E-Rated 20E-300E	CLE, 150E	150.0A 150.0A	150.0A 150.0A
SWGR 1	FS TFR2953 High Voltage	CUTLER-HAMMER CLE, 15.5kV E-Rated 20E-300E	CLE, 300E	300.0A 300.0A	300.0 Amps
AHU1281 DISC	FU AHU1281 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	8.0A 8.0A	8.0A 8.0A
AHU1285 DISC	FU AHU1285 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	10.0A 10.0A	10.0A 10.0A
MCC-2	FU BIO FILT Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	40.0A 40.0A	40.0A 40.0A
MCC-2	FU CV6193 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	6.0A 6.0A	6.0A 6.0A
MCC-2	FU CV6194 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	6.0A 6.0A	6.0A 6.0A



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Device Location	Device Name in Model /Low or High Voltage	Device Description	Model	Existing Cartridge/Fuse Sizes	Recommended Cartridge/Fuse Size
MCC-2	FU E CLAR Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	6.0A 6.0A	6.0A 6.0A
MCC-2	FU GDR6171 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	20.0A 20.0A	20.0A 20.0A
MCC-2	FU GDR6172 Low Voltage	LITTELFUSE FLSR, 600V RK5 15-600A	FLSR	30.0A 30.0A	30.0A 30.0A
HC1303 DISC	FU HC1303 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	40.0A 40.0A	40.0A 40.0A
OFFICE LAB SWITCHES	FU LAB PNL A Low Voltage	GOULD SHAWMUT OT, 250V Class K-5 15-600A	OT	400.0A 400.0A	400.0A 400.0A
OFFICE LAB SWITCHES	FU LAB PNL A0 Low Voltage	GOULD SHAWMUT OT, 250V Class K-5 15-600A	OT	200.0A 200.0A	200.0A 200.0A
MCC-2	FU MCC-2 MAIN Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	225.0A 225.0A	225.0A 225.0A
SWBD 1	FU MCC-4 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	200.0A 200.0A	200.0A 200.0A



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**APPENDIX 6
 EXISTING AND RECOMMENDED
 FUSE INFORMATION**

Device Location	Device Name in Model /Low or High Voltage	Device Description	Model	Existing Cartridge/Fuse Sizes	Recommended Cartridge/Fuse Size
MCC-2	FU P6011 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	20.0A 20.0A	20.0A 20.0A
MCC-2	FU P6013 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	25.0A 25.0A	25.0A 25.0A
MCC-2	FU P6021 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	20.0A 20.0A	20.0A 20.0A
MCC-2	FU P6023 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	25.0A 25.0A	25.0A 25.0A
MCC-2	FU P6112 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	15.0A 15.0A	15.0A 15.0A
MCC-2	FU P6122 Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	15.0A 15.0A	15.0A 15.0A
SWBD 1	FU PANEL C Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	40.0A 40.0A	40.0A 40.0A



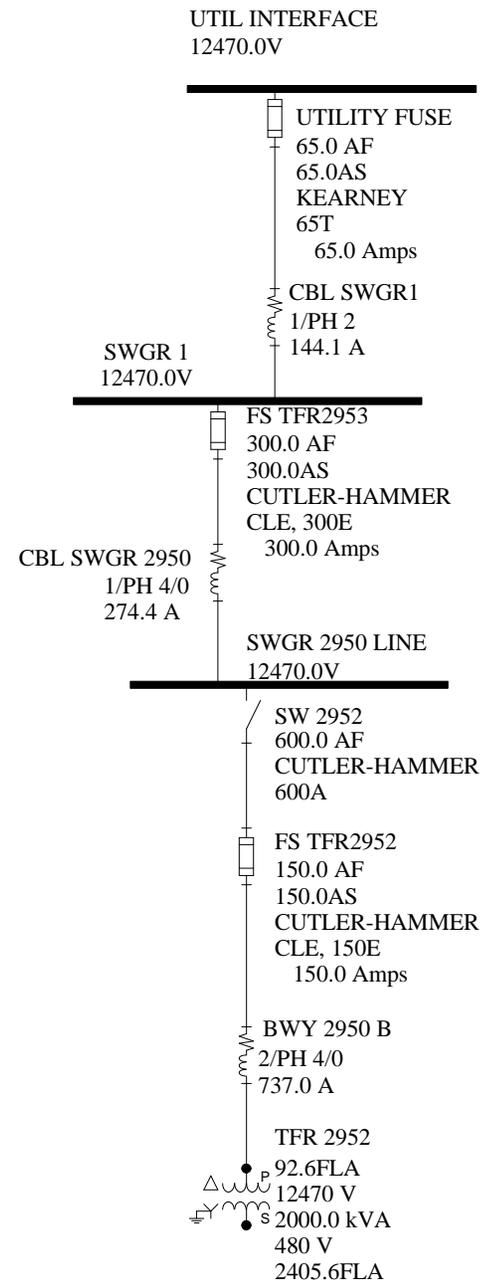
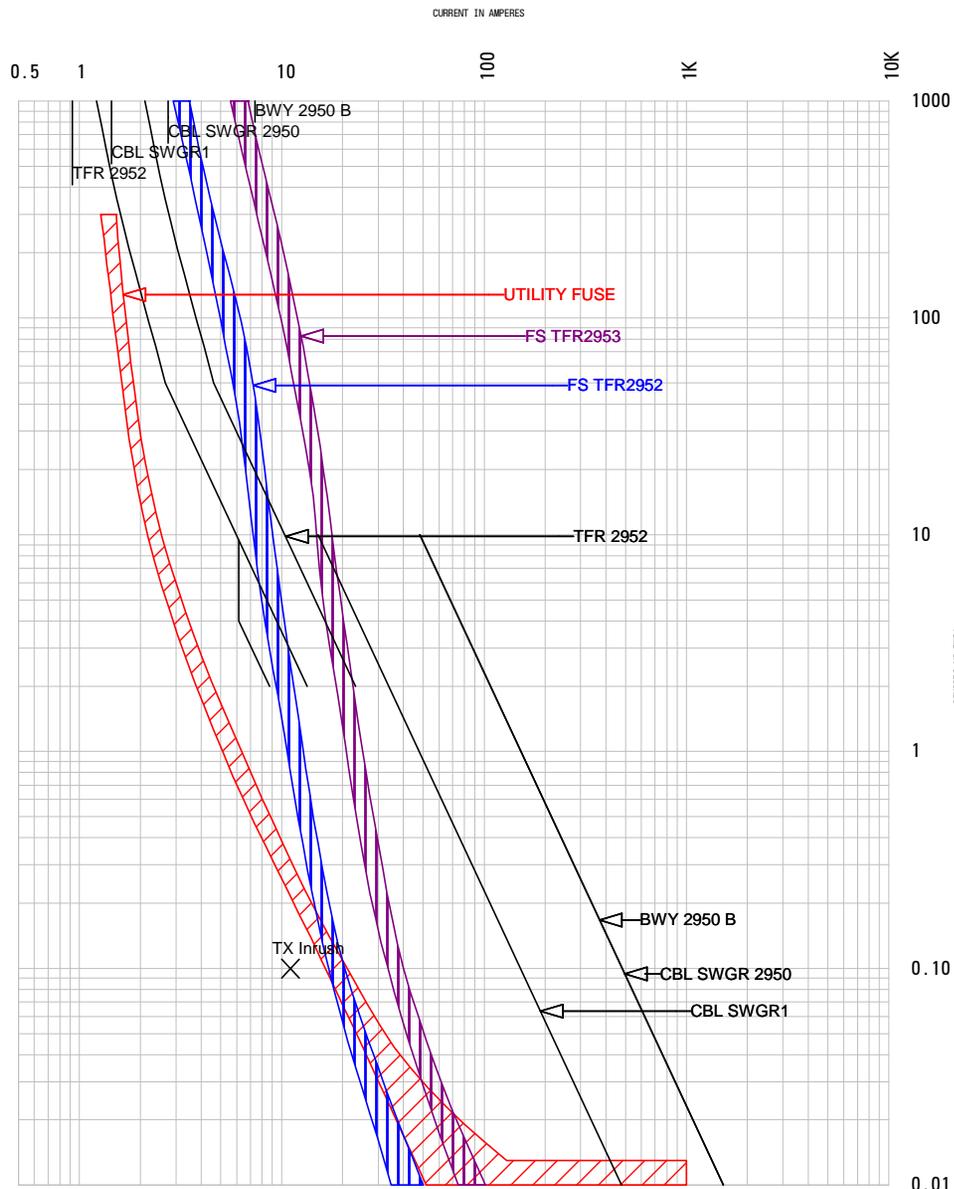
Electrical Reliability Services

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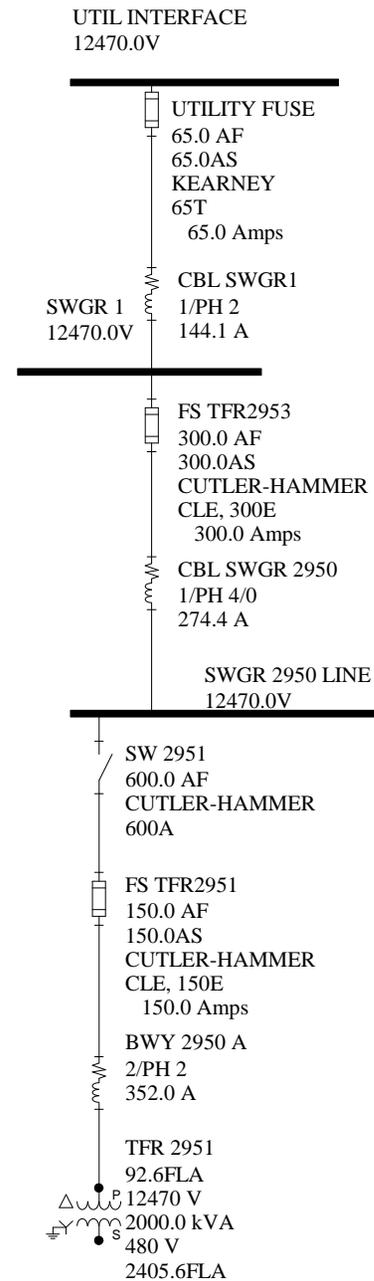
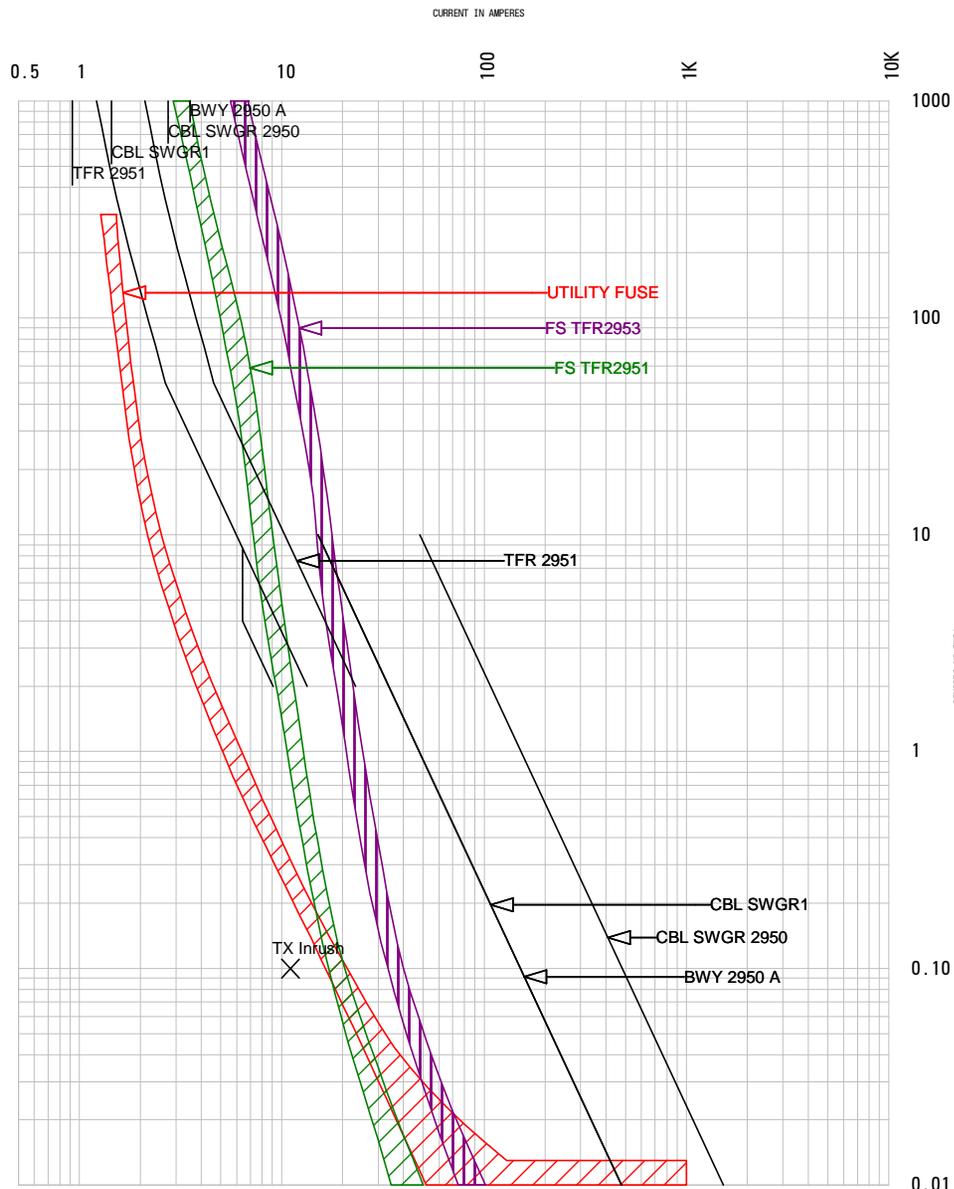
**APPENDIX 6
 EXISTING AND RECOMMENDED
 FUSE INFORMATION**

Device Location	Device Name in Model /Low or High Voltage	Device Description	Model	Existing Cartridge/Fuse Sizes	Recommended Cartridge/Fuse Size
MCC-2	FU SEAL WATER Low Voltage	GOULD SHAWMUT TRS, 600V Class RK5 15-600A	TRS	30.0A 30.0A	30.0A 30.0A
SWBD 1	FU SPARE (OLD MCC1) Low Voltage	BUSSMANN KRP-C, 600V Class L 601-6000A	KRP-C	1200.0A 1200.0A	1200.0A 1200.0A
SWBD 1	FU SPARE 400A Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	400.0A 400.0A	400.0A 400.0A
SWGR 1	FU TFR LAB High Voltage	HI-TECH TRANS-GUARD EX, 8.3kV 6-125A	Trans-Guard EX	100.0A 100.0A	20.0A 20.0A
MCC-2	FU W CLAR Low Voltage	BUSSMANN FRS-R, 600V Class RK5 1-600A	FRS-R	7.5A 7.5A	7.5A 7.5A

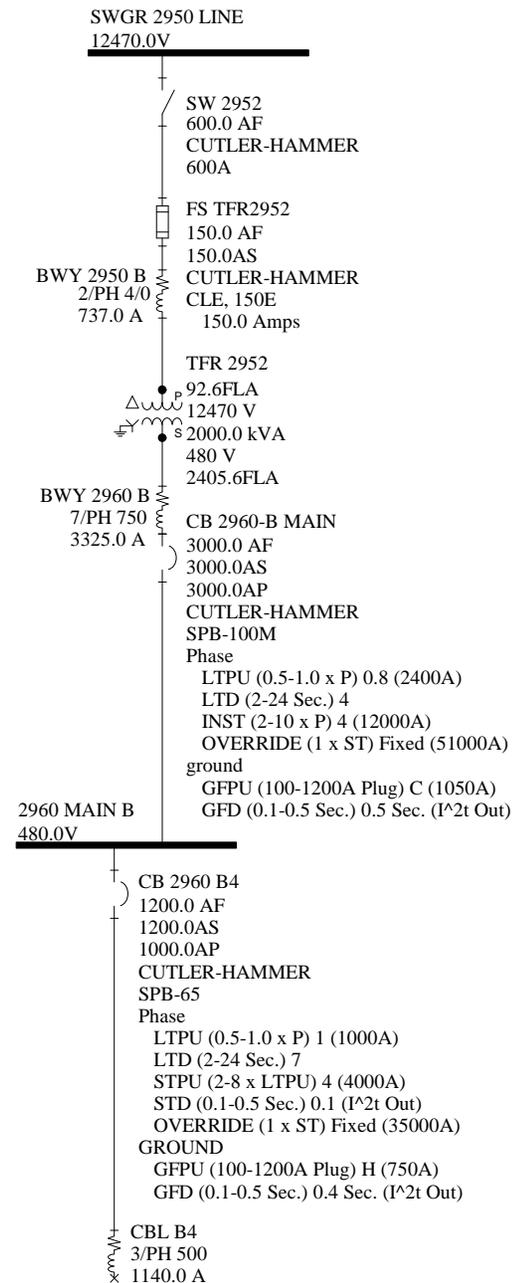
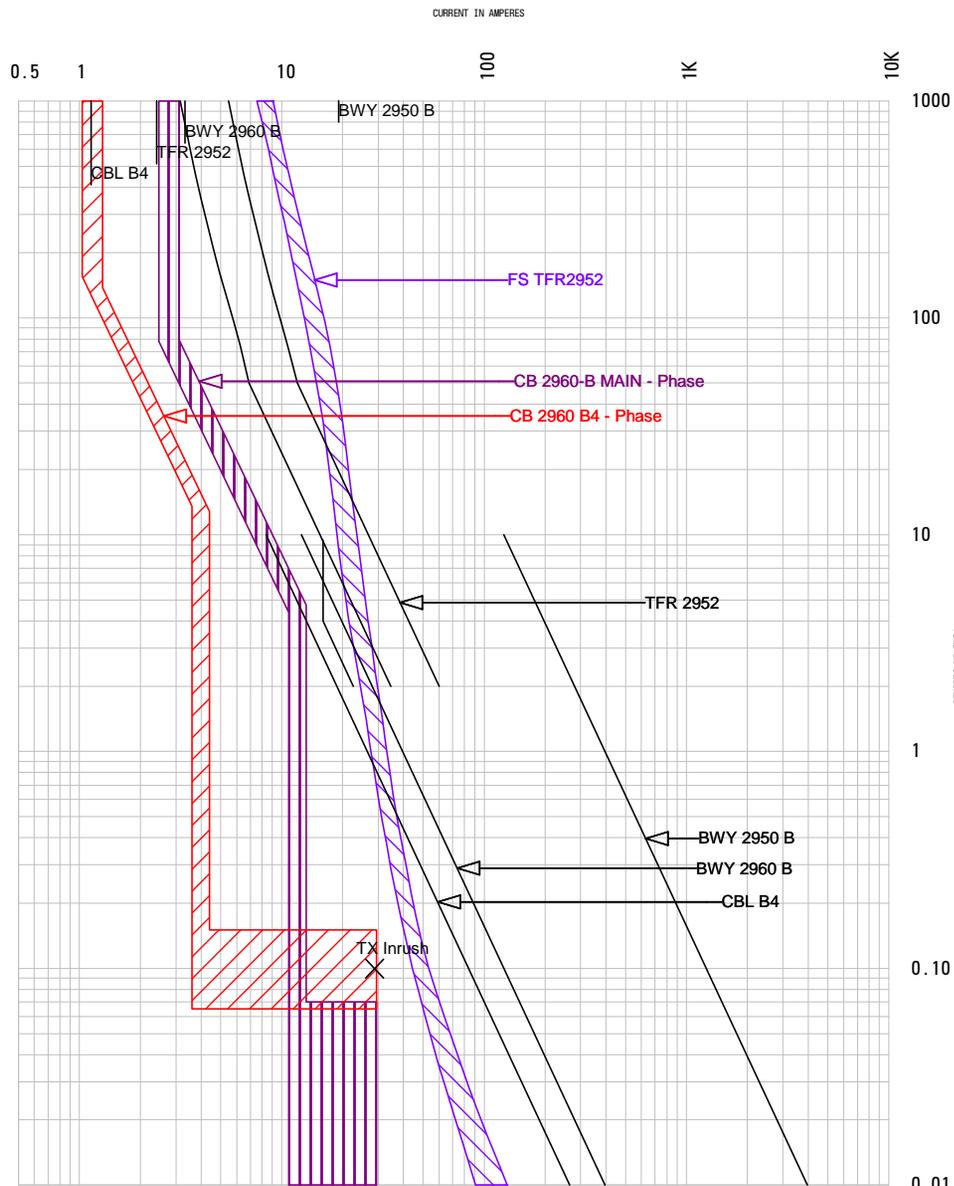
APPENDIX 7:COORDINATION CURVES



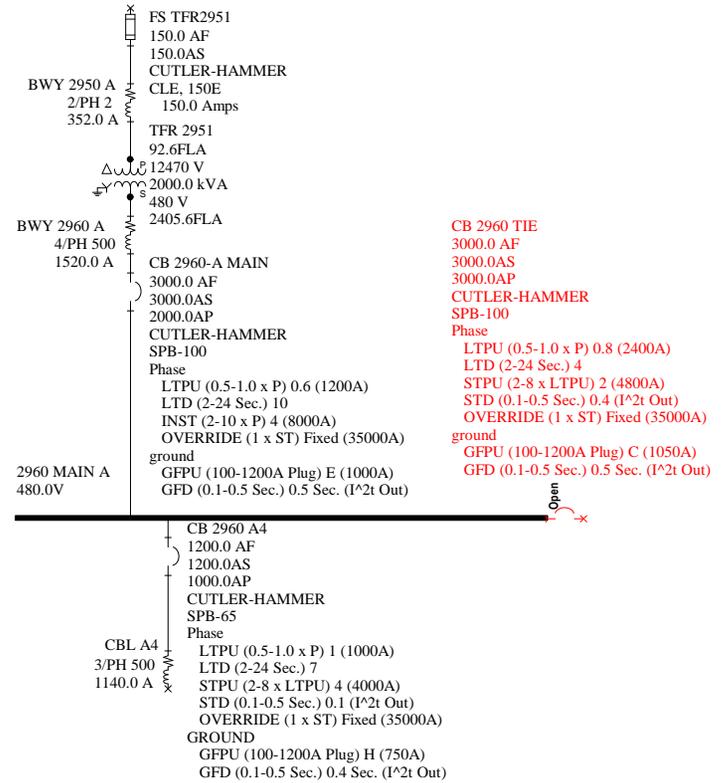
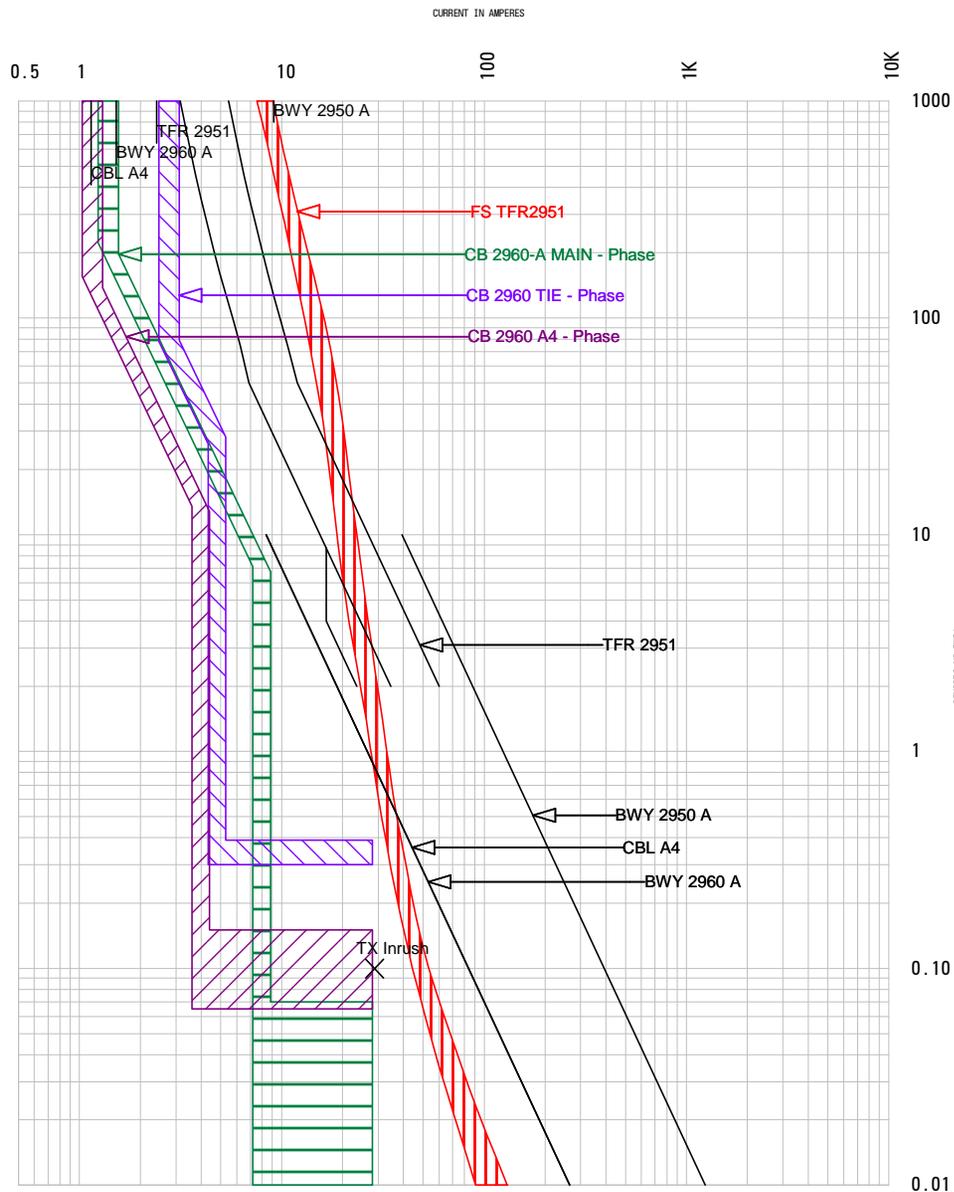
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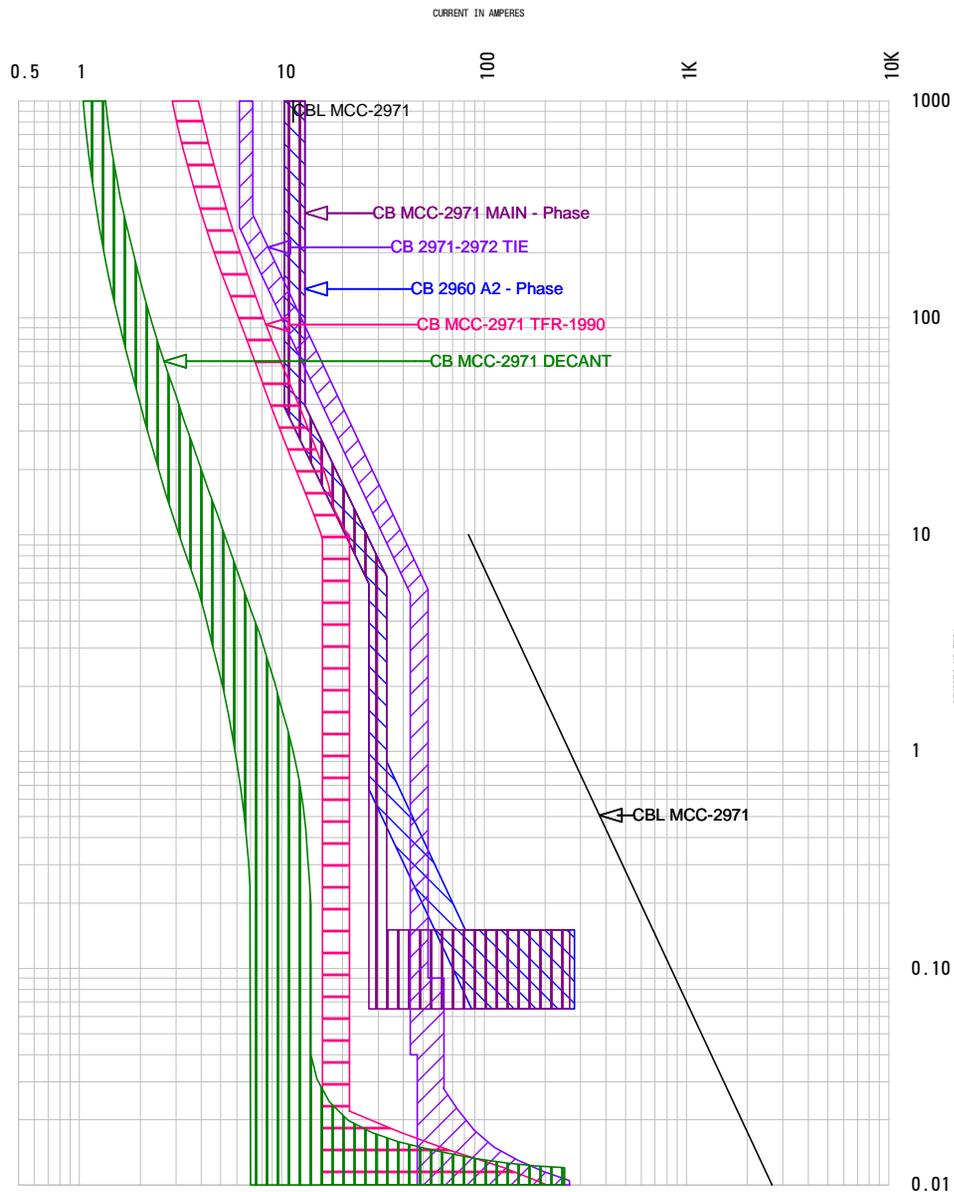
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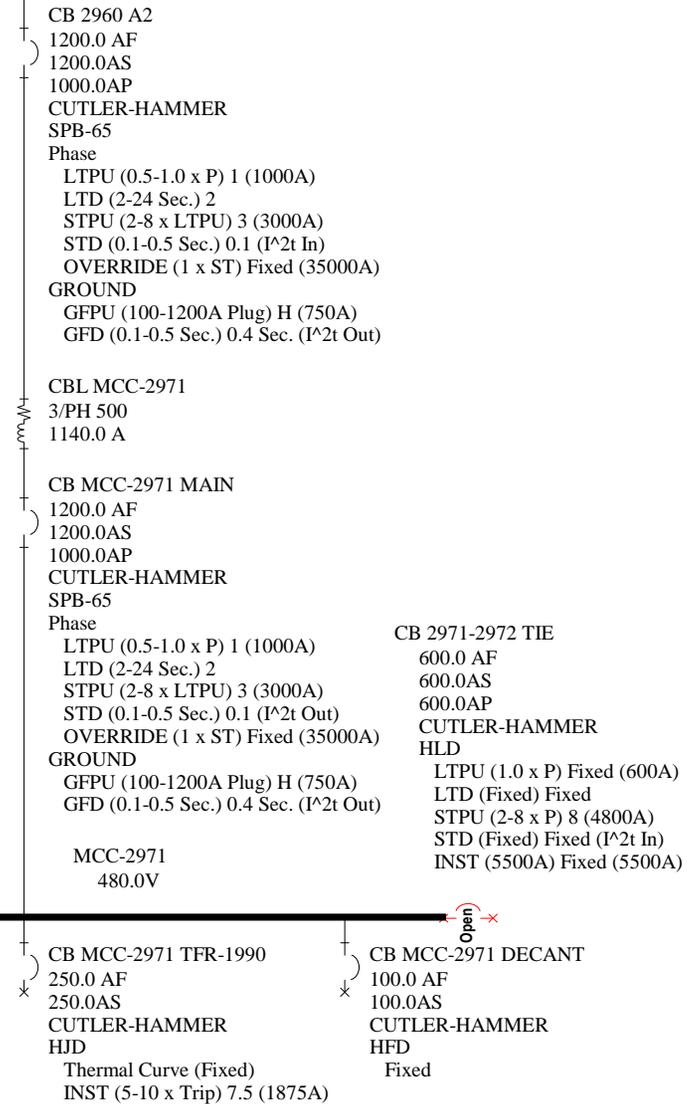
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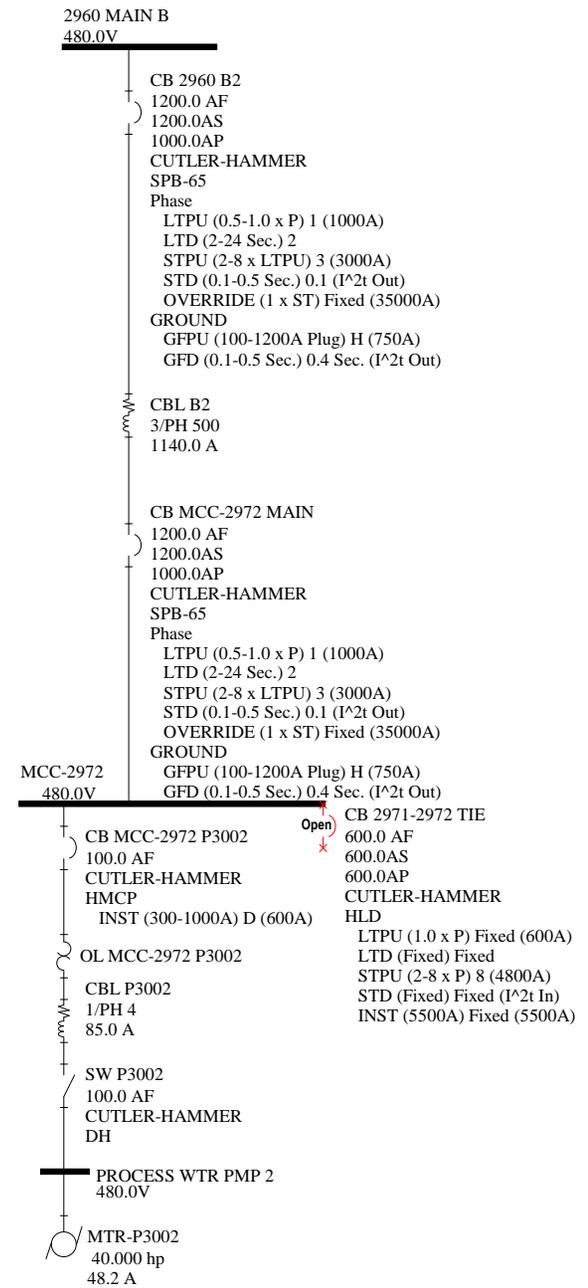
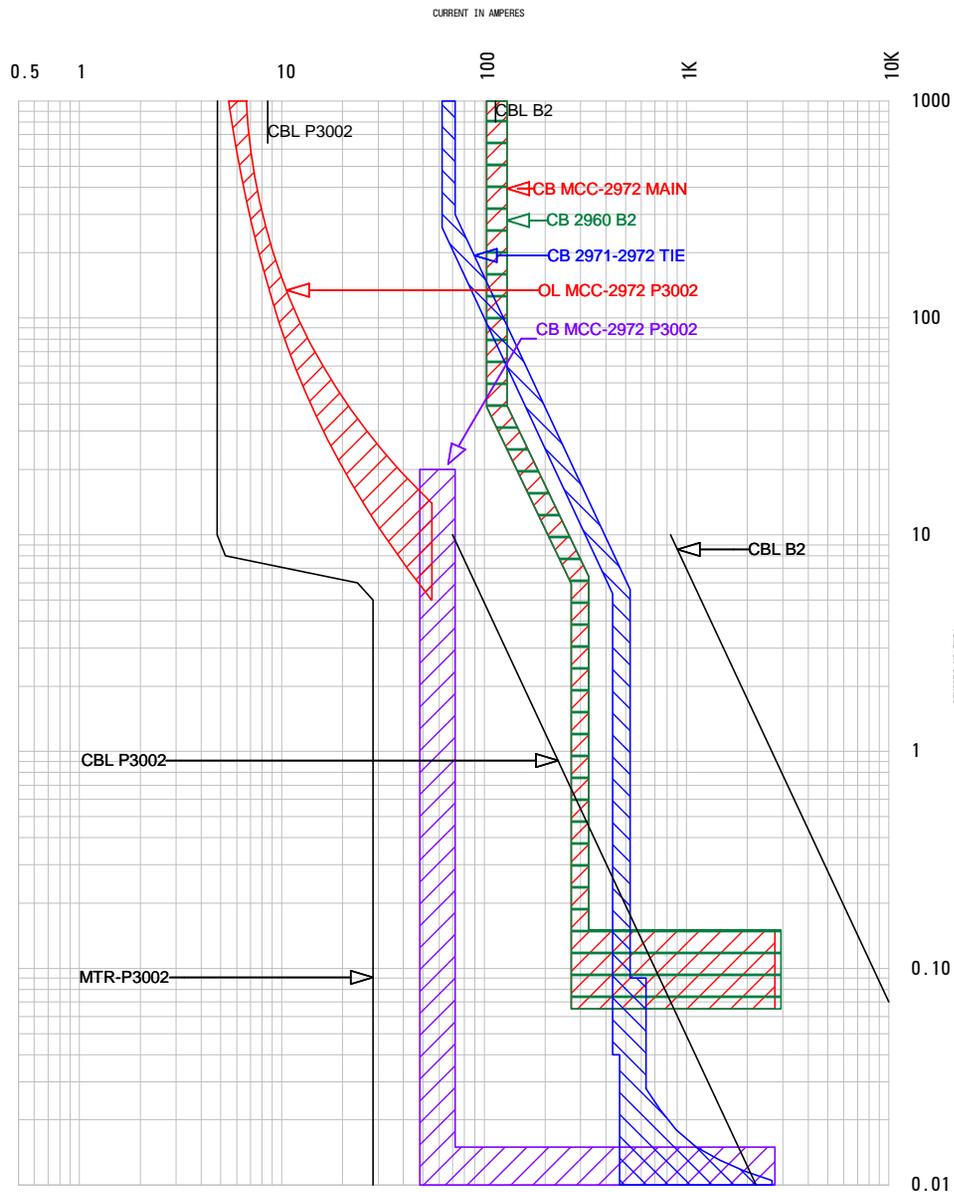
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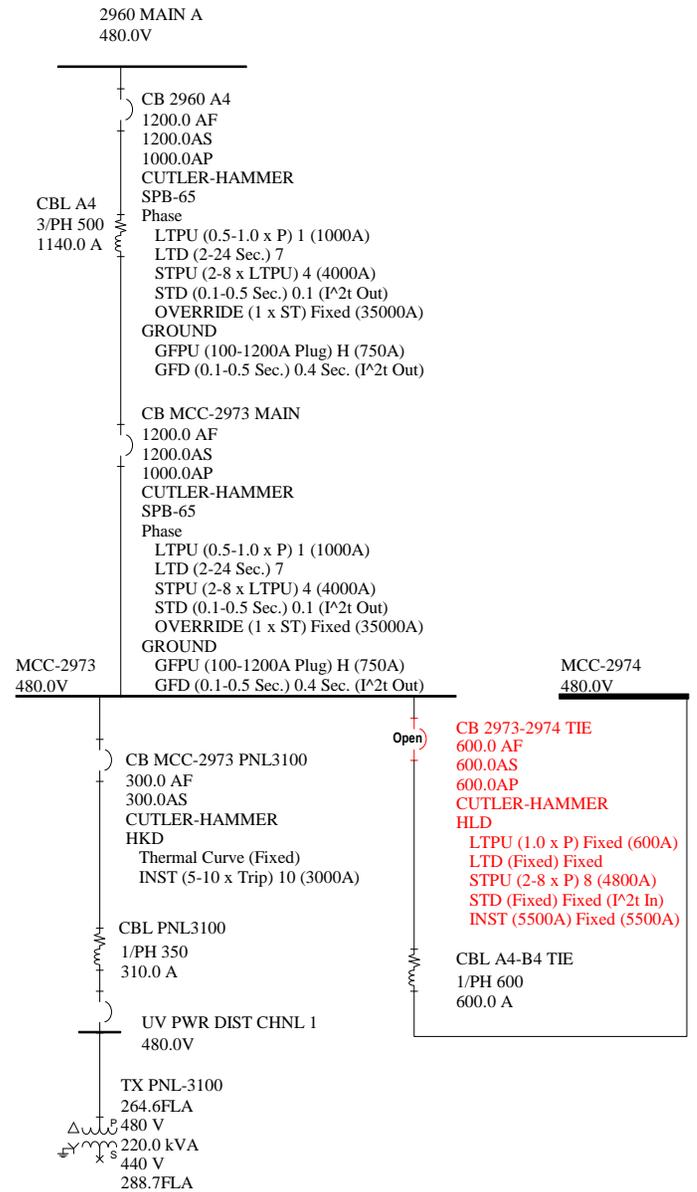
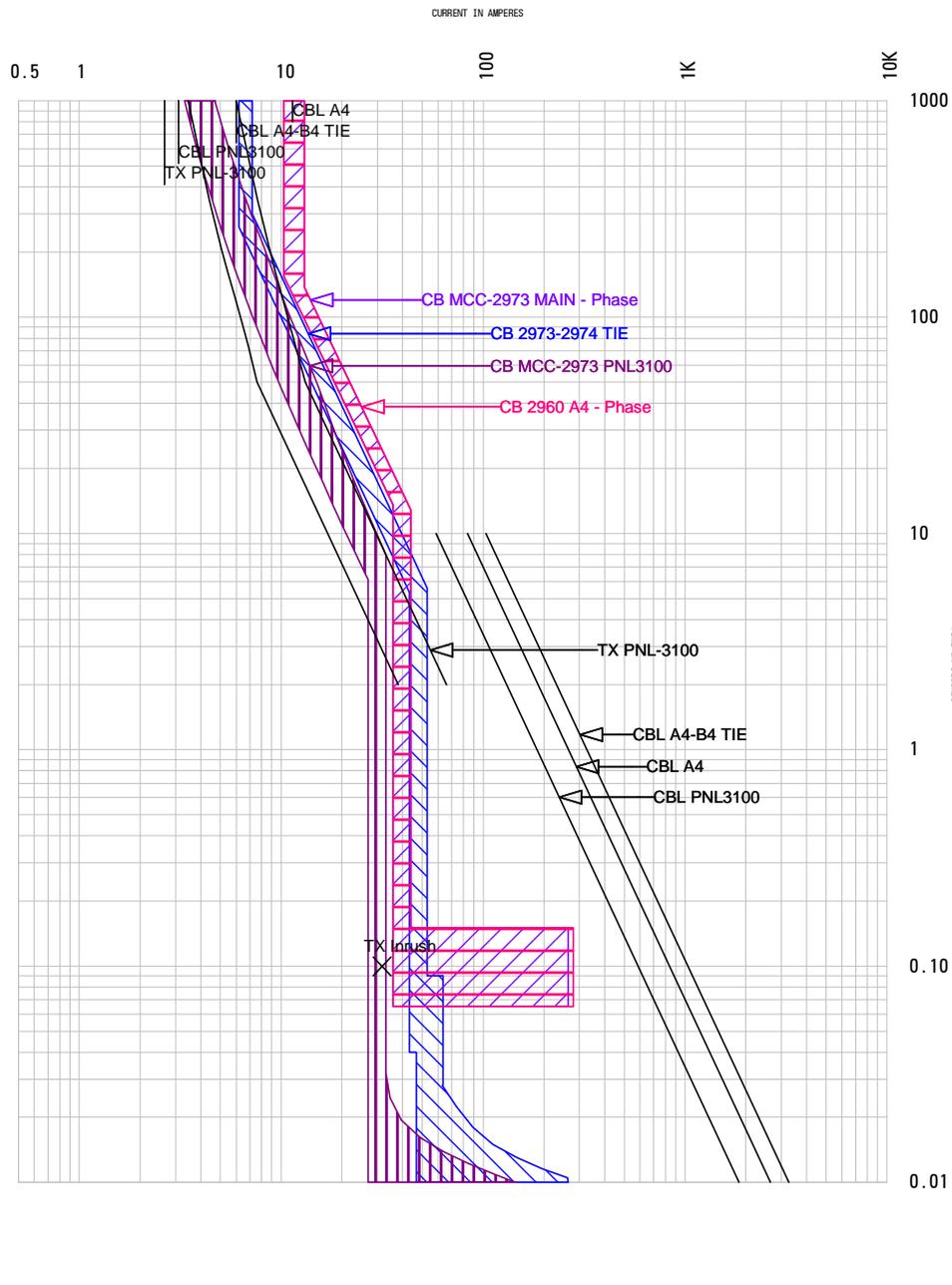
2960 MAIN A
480.0V



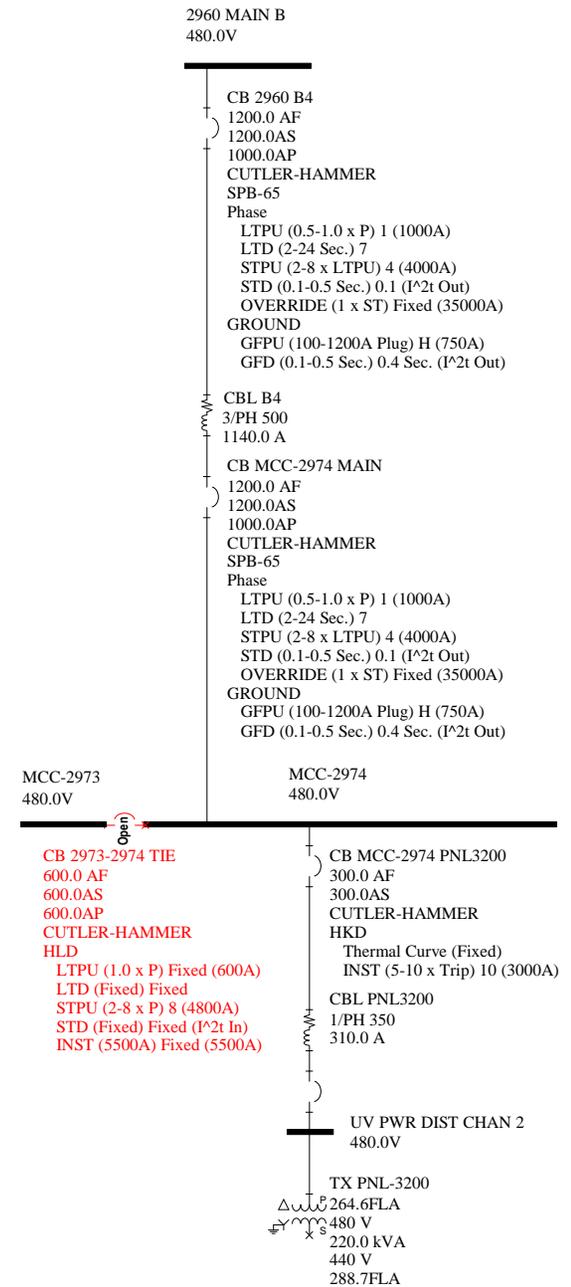
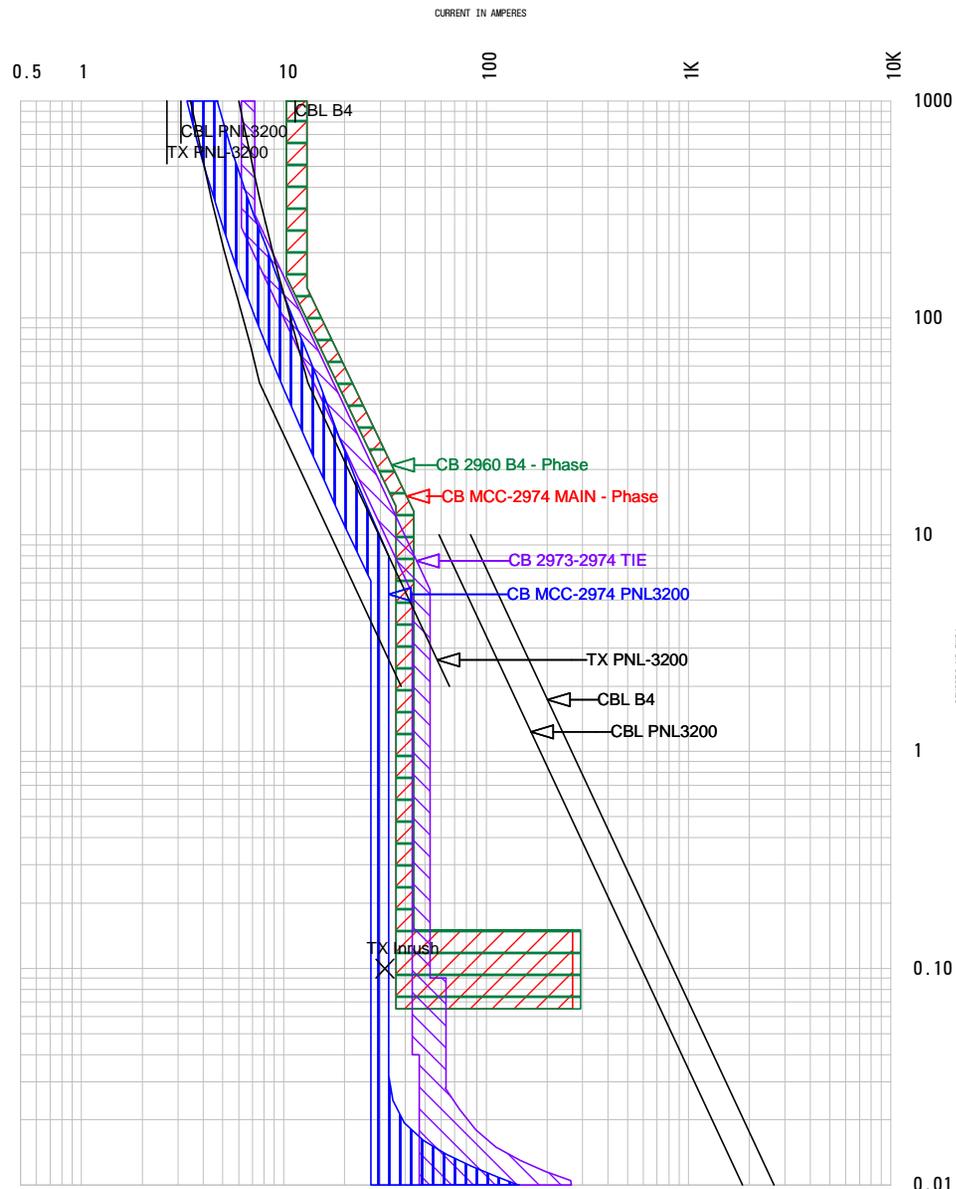
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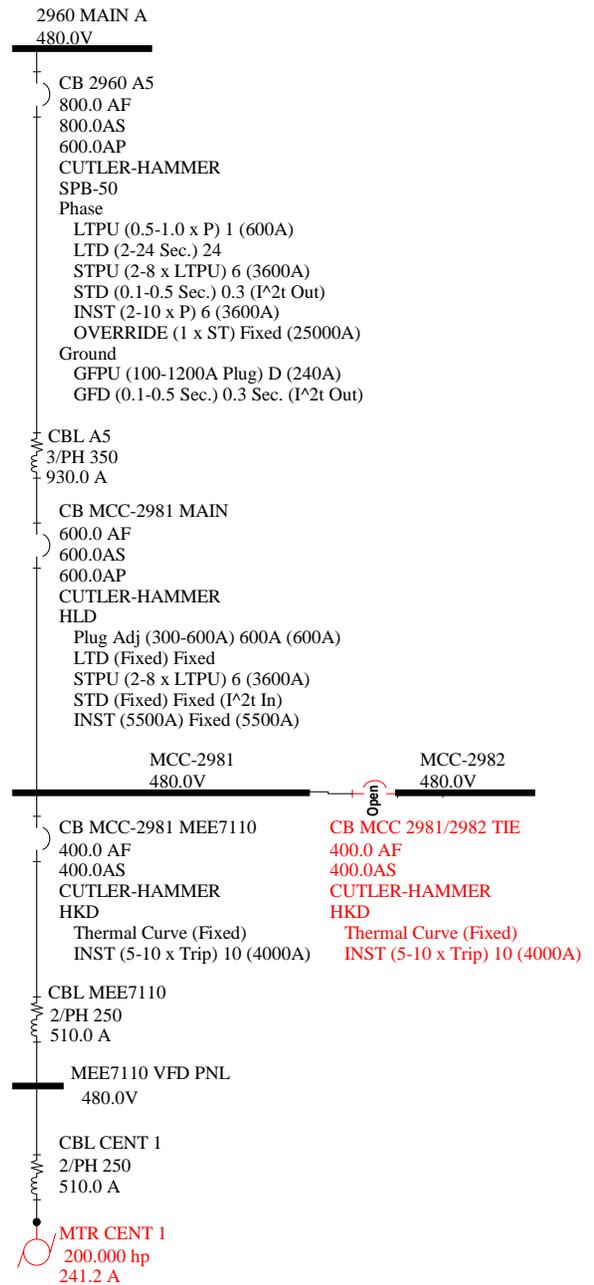
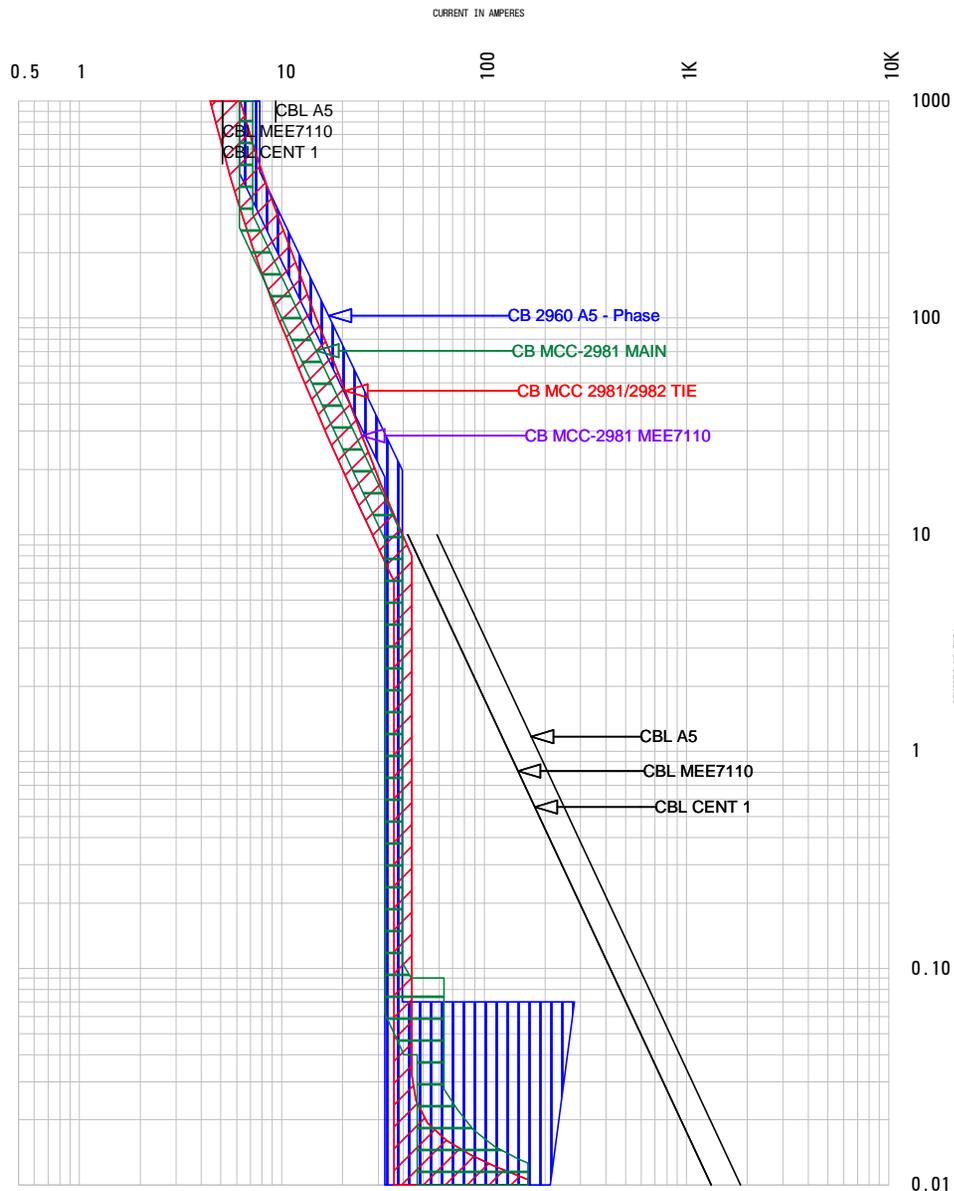
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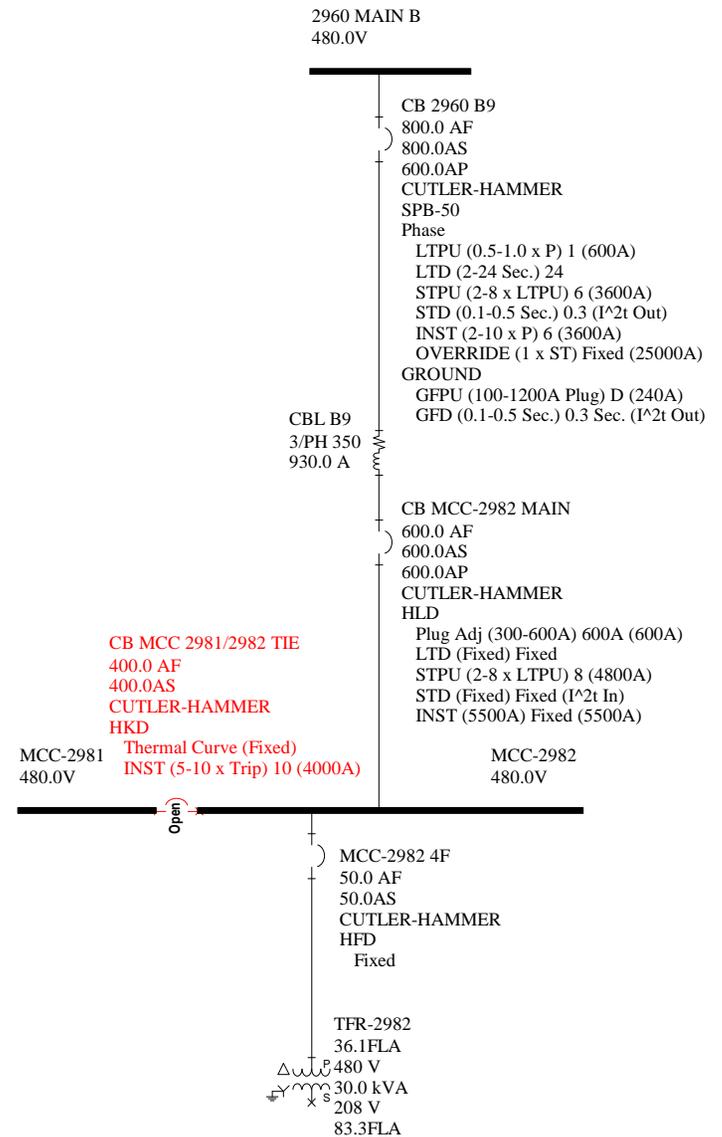
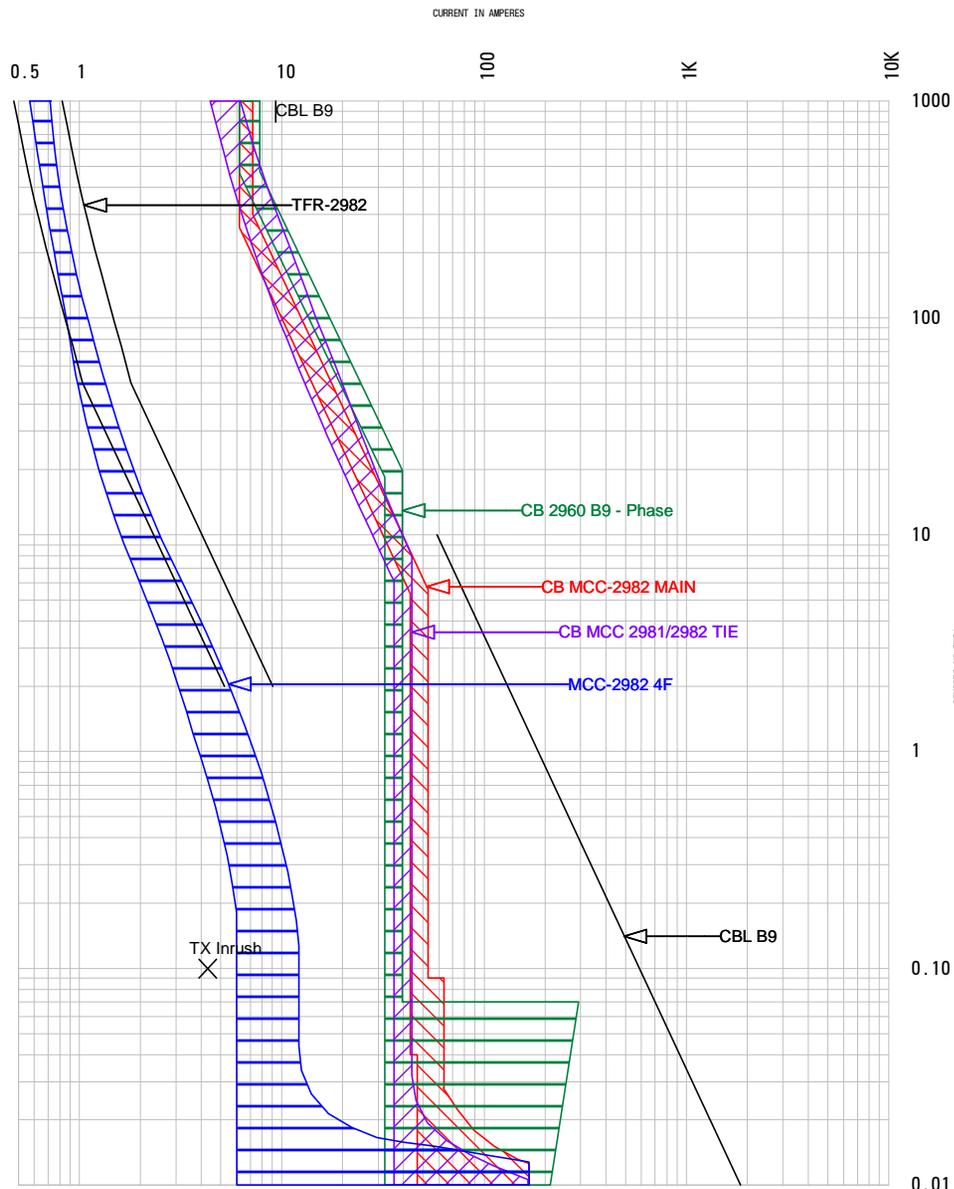
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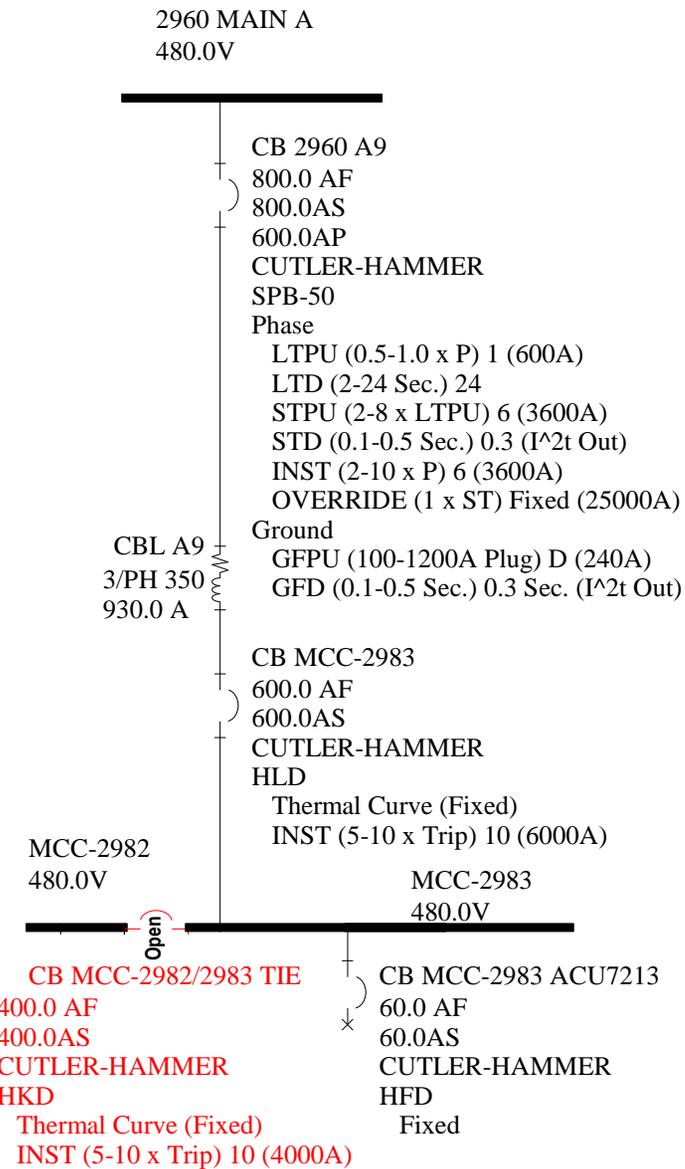
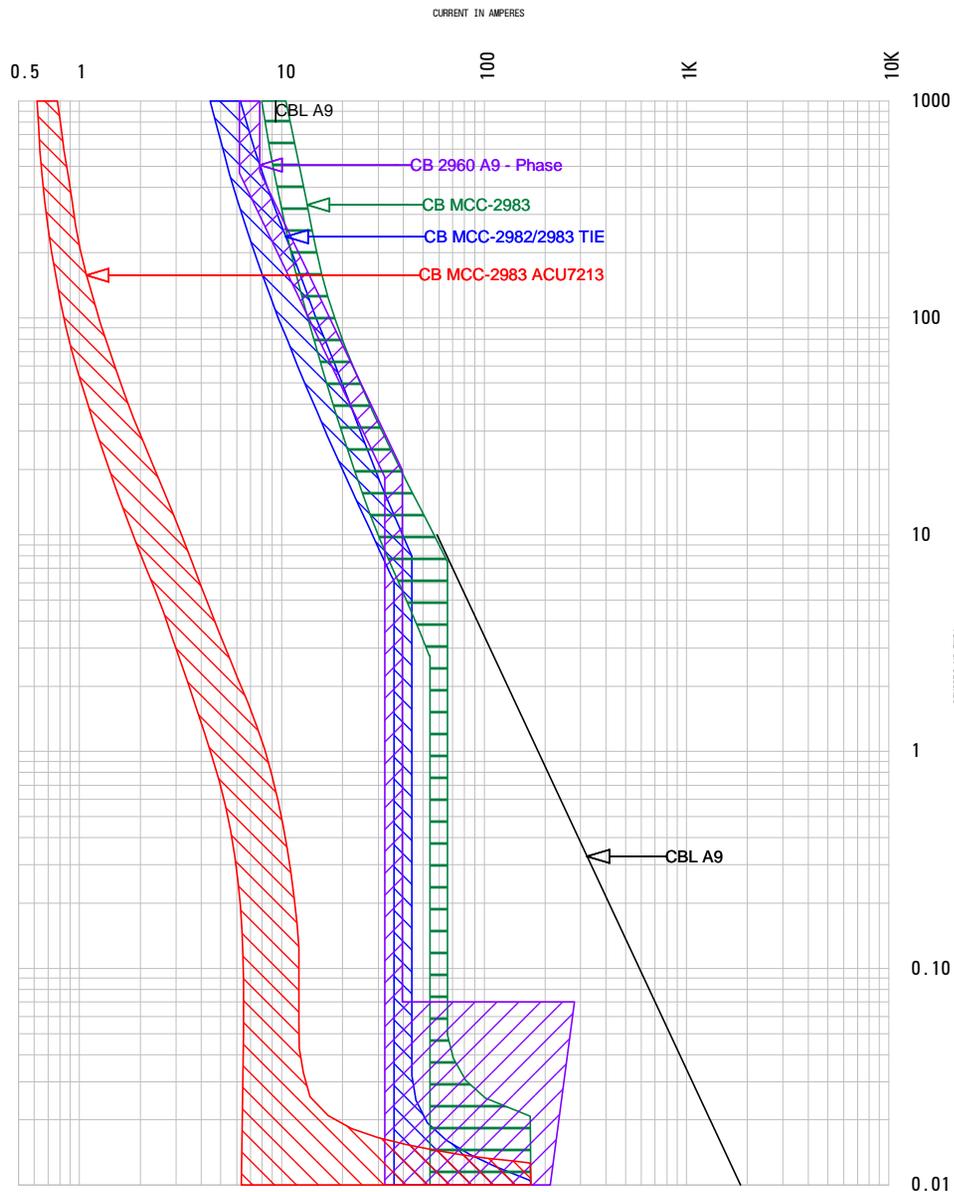
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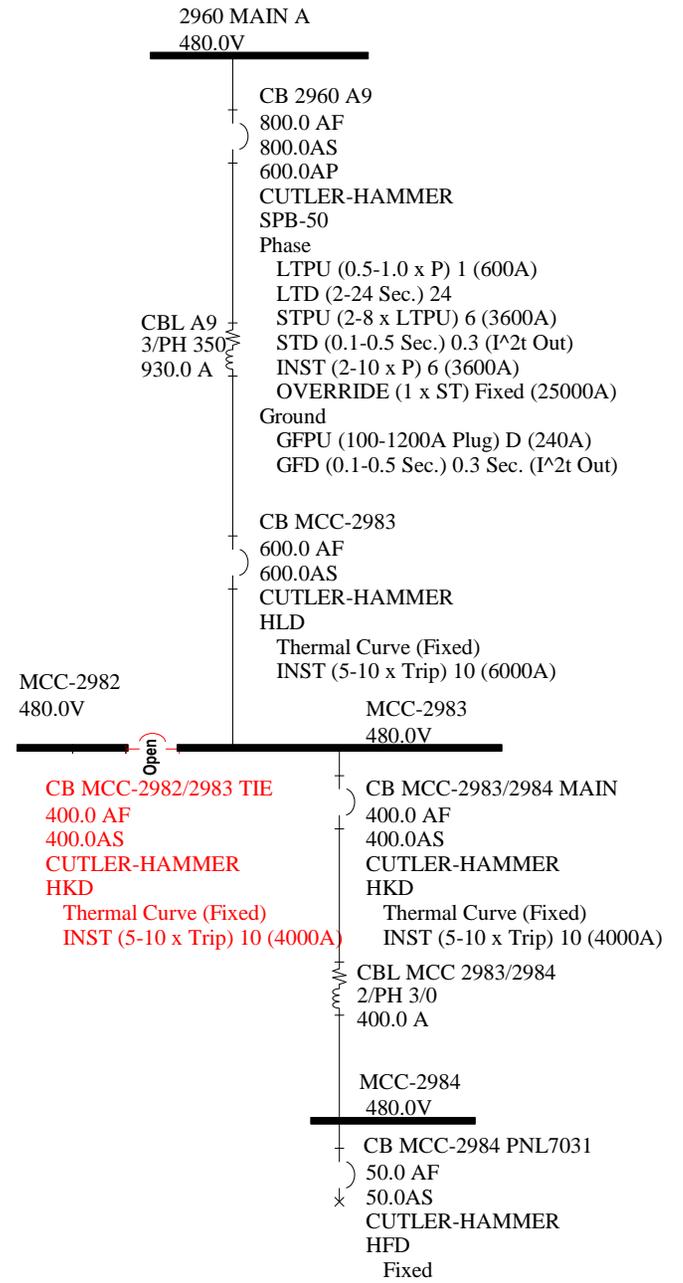
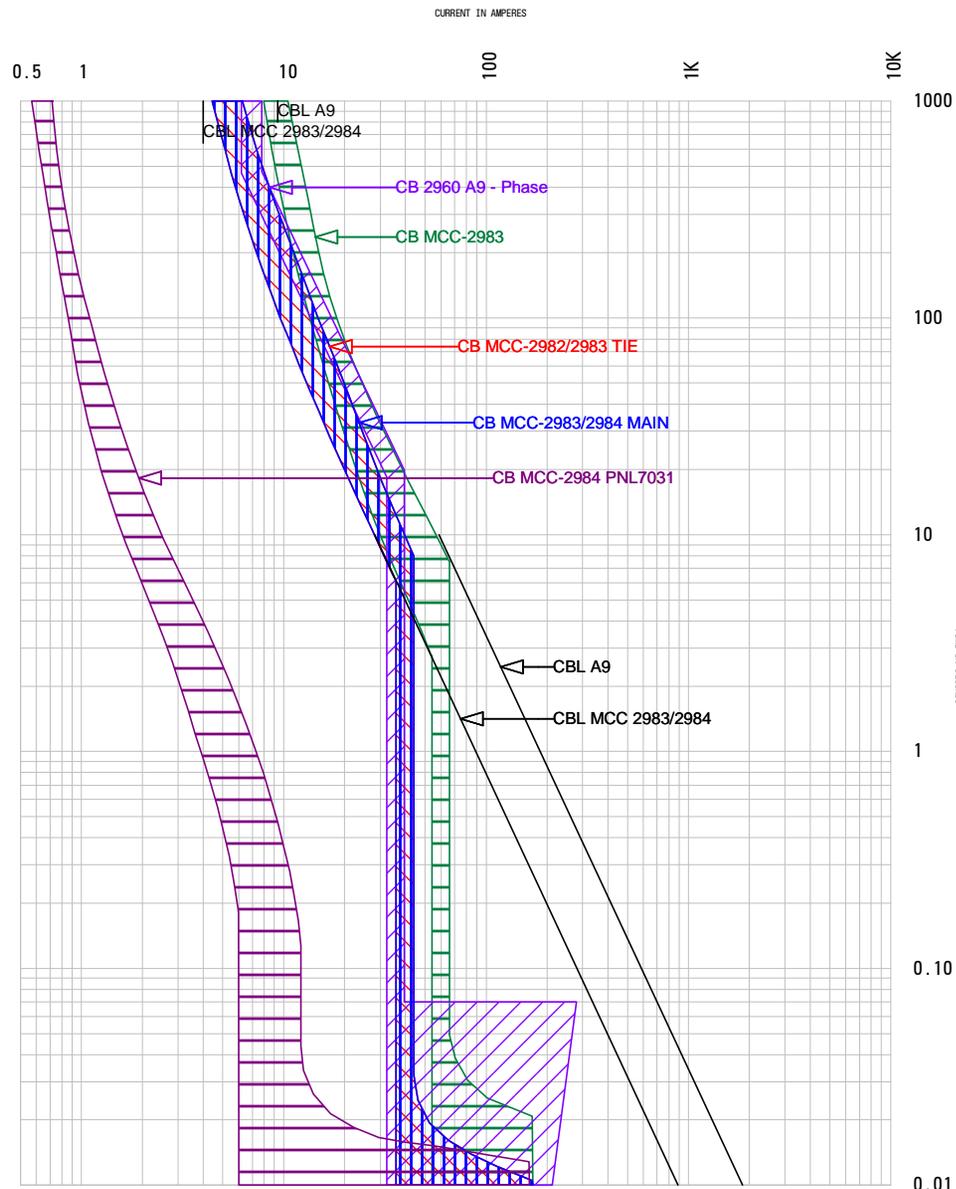
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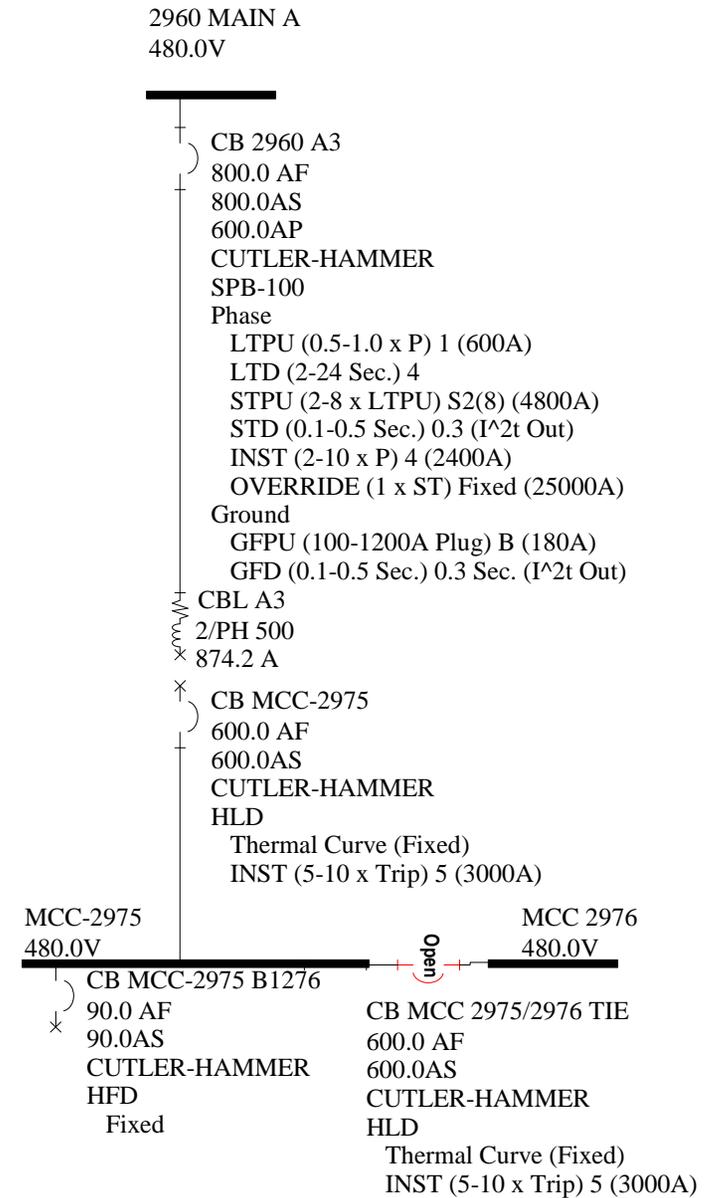
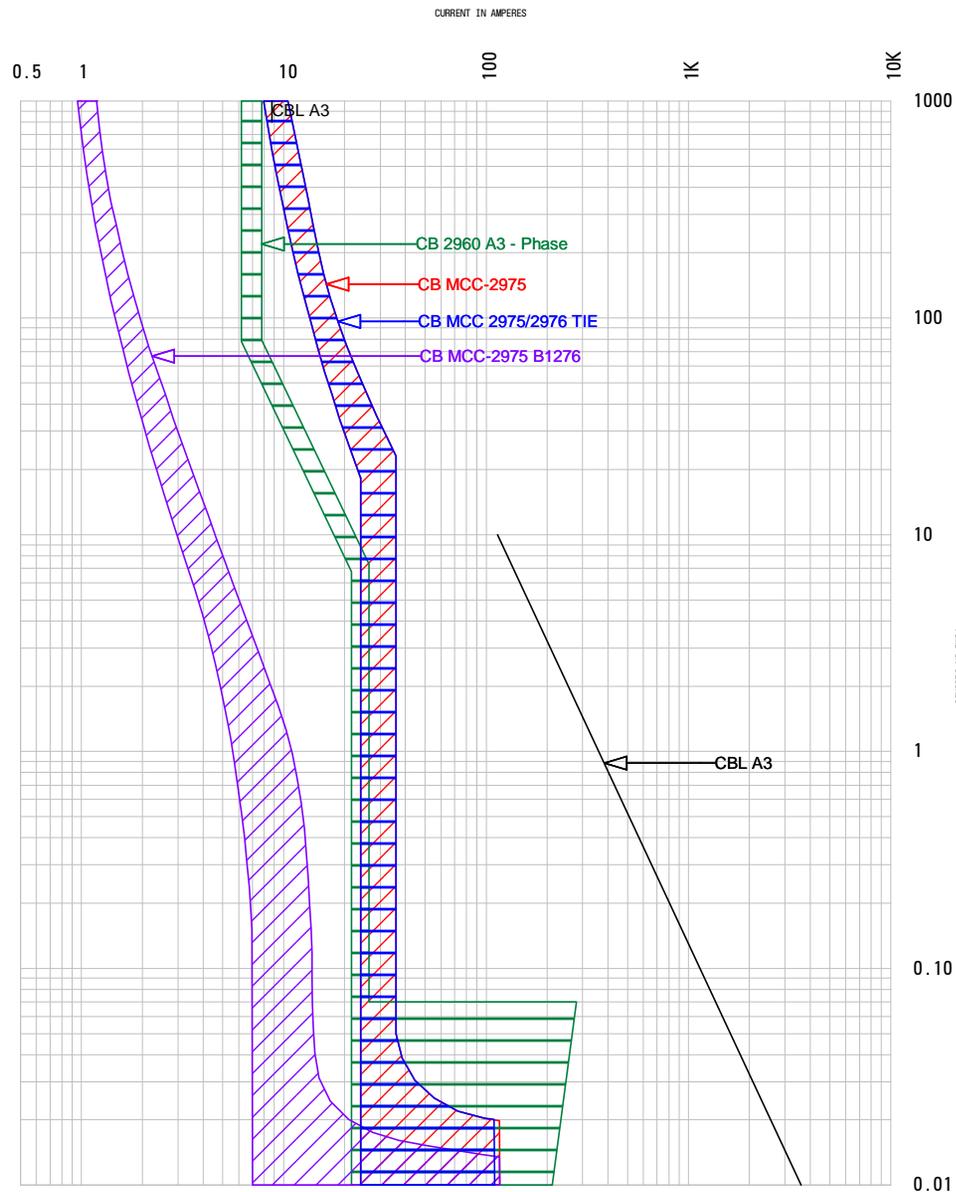
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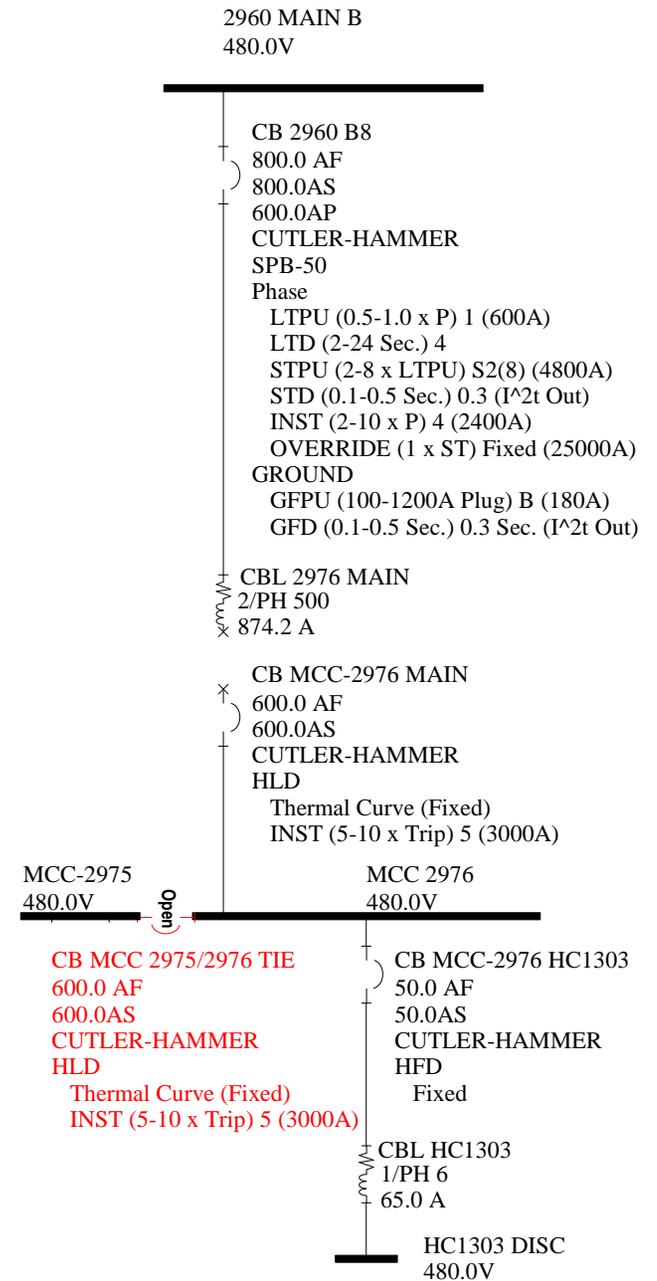
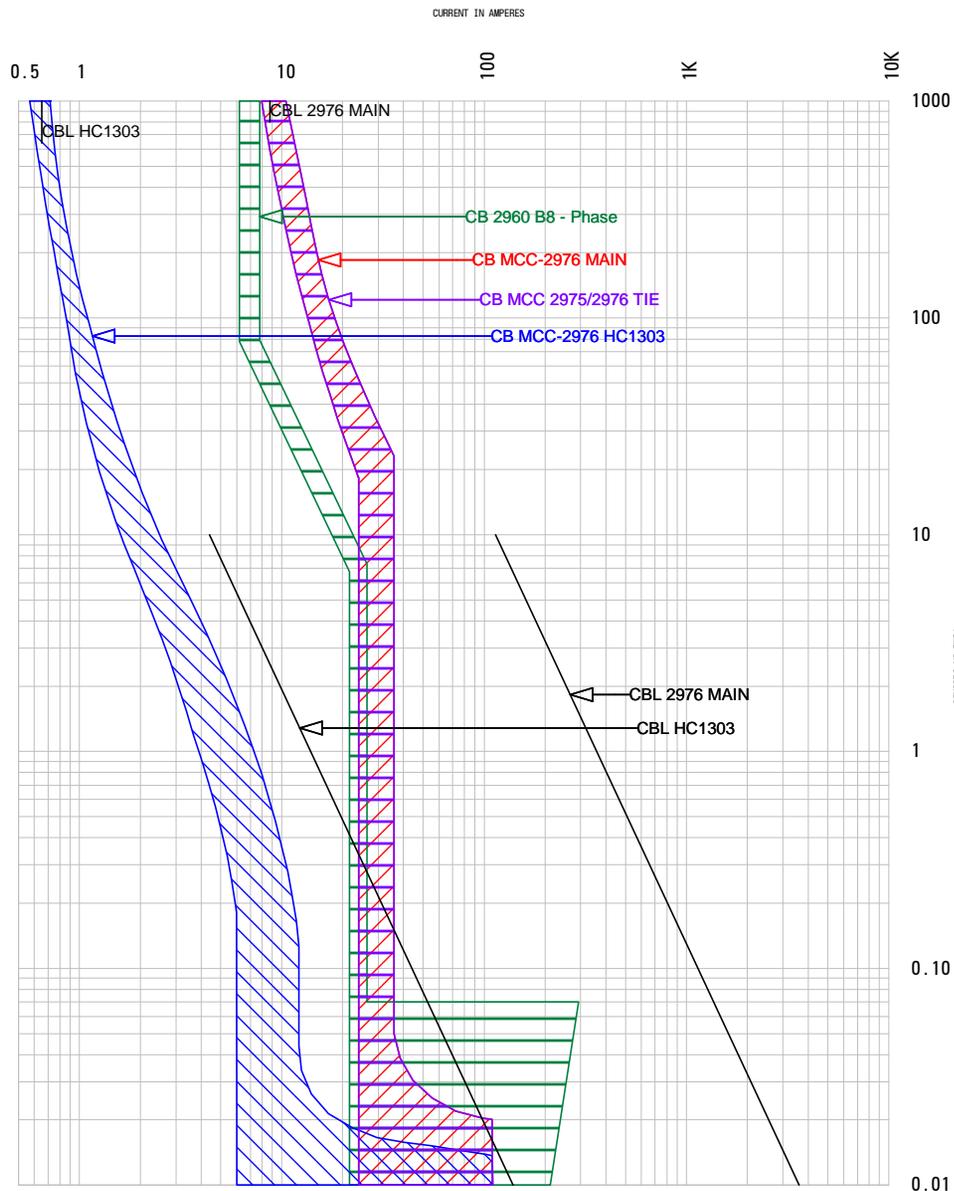
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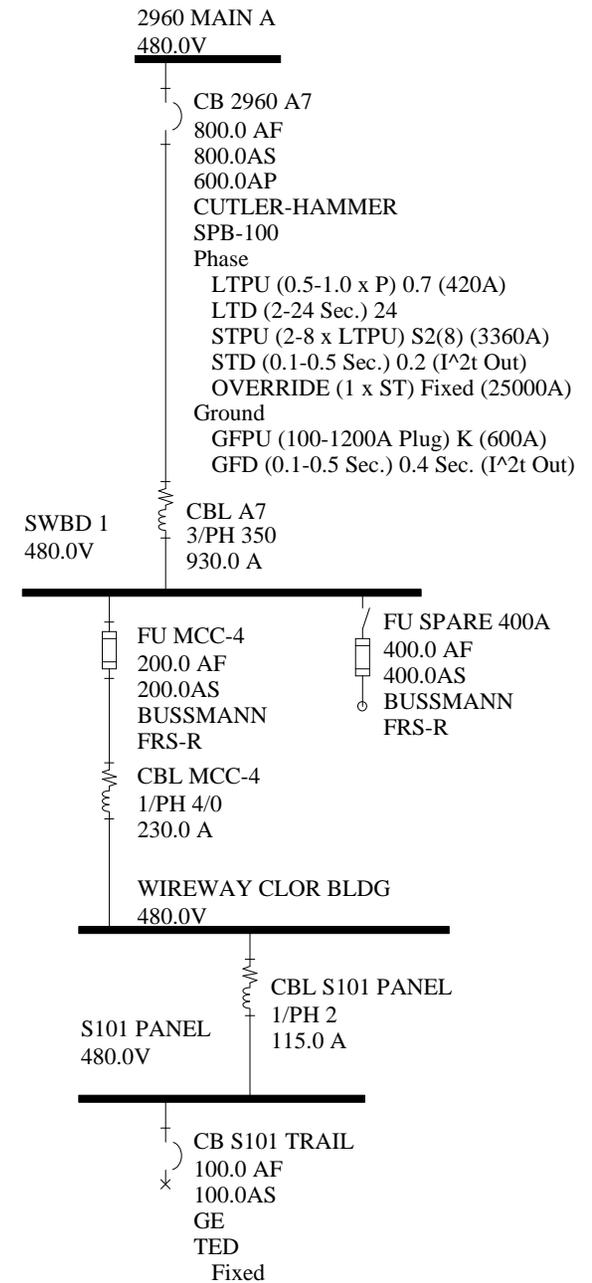
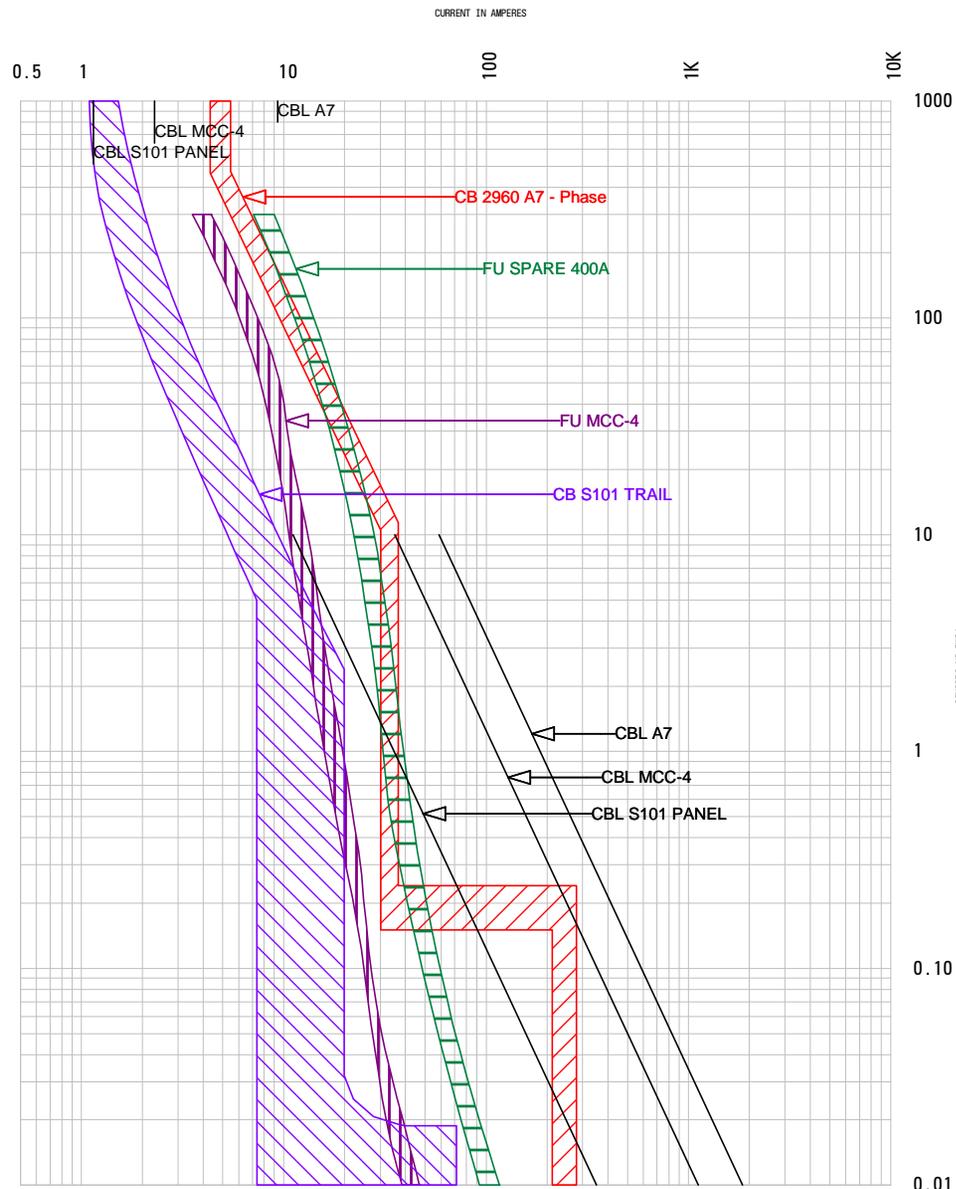
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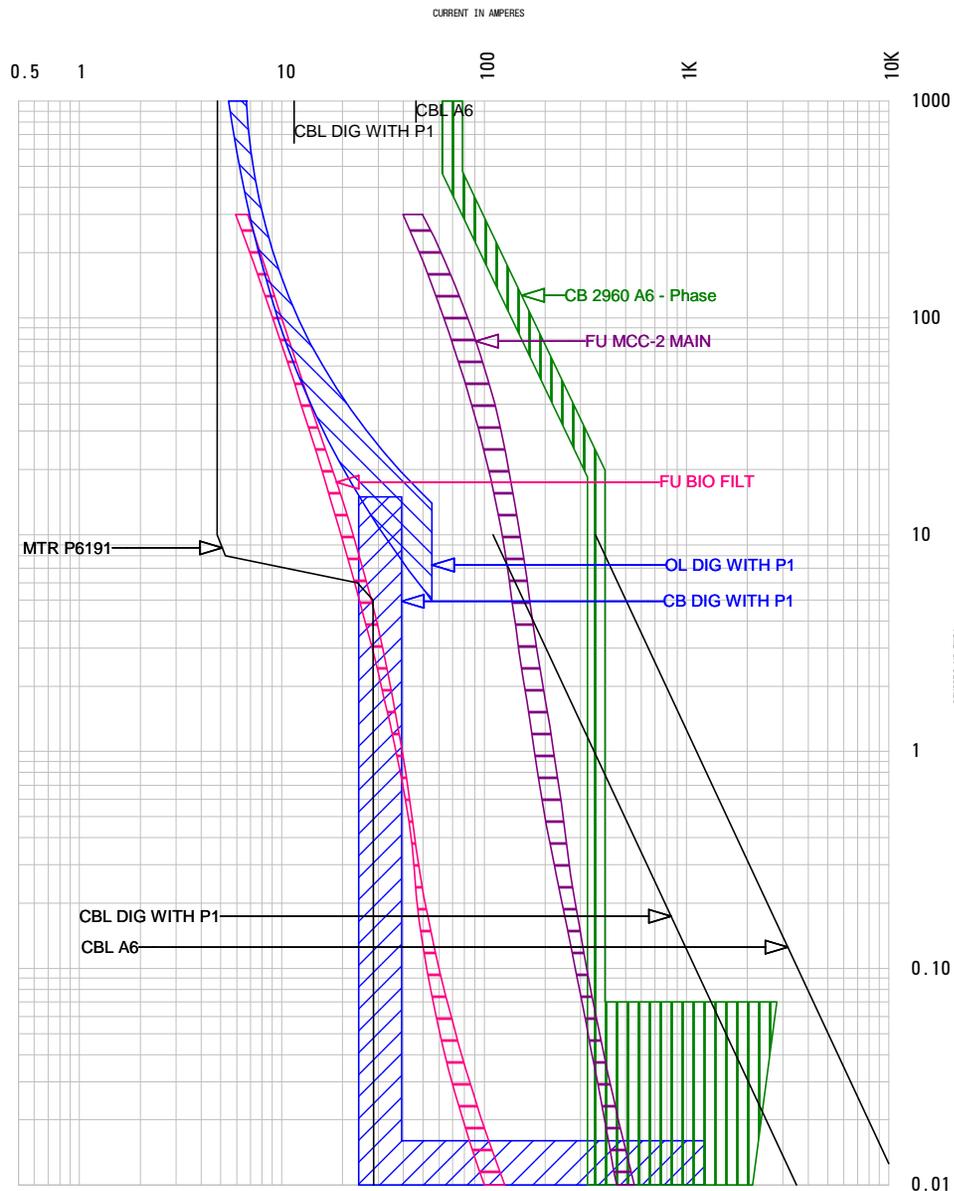
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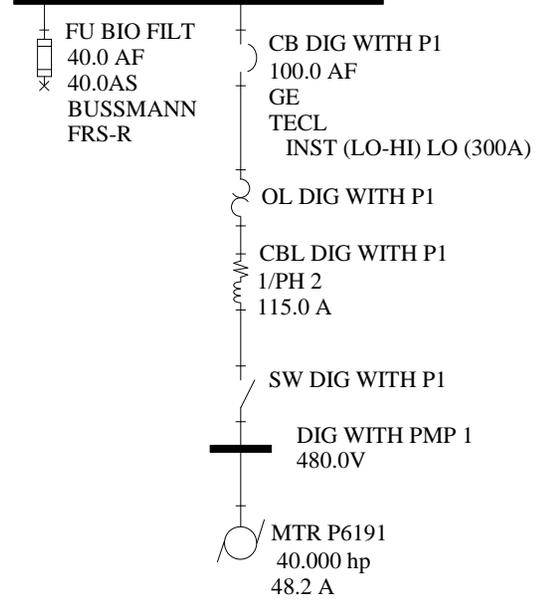
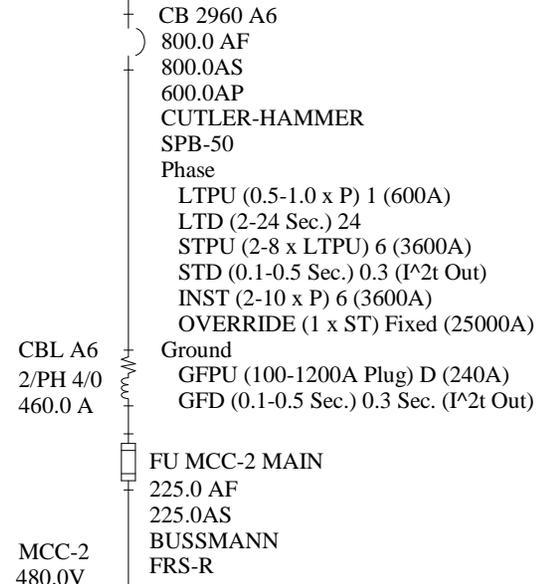
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Actual Current=Displayed Current x 100 at 480 V

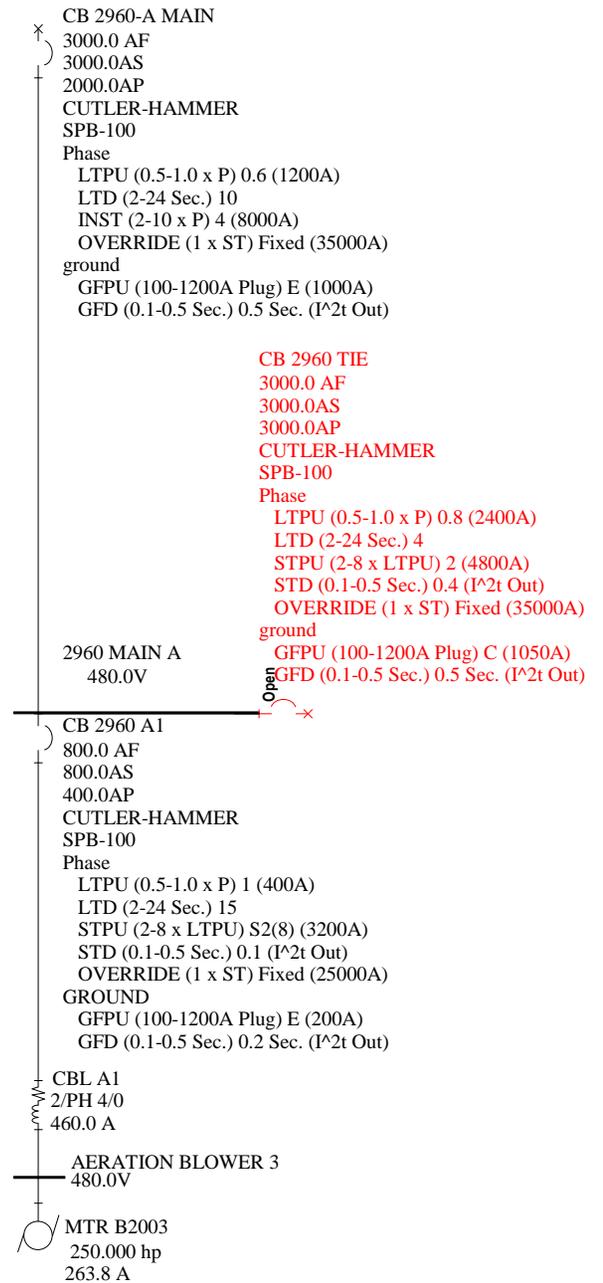
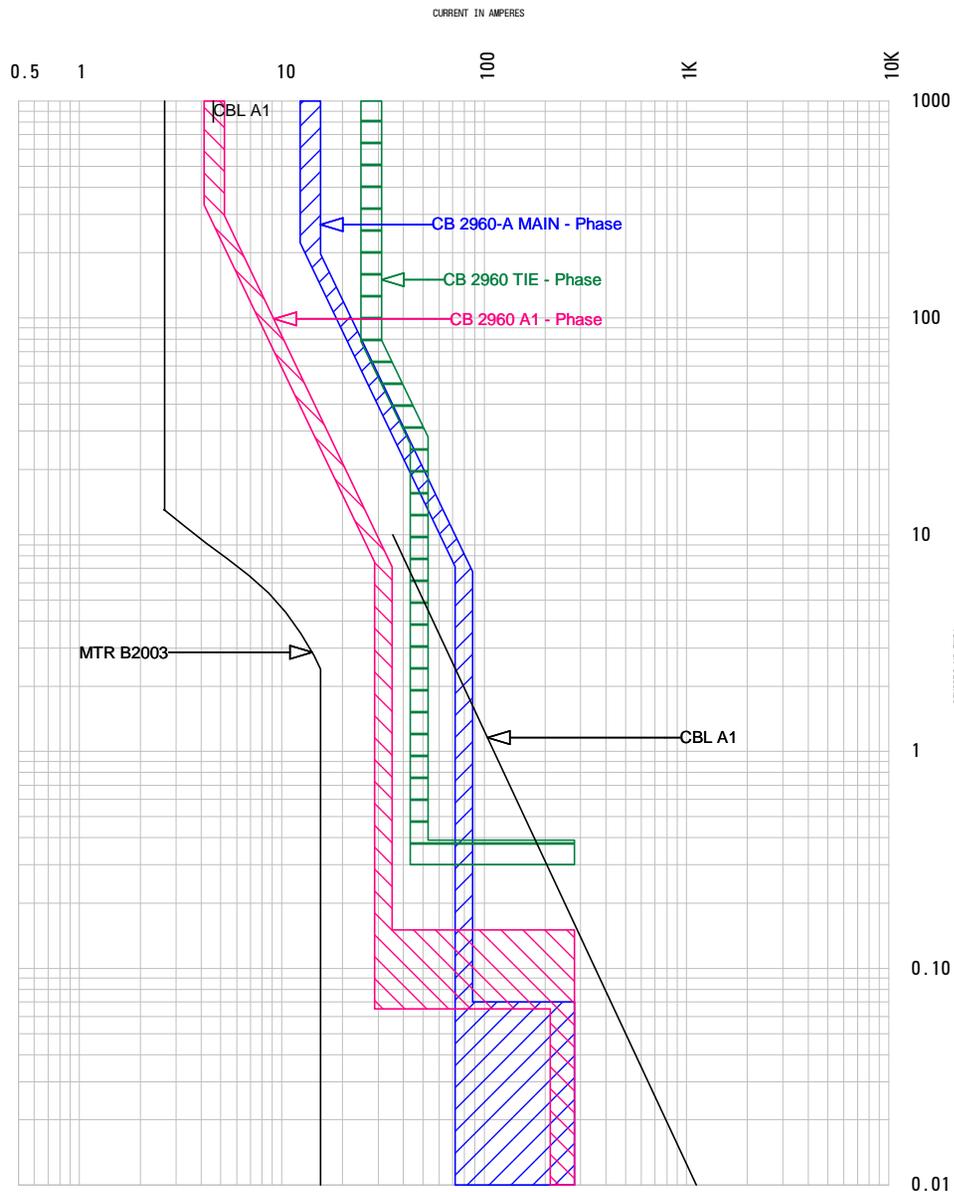


2960 MAIN A
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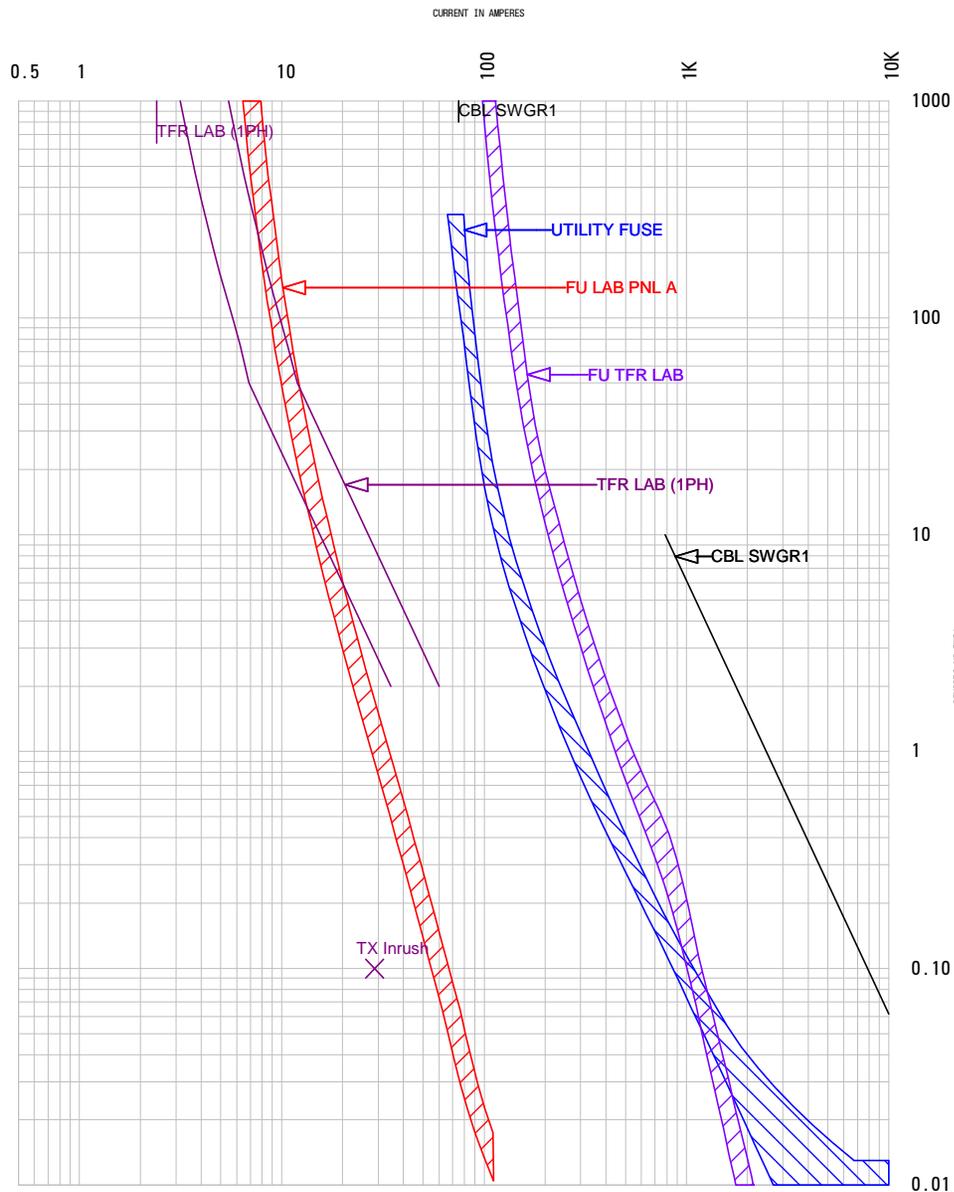


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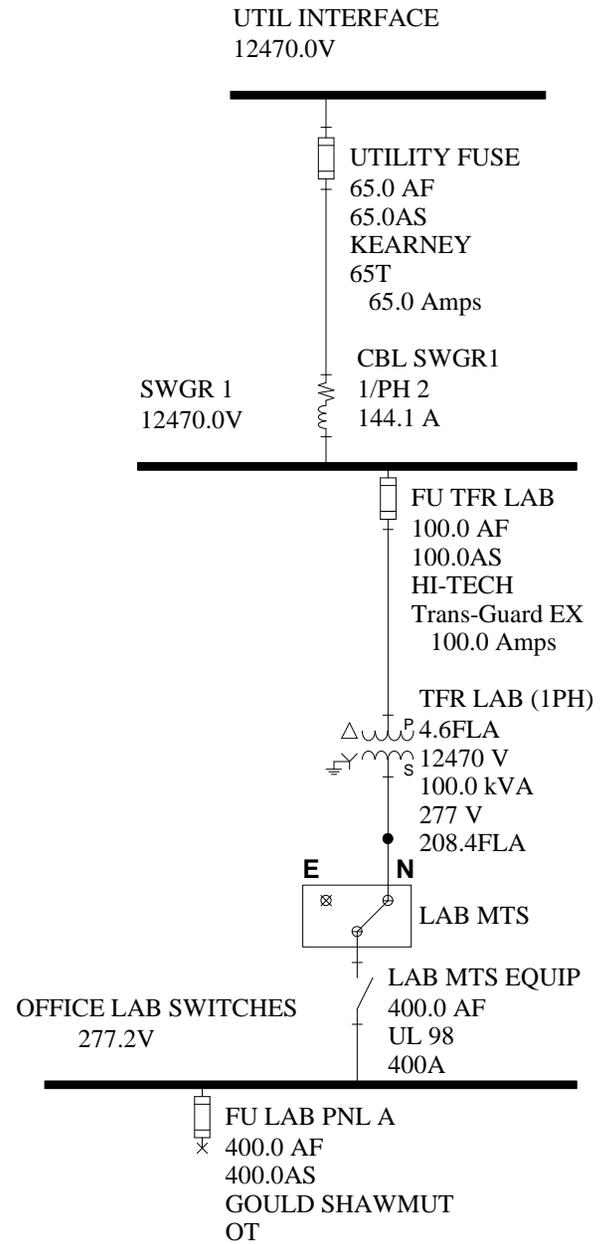


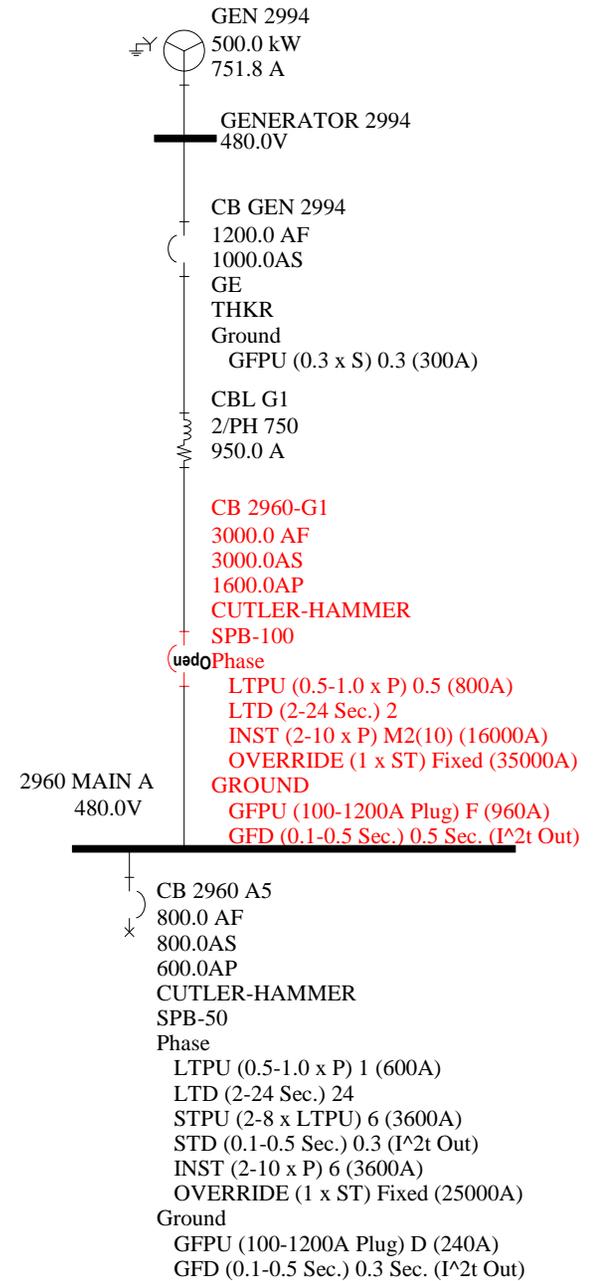
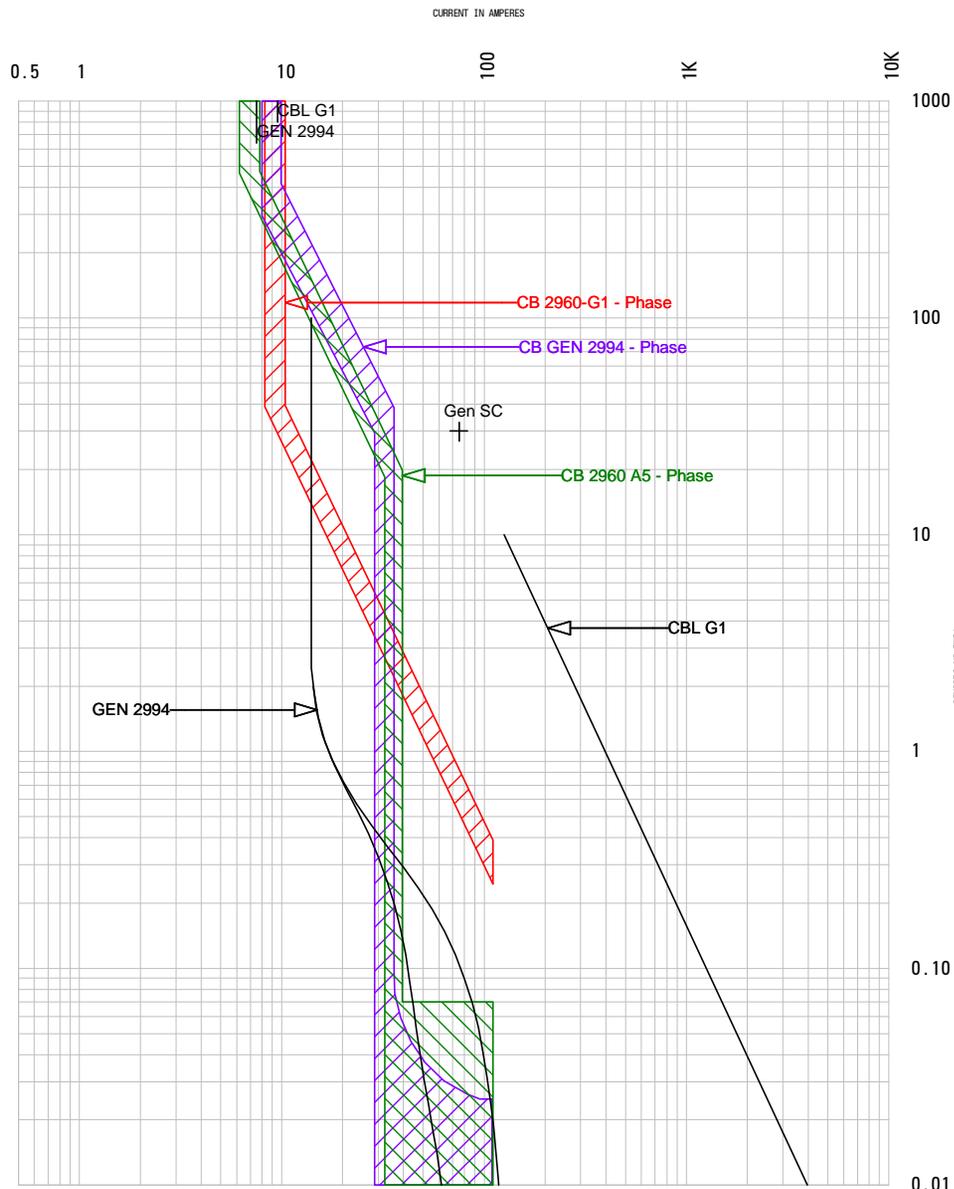


Actual Current=Displayed Current x 100 at 480 V

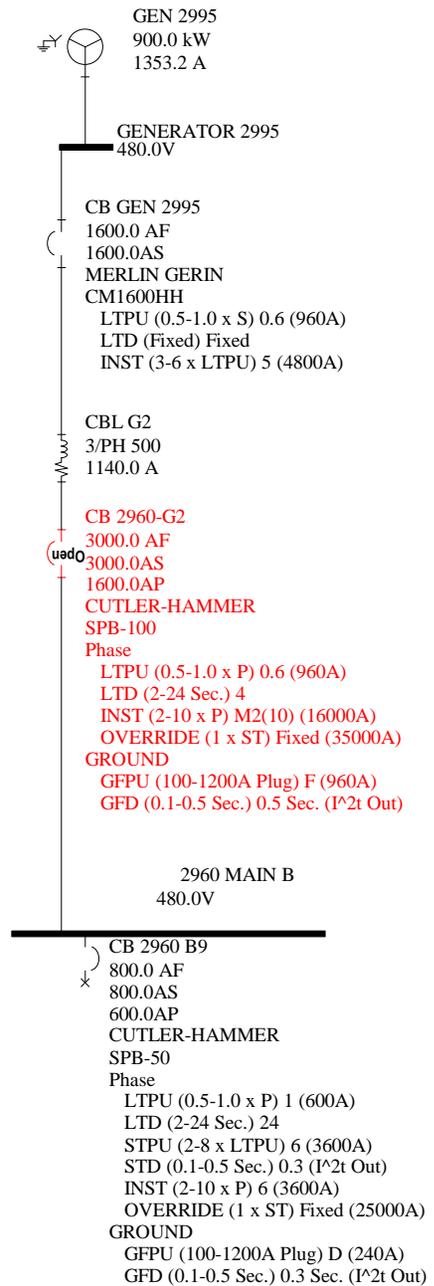
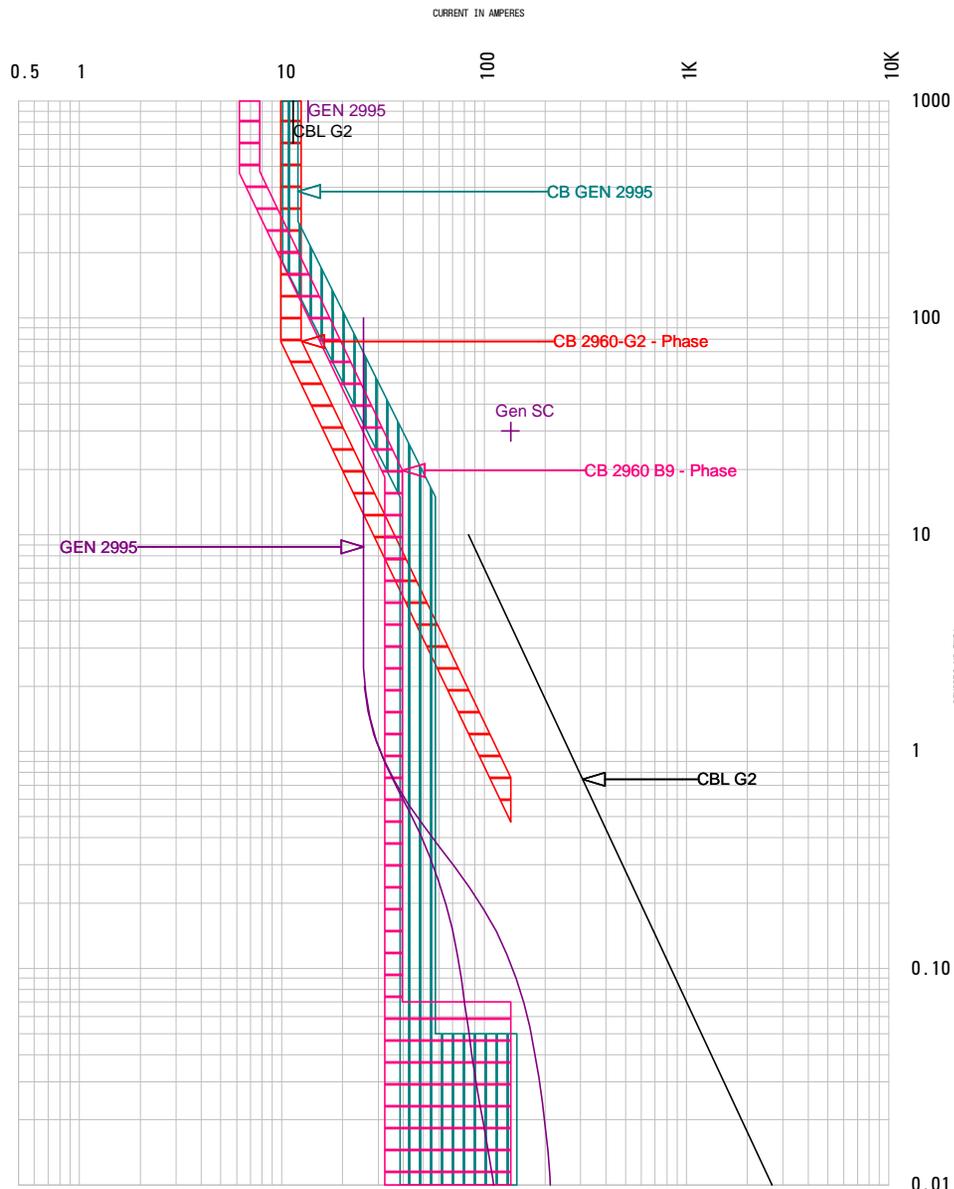


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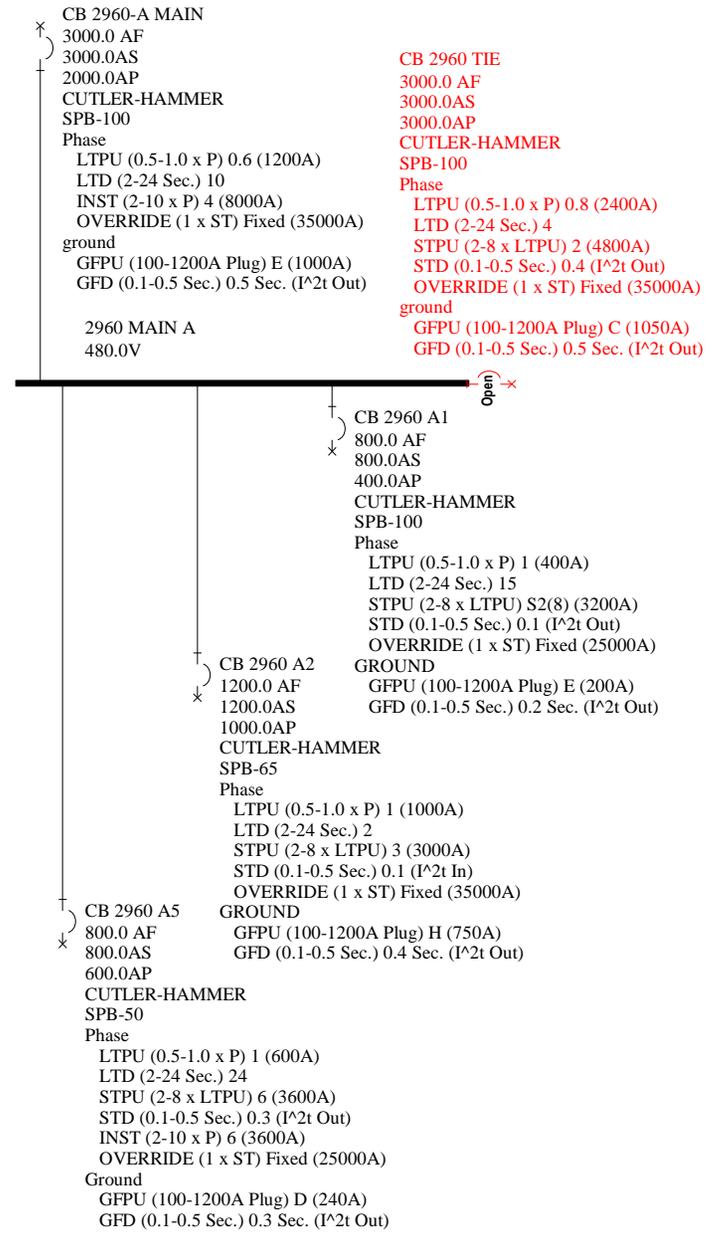
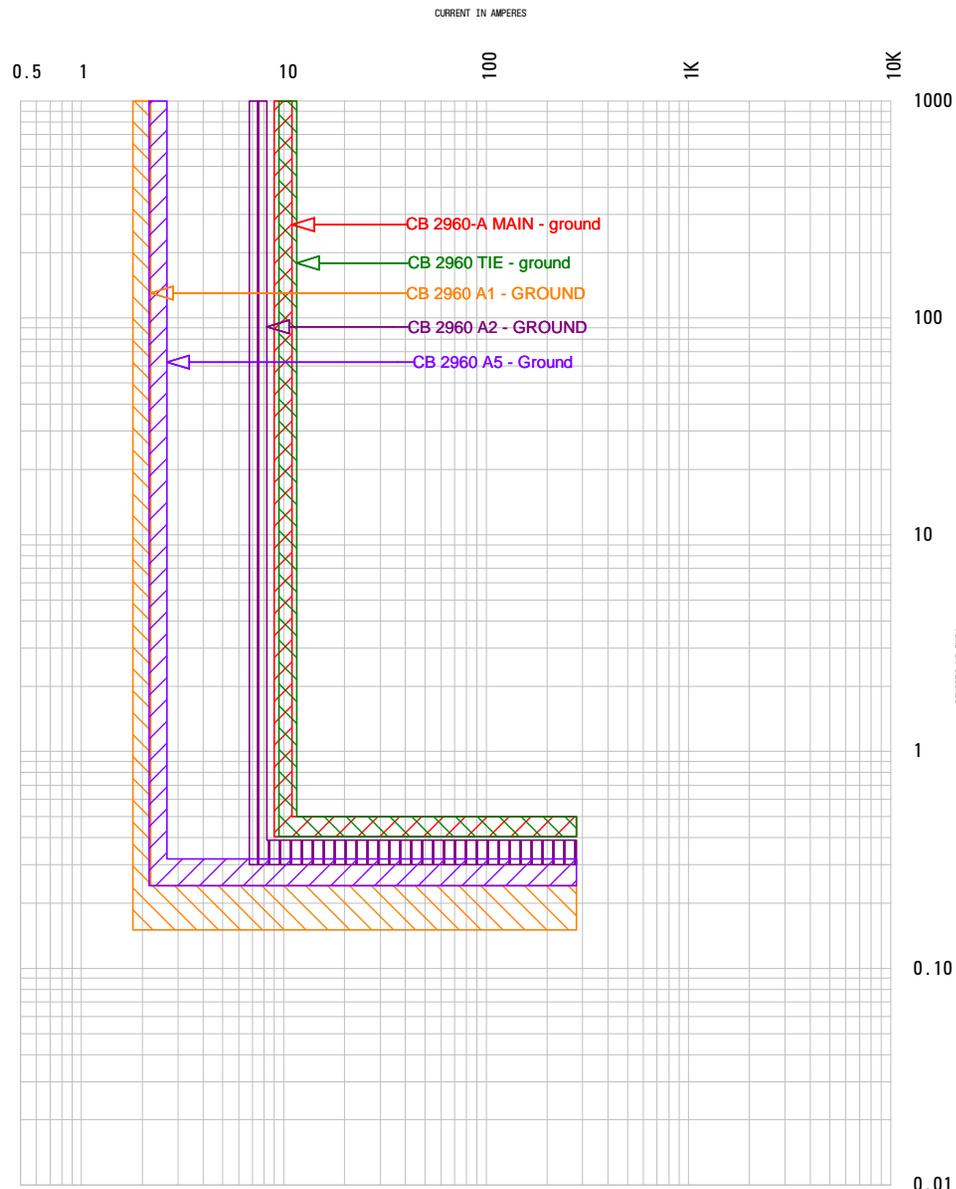




Actual Current=Displayed Current x 100 at 480 V

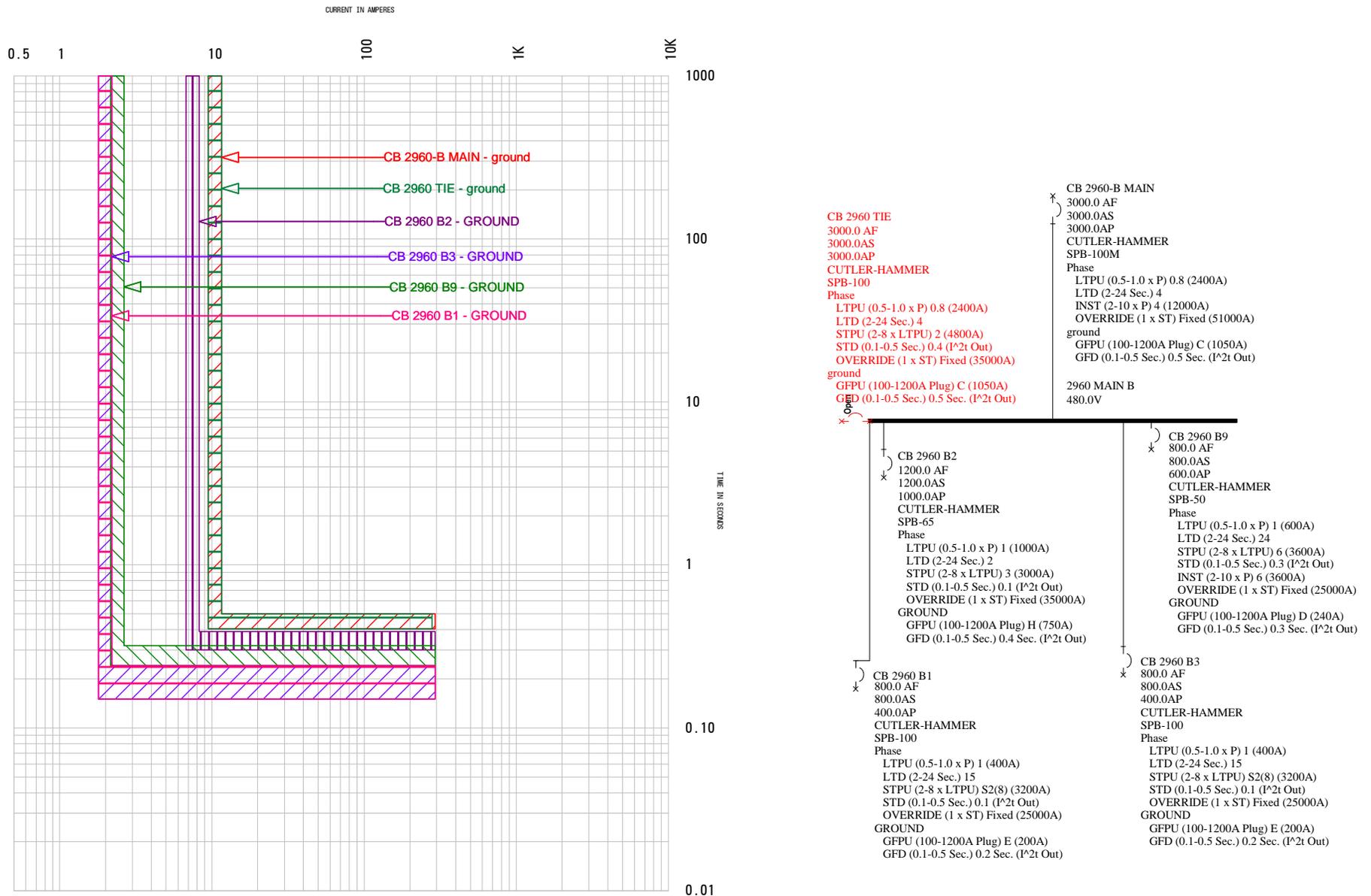


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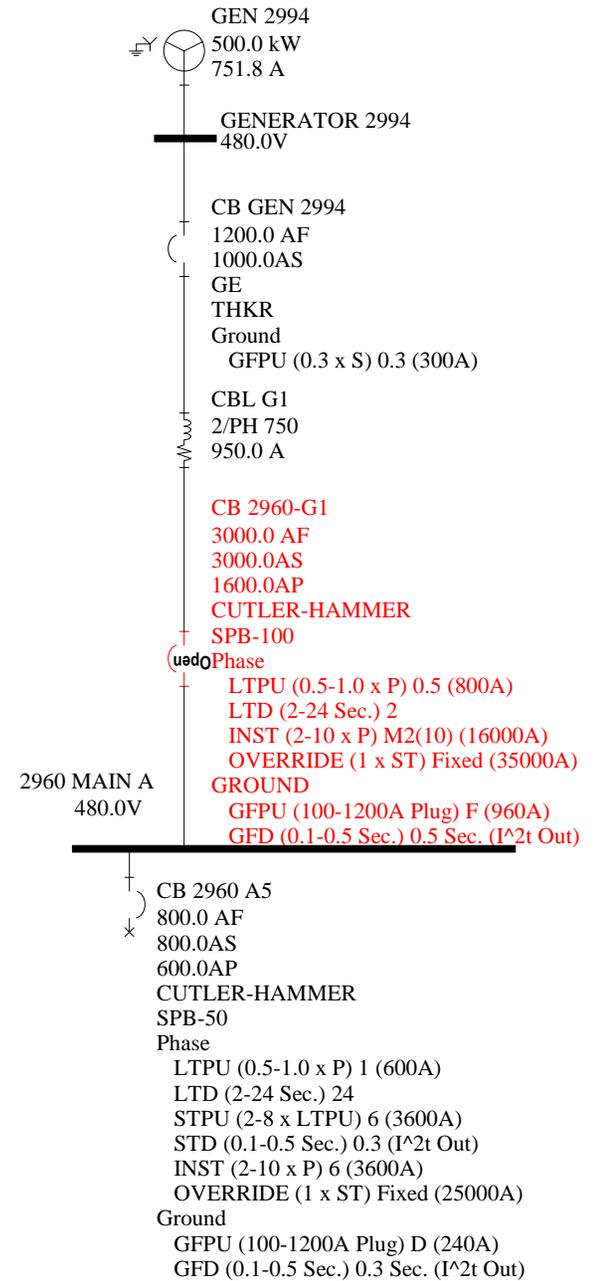
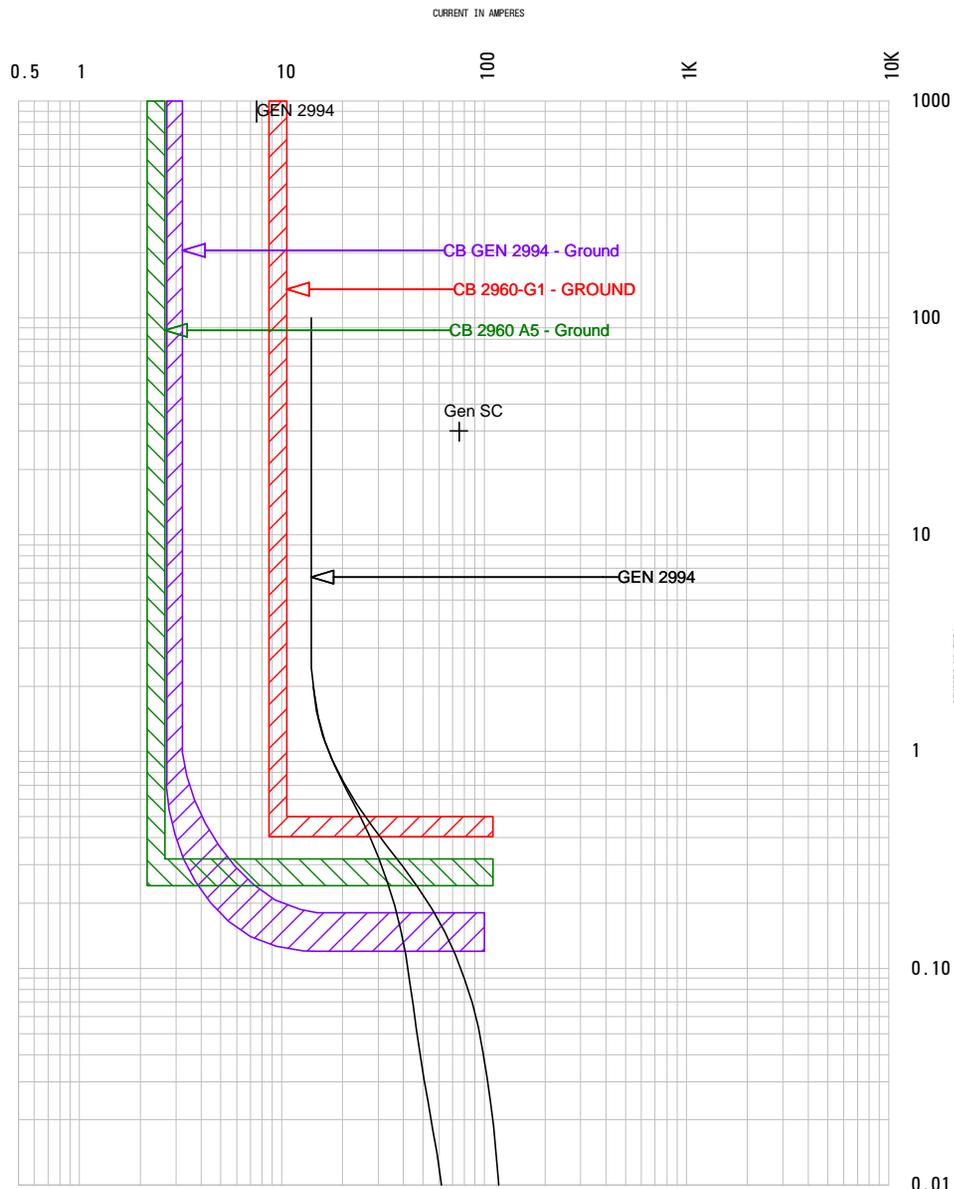


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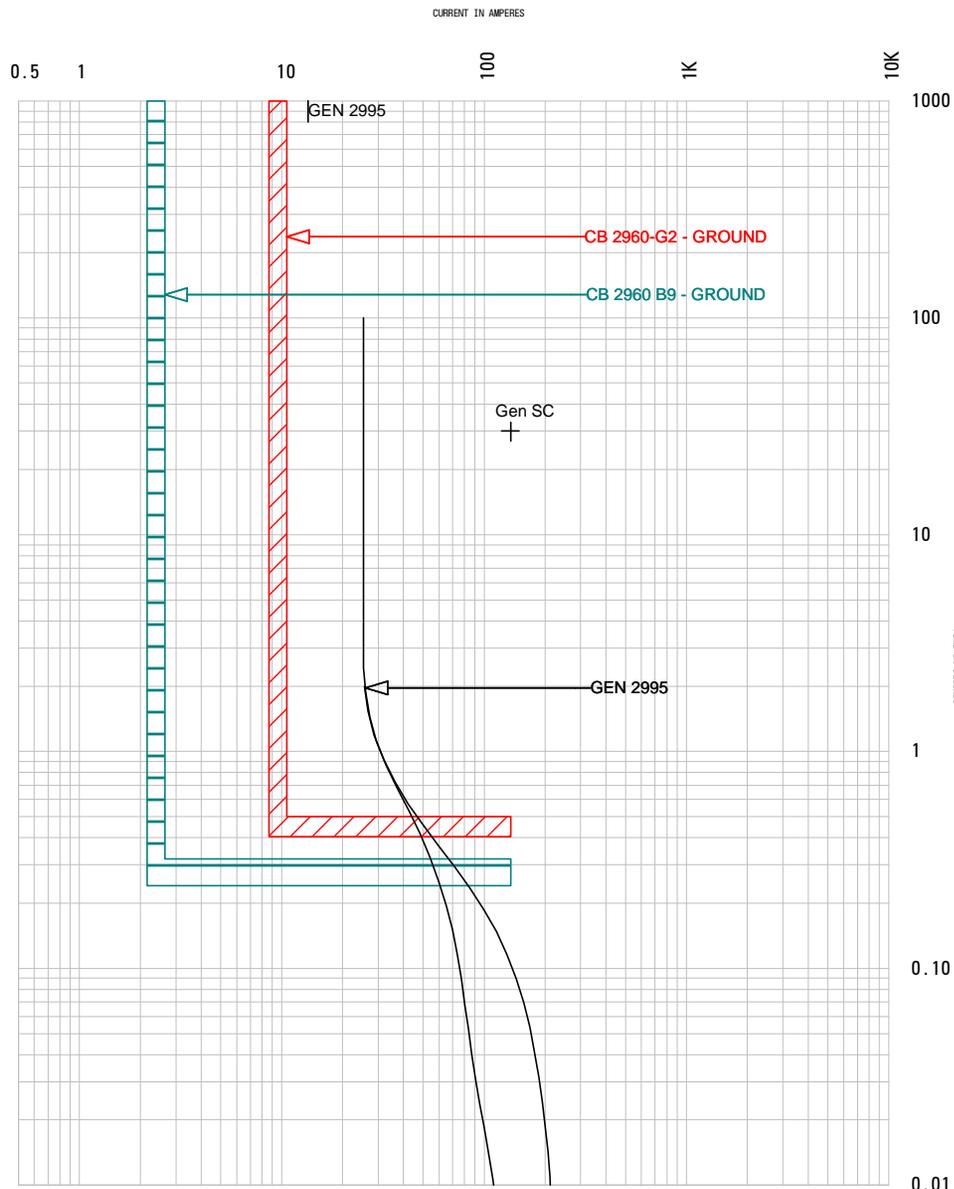




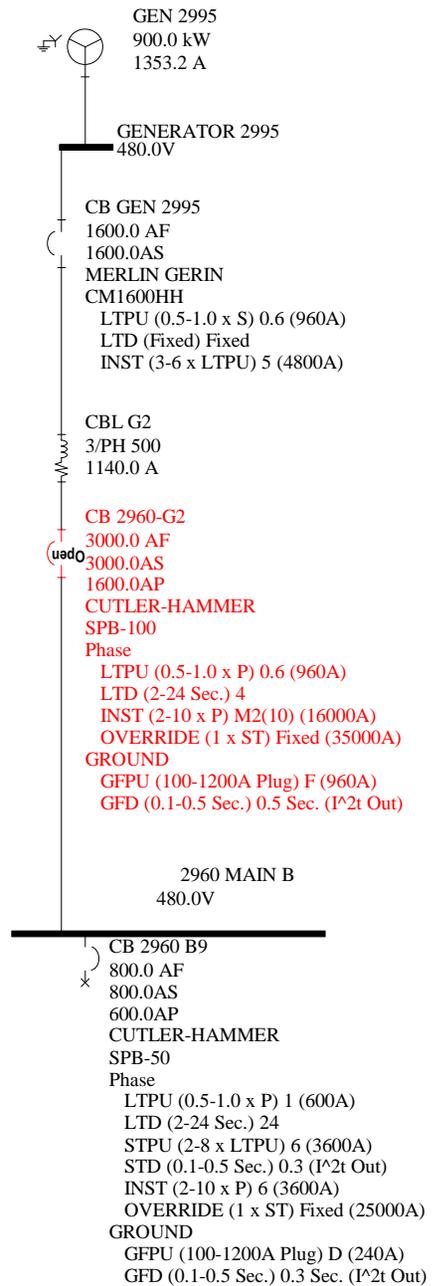
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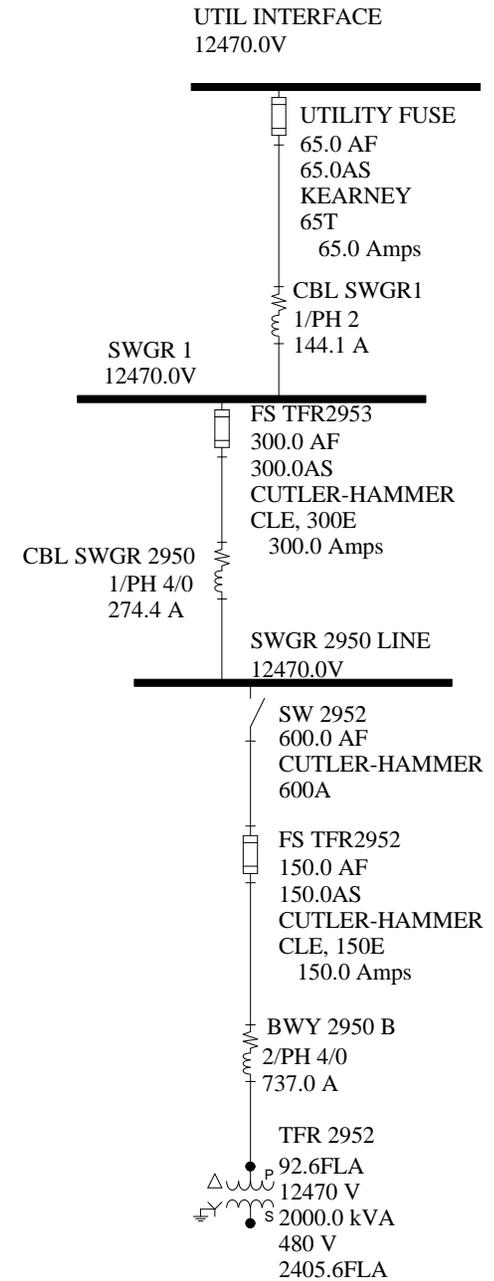
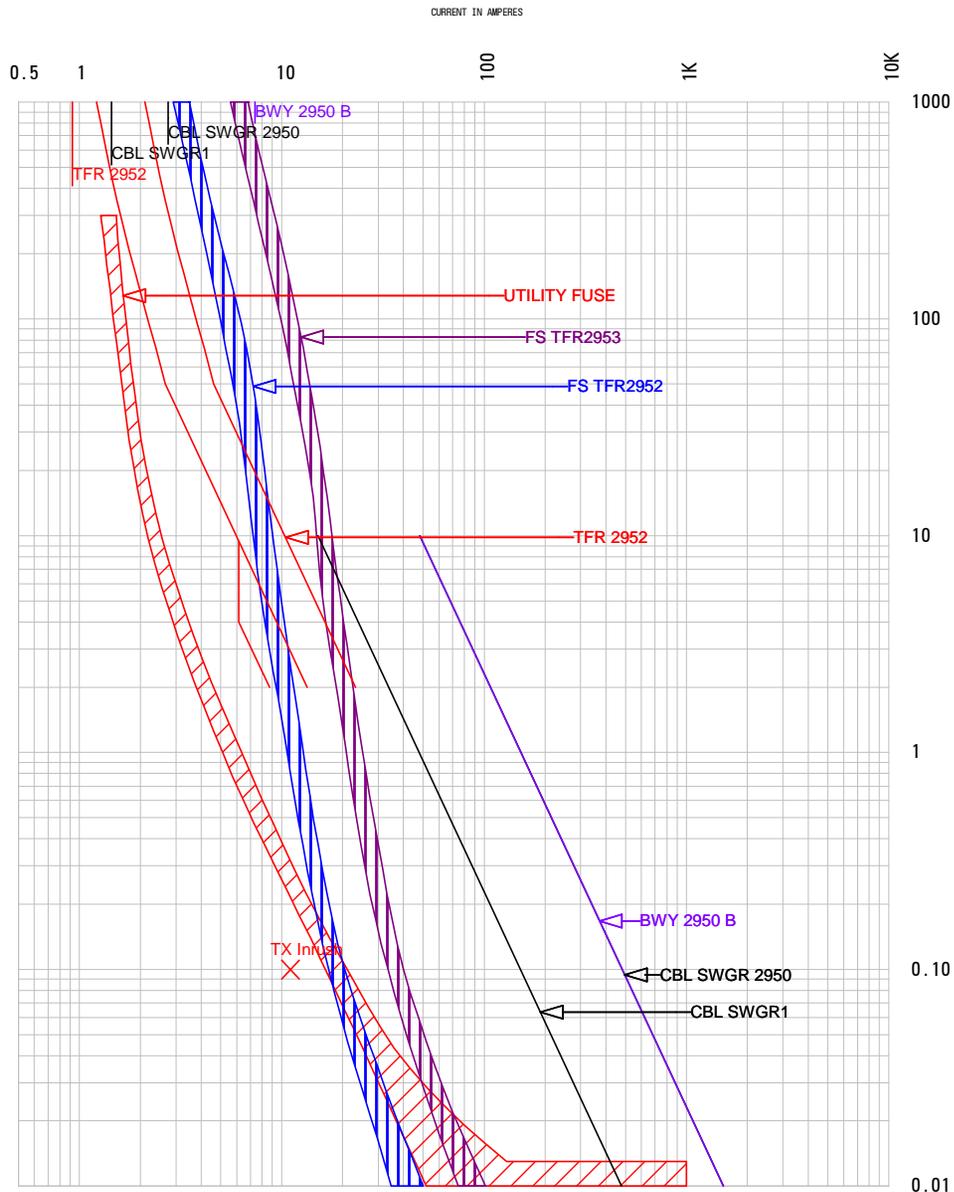


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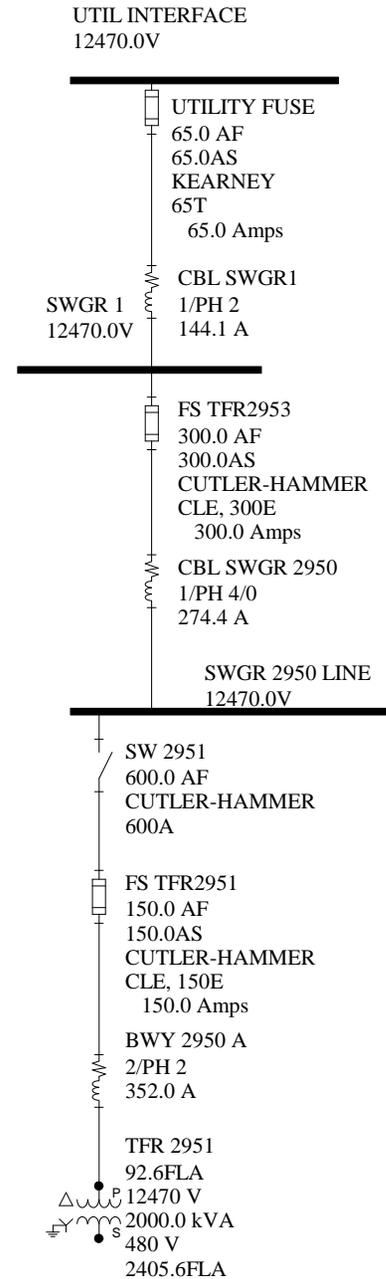
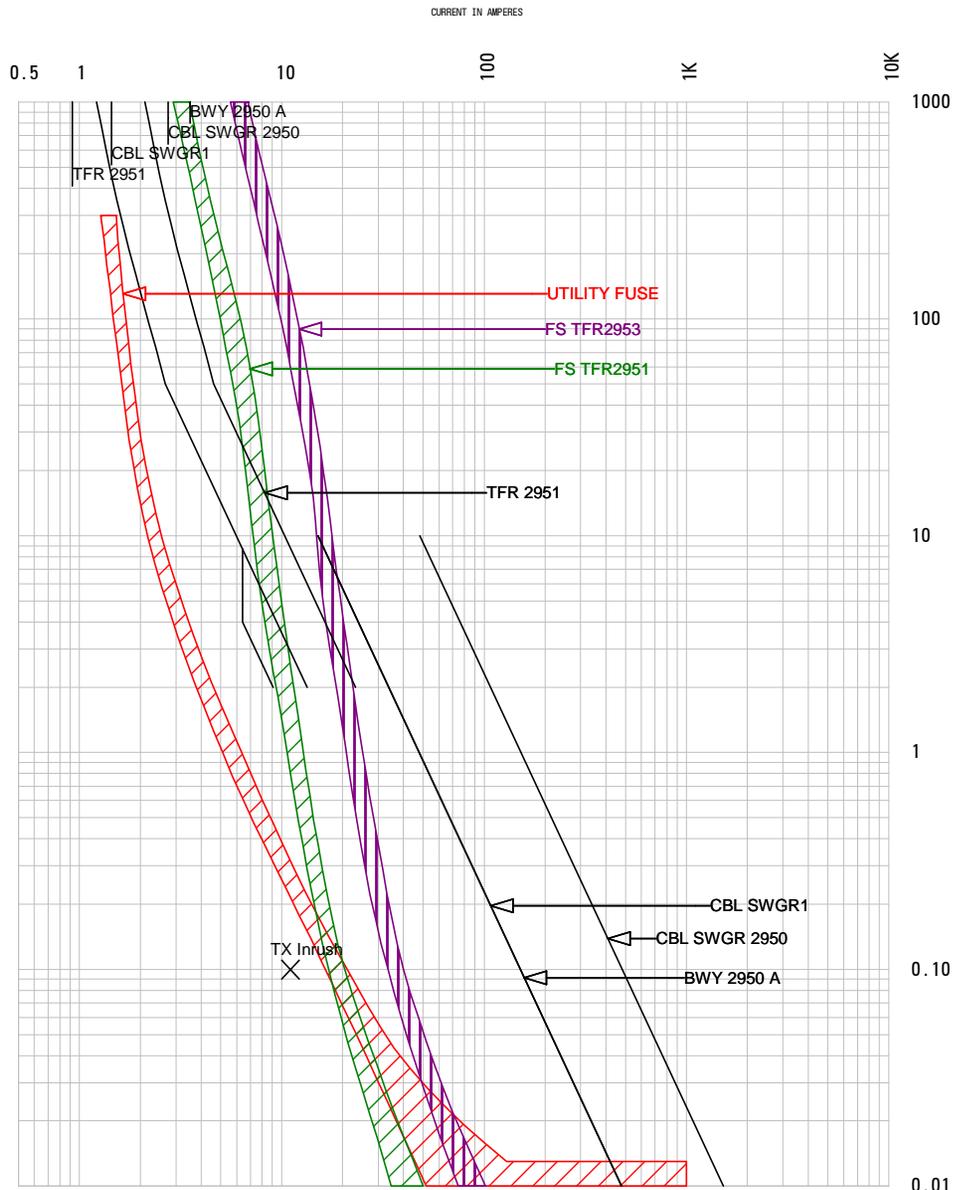


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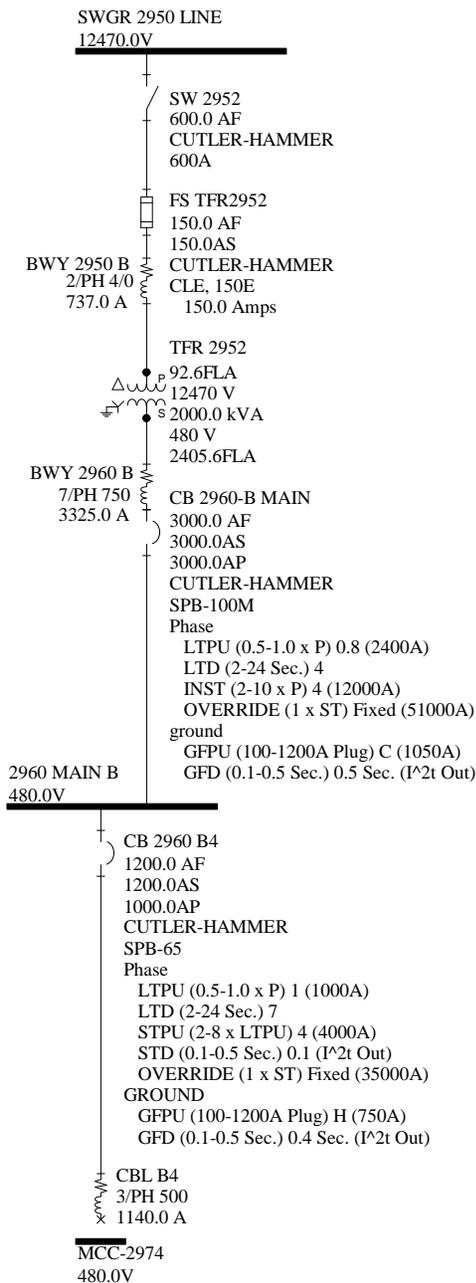
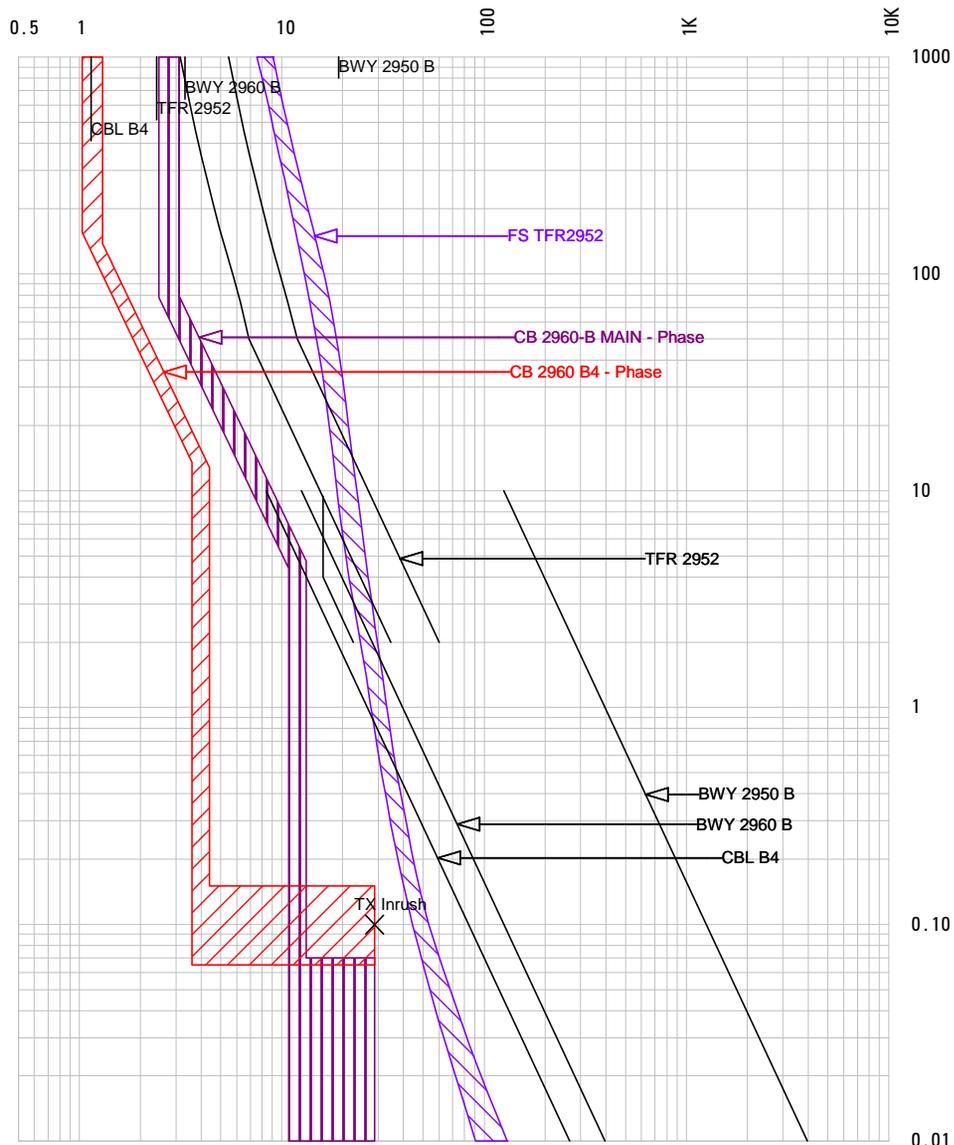


Actual Current=Displayed Current x 100 at 12470 V



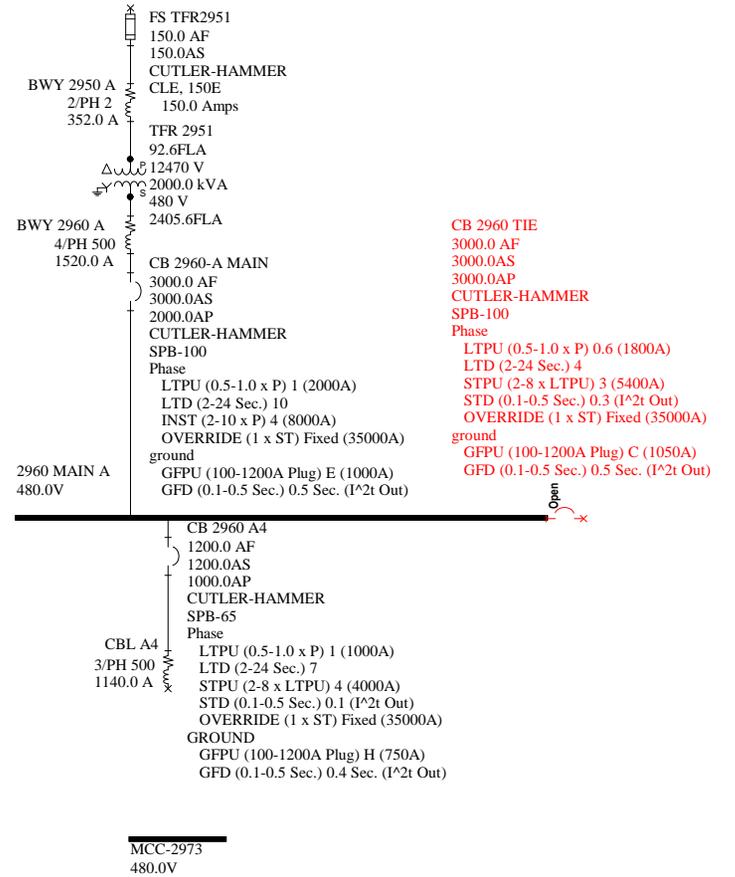
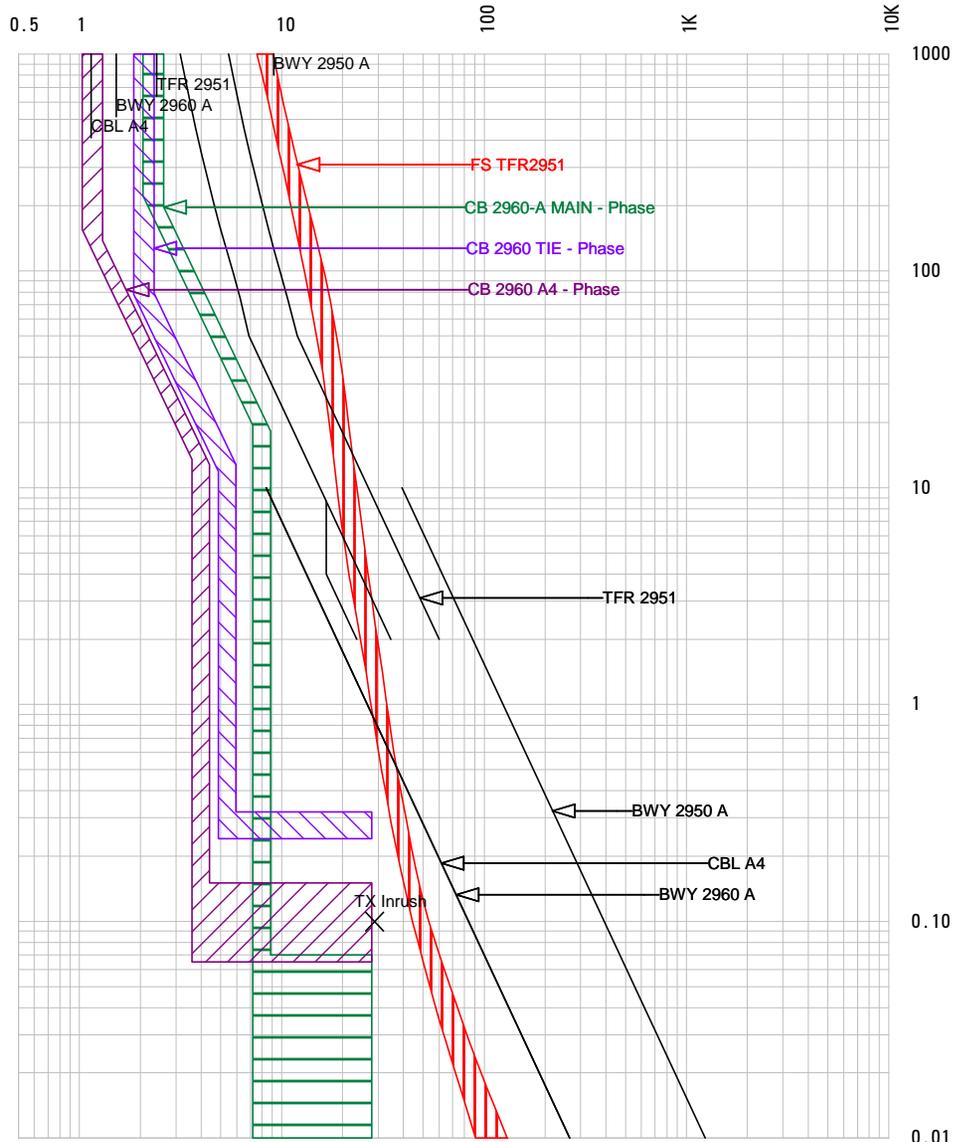
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CURRENT IN AMPERES

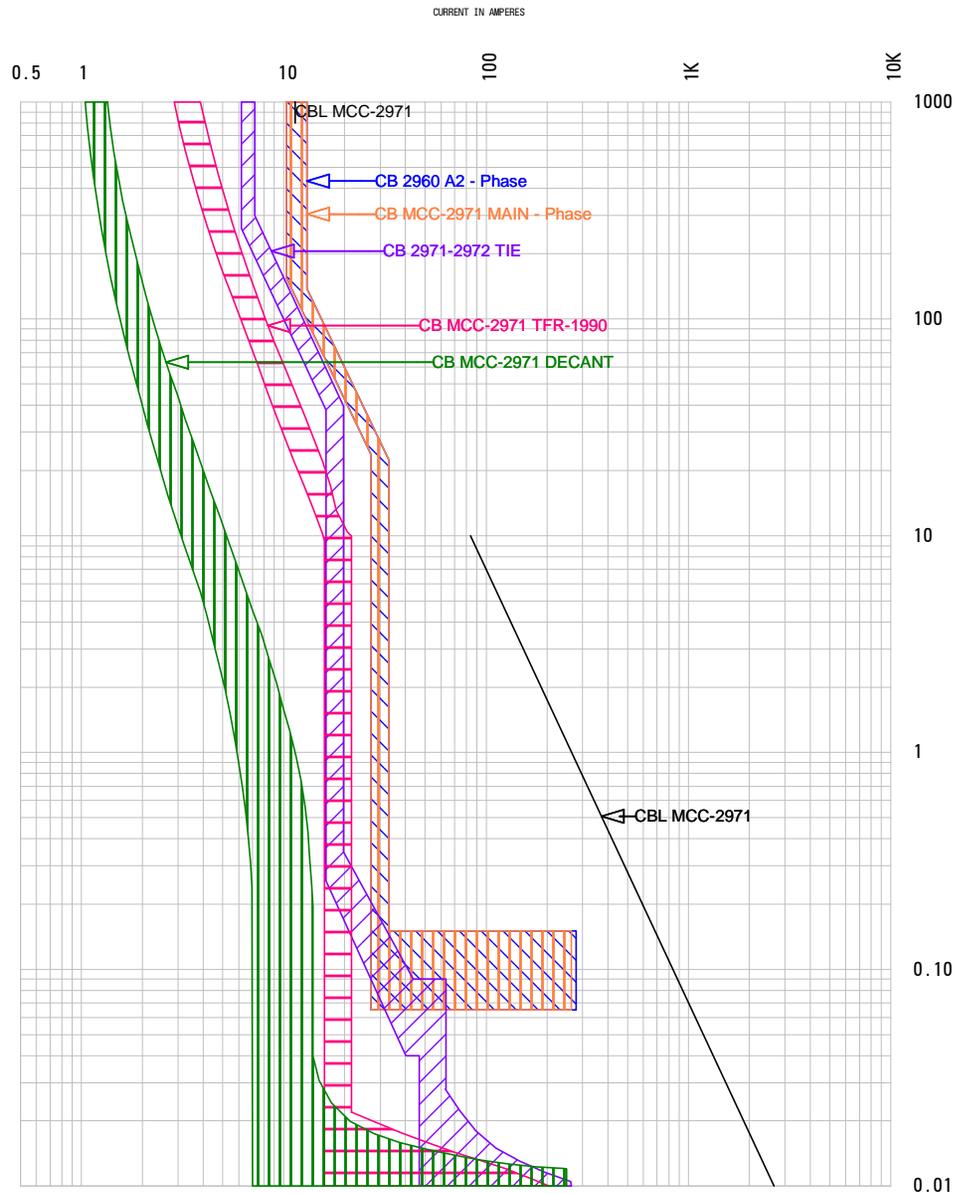


Actual Current=Displayed Current x 1000 at 480 V

CURRENT IN AMPERES

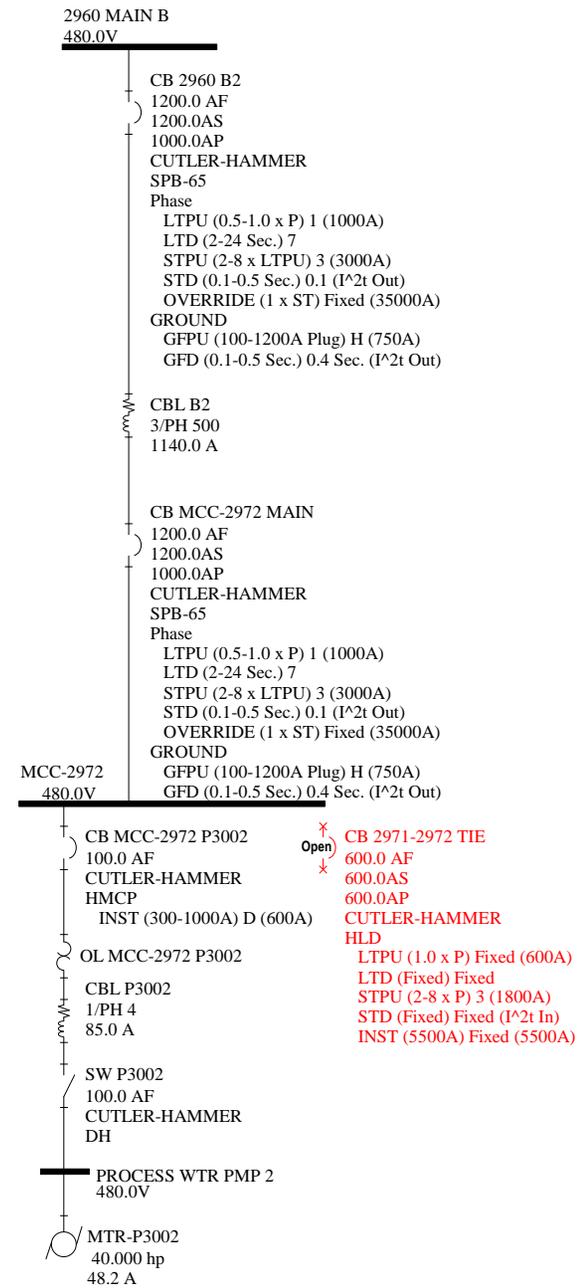
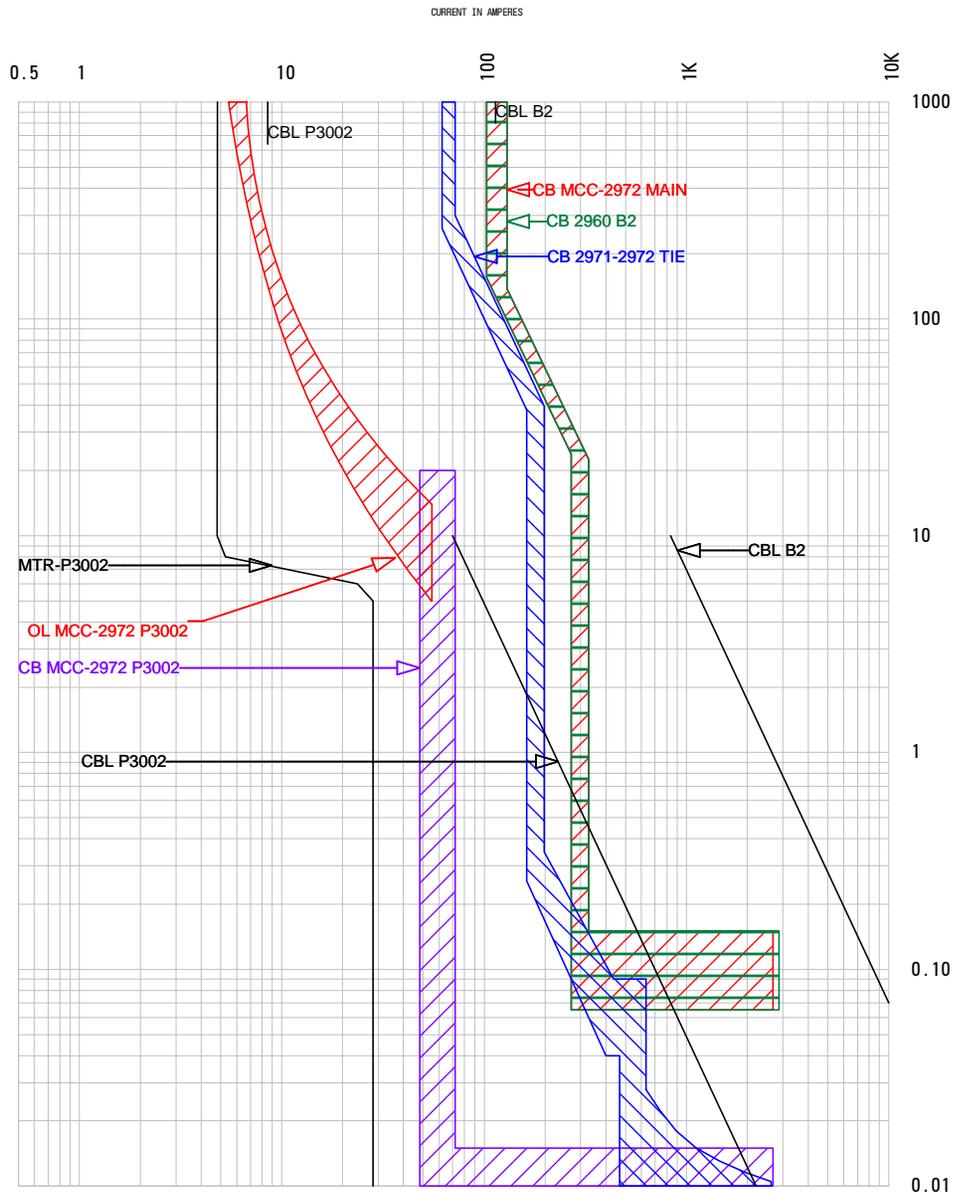


Actual Current=Displayed Current x 1000 at 480 V

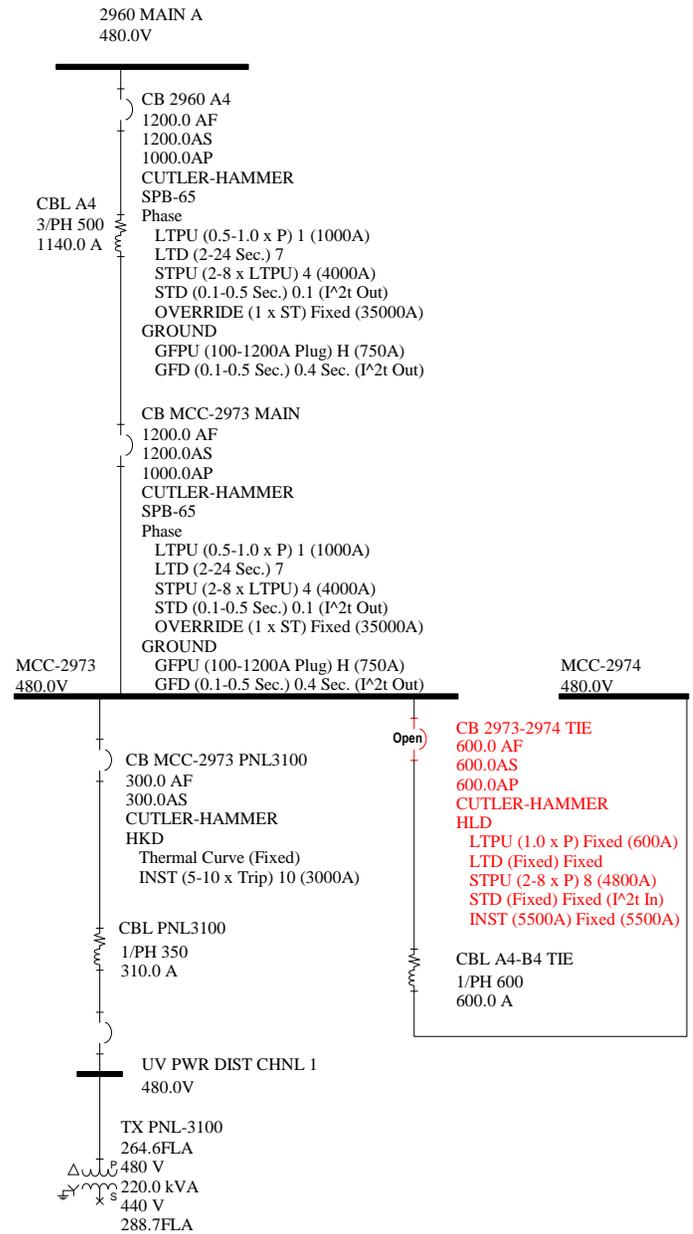
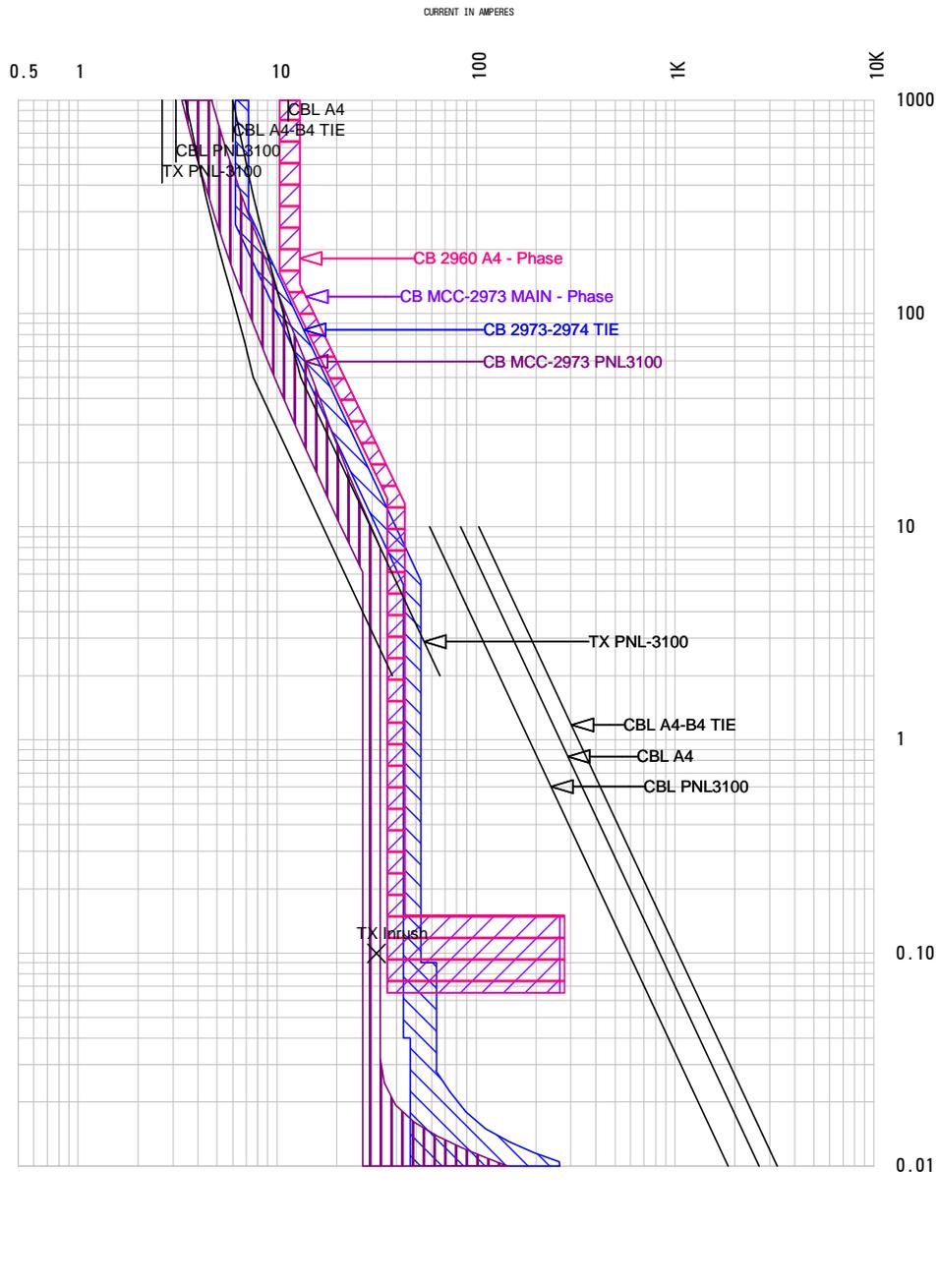


2960 MAIN A 480.0V	
CB 2960 A2 1200.0 AF 1200.0AS 1000.0AP CUTLER-HAMMER SPB-65 Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 3 (3000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)	
CBL MCC-2971 3/PH 500 1140.0 A	
CB MCC-2971 MAIN 1200.0 AF 1200.0AS 1000.0AP CUTLER-HAMMER SPB-65 Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 3 (3000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFPU (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)	
	CB 2971-2972 TIE 600.0 AF 600.0AS 600.0AP CUTLER-HAMMER HLD LTPU (1.0 x P) Fixed (600A) LTD (Fixed) Fixed STPU (2-8 x P) 3 (1800A) STD (Fixed) Fixed (I ² t In) INST (5500A) Fixed (5500A)
MCC-2971 480.0V	
CB MCC-2971 TFR-1990 250.0 AF 250.0AS CUTLER-HAMMER HJD Thermal Curve (Fixed) INST (5-10 x Trip) 7.5 (1875A)	
CB MCC-2971 DECANT 100.0 AF 100.0AS CUTLER-HAMMER HFD Fixed	

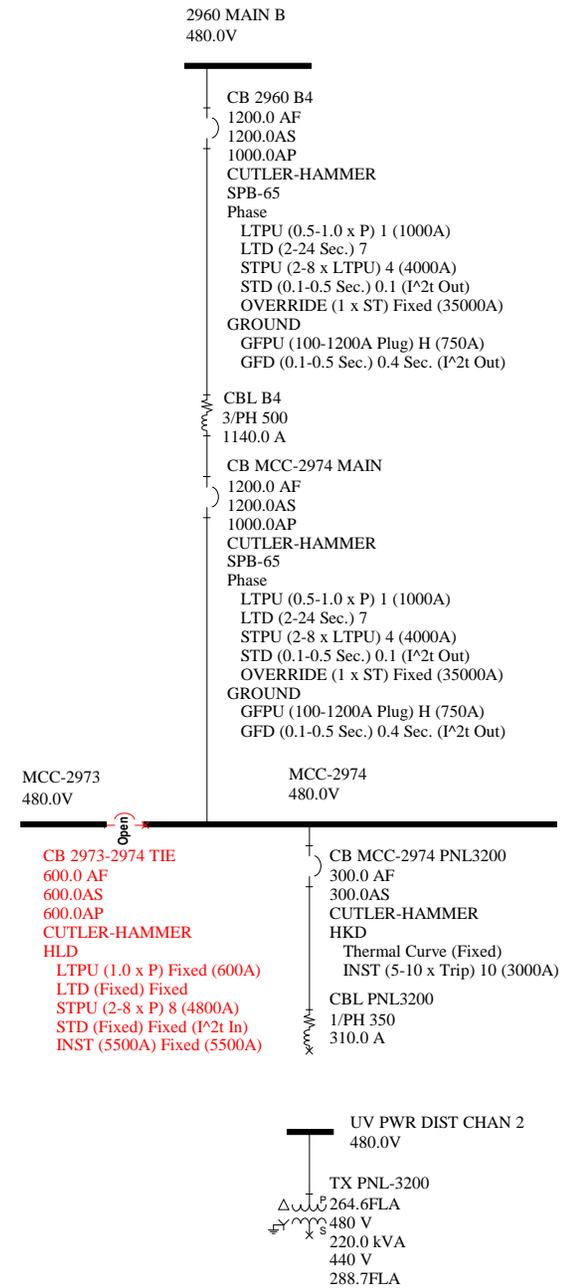
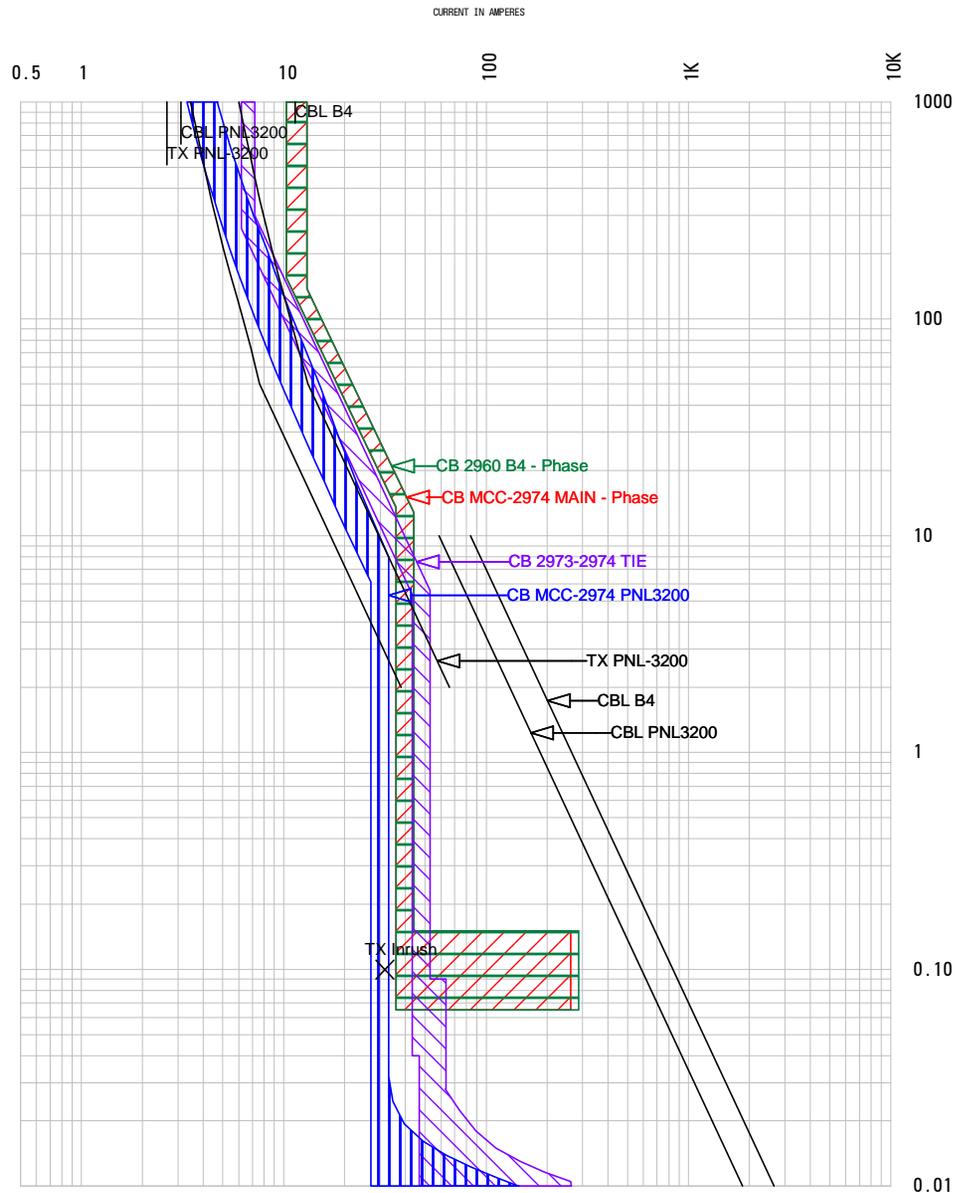
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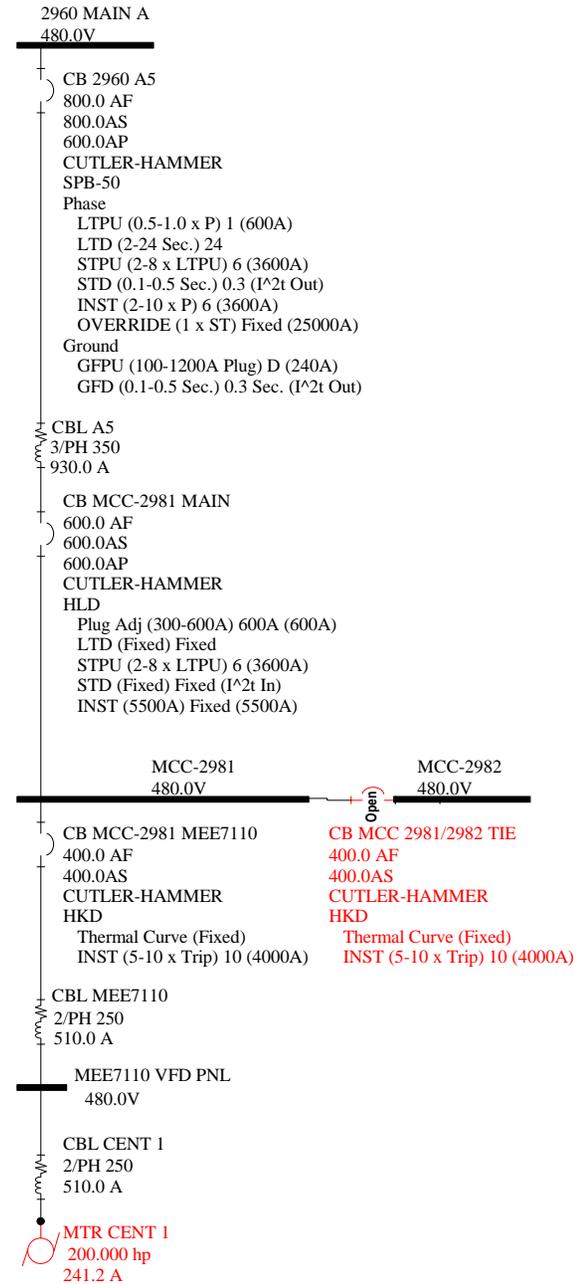
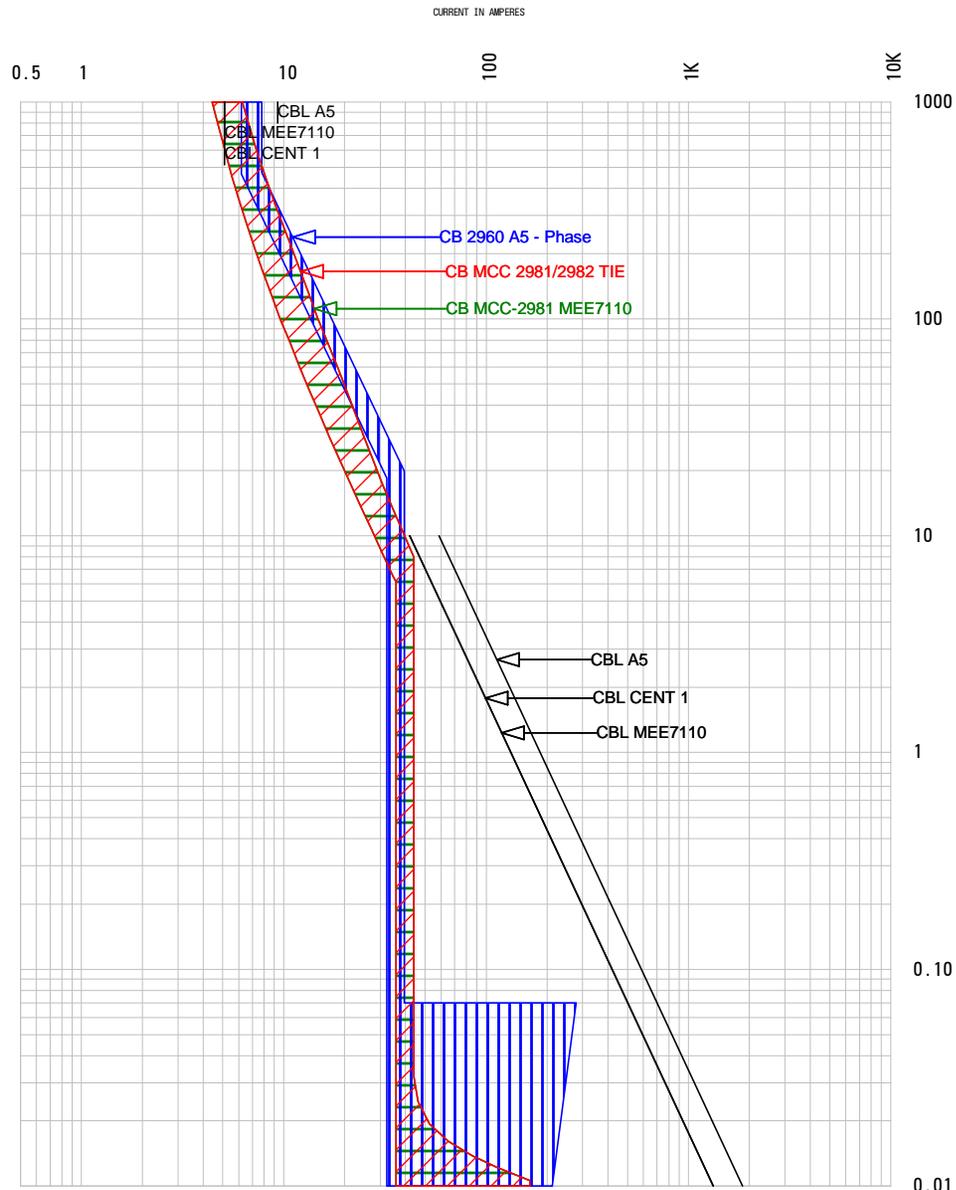
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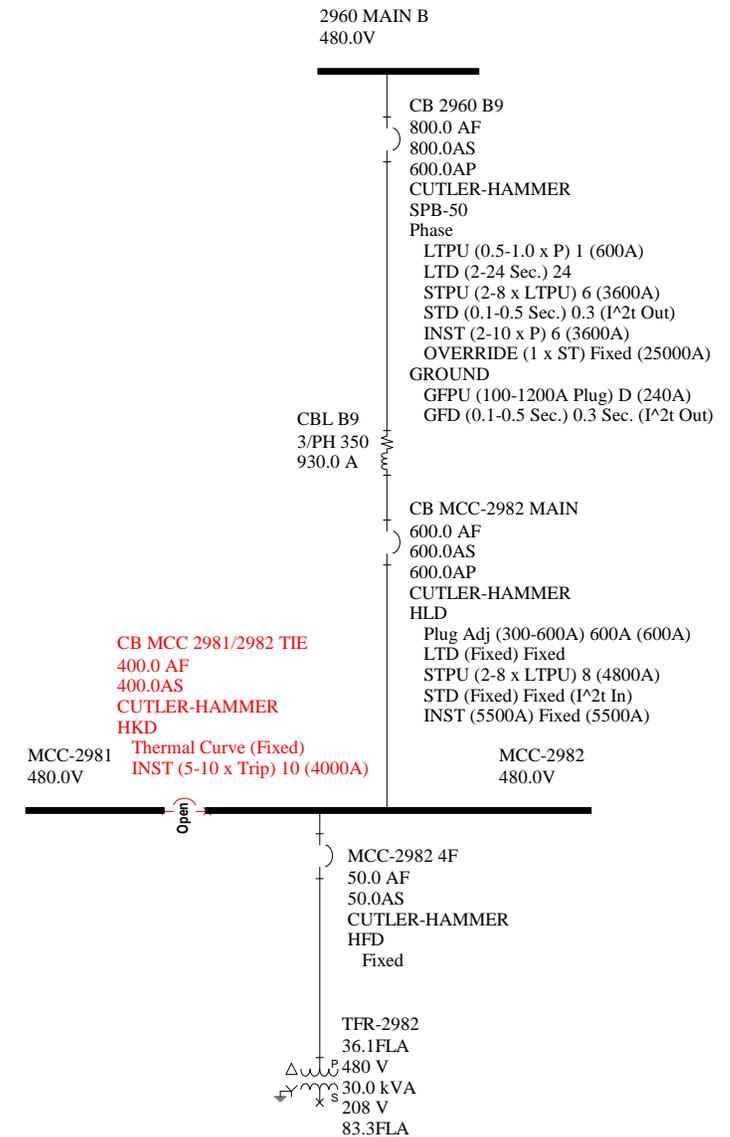
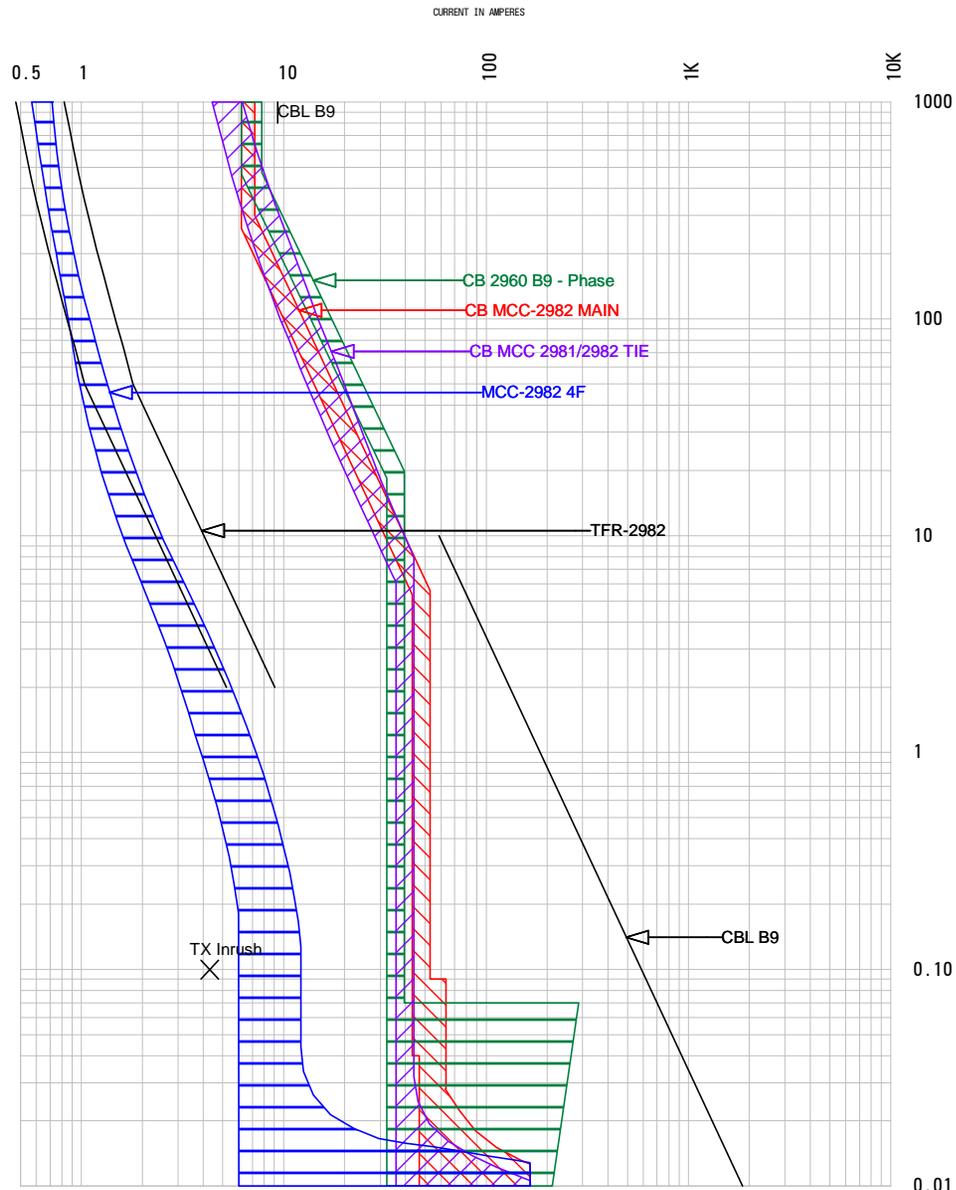
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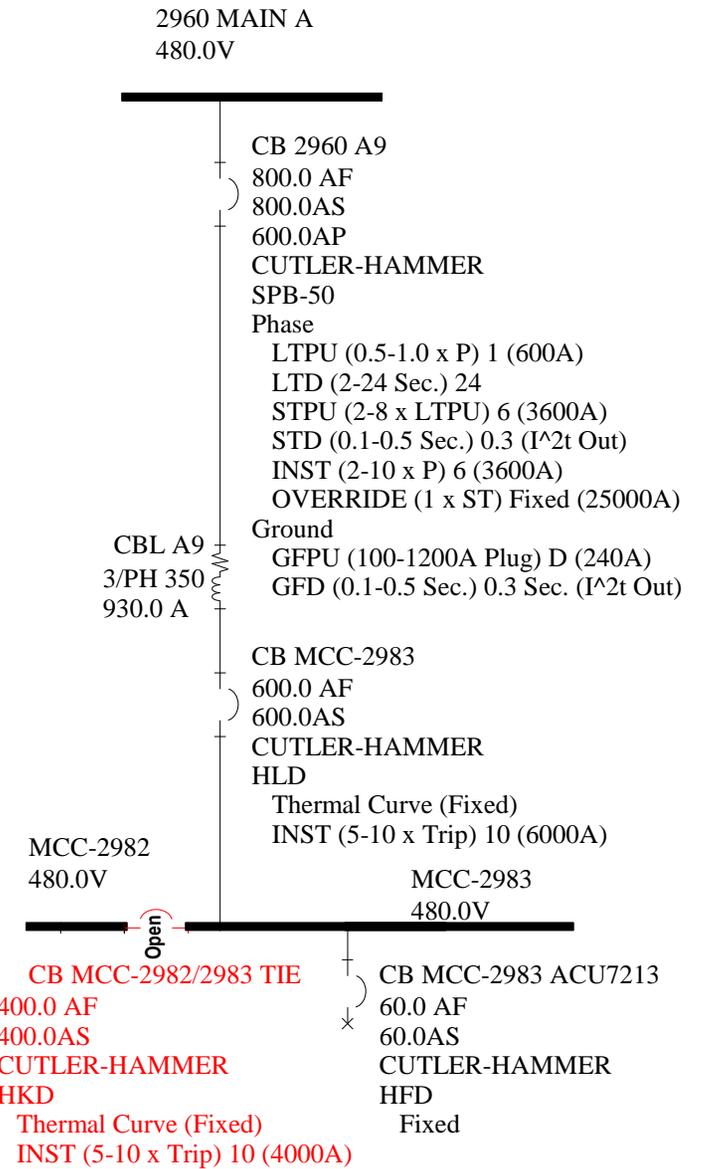
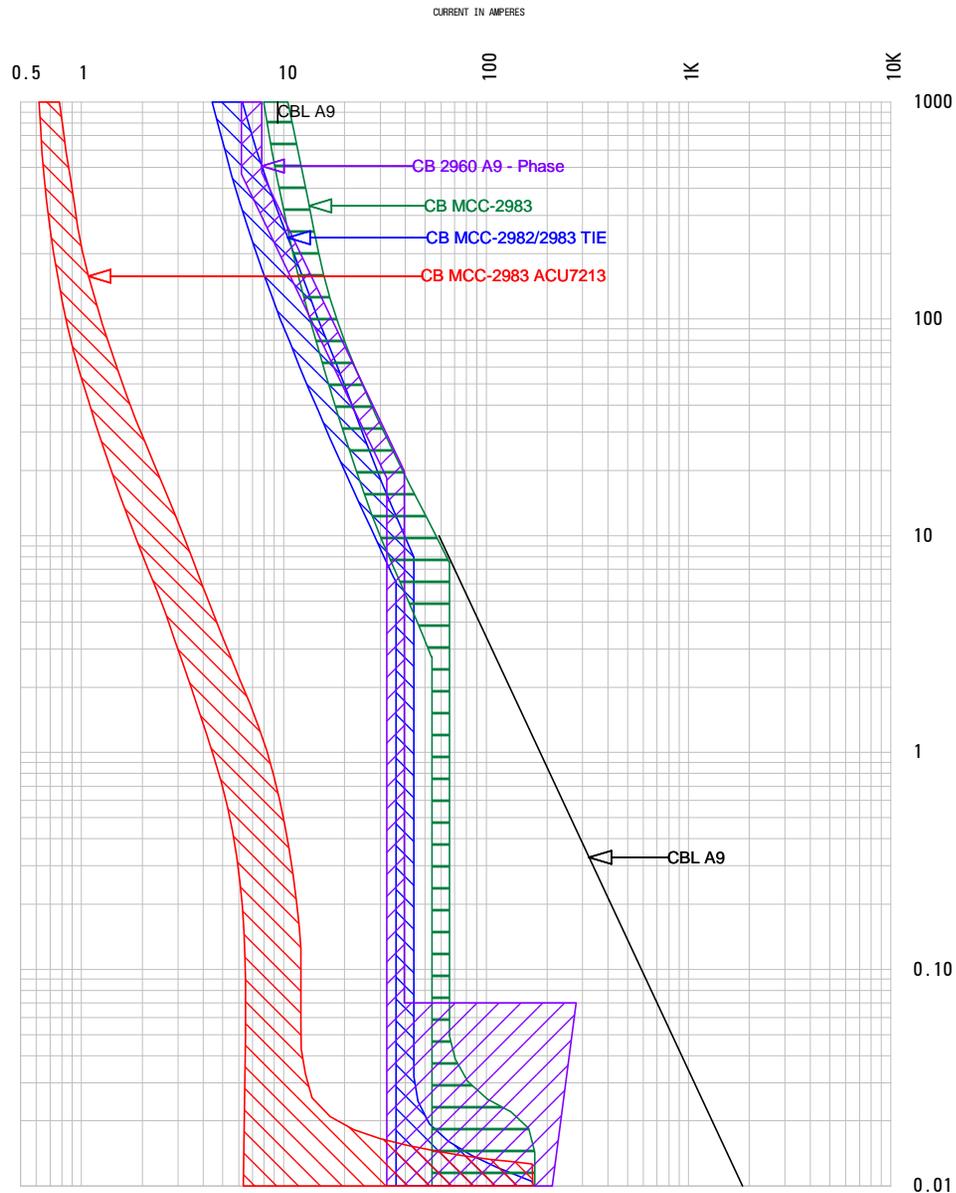
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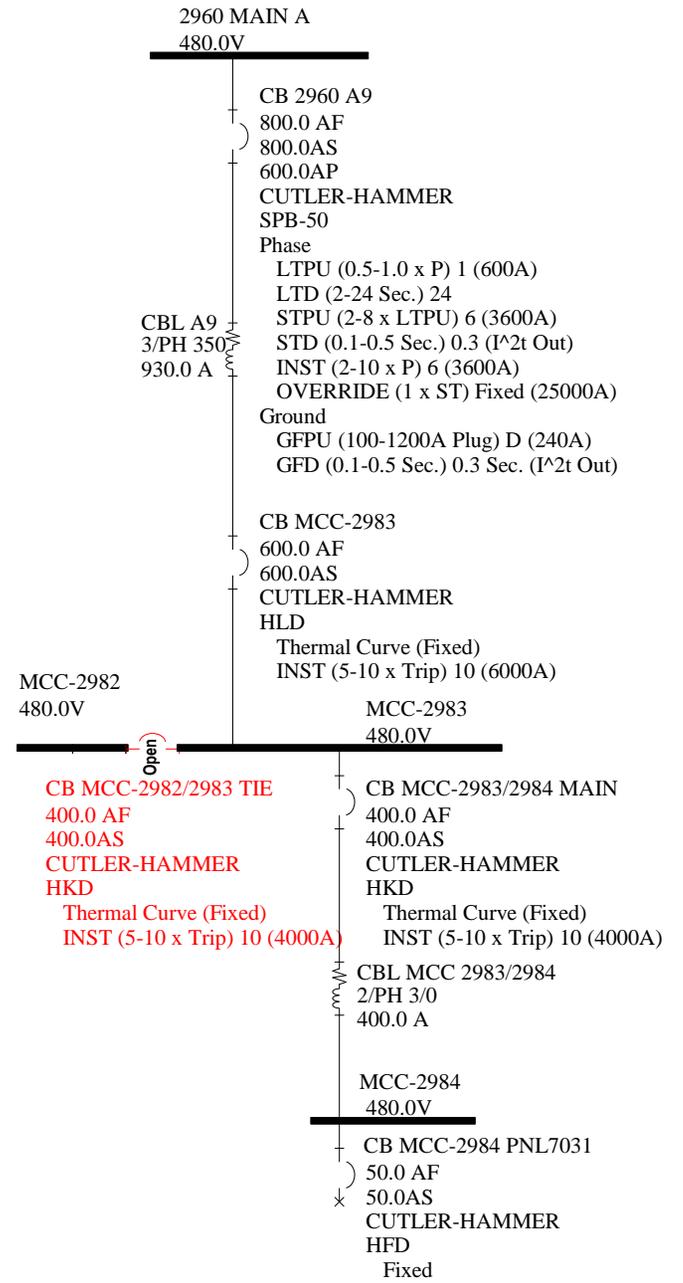
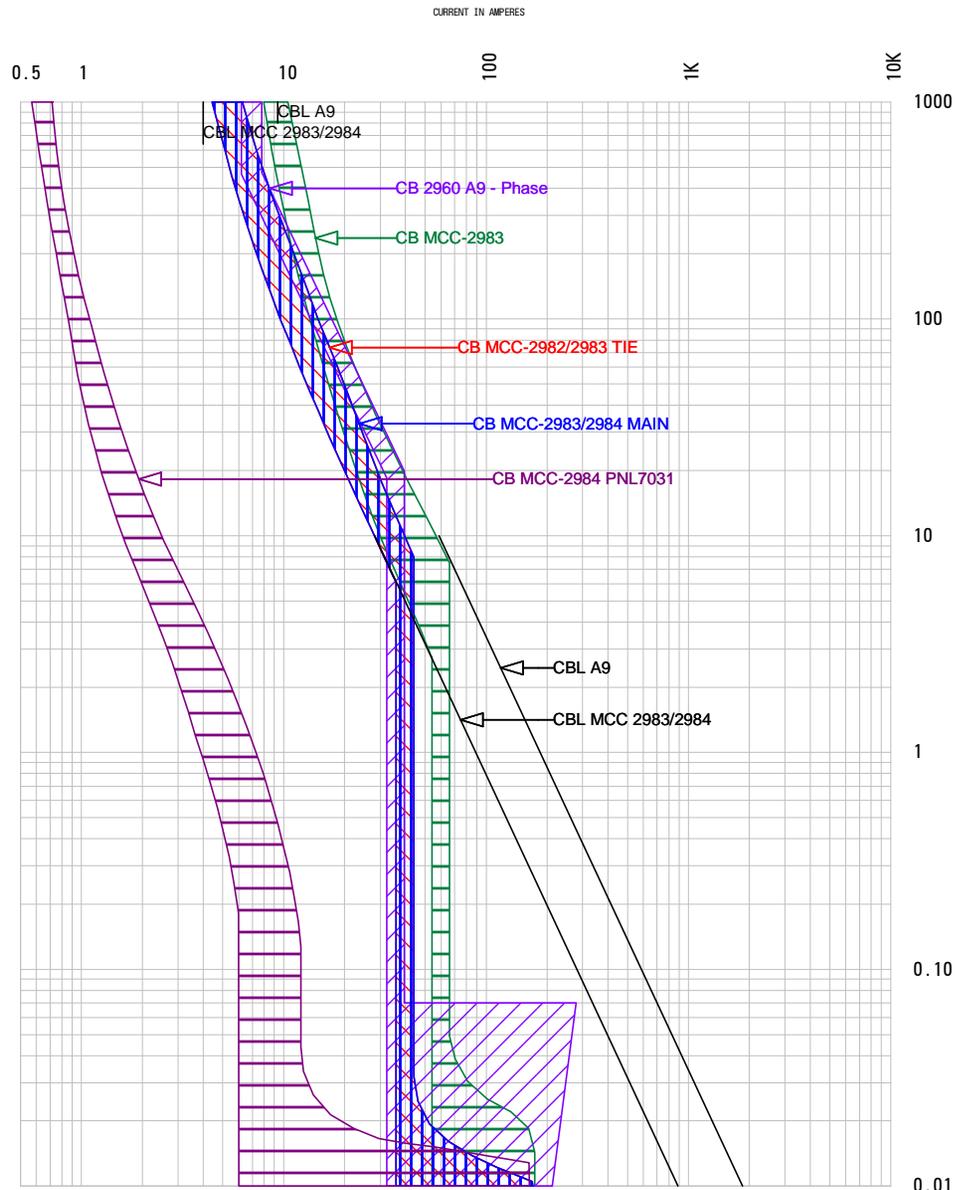
Actual Current=Displayed Current x 100 at 480 V



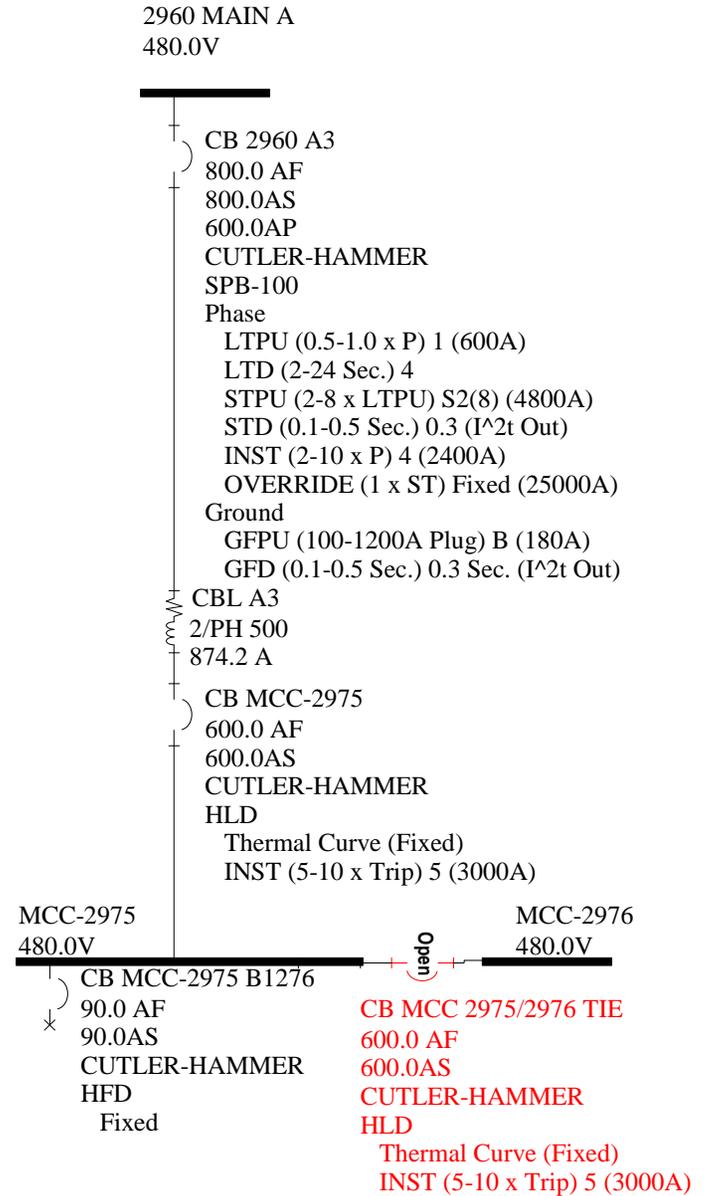
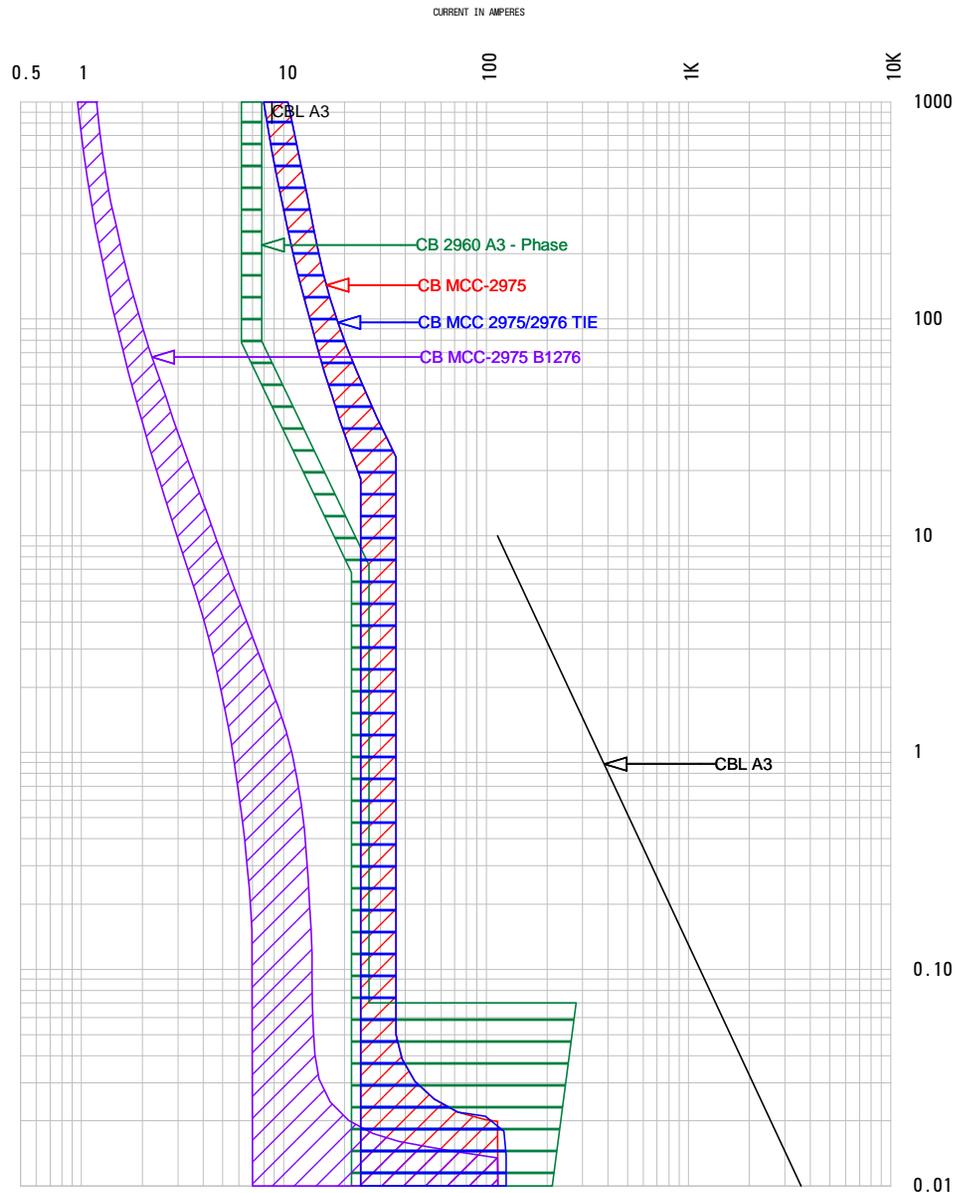
Actual Current=Displayed Current x 100 at 480 V



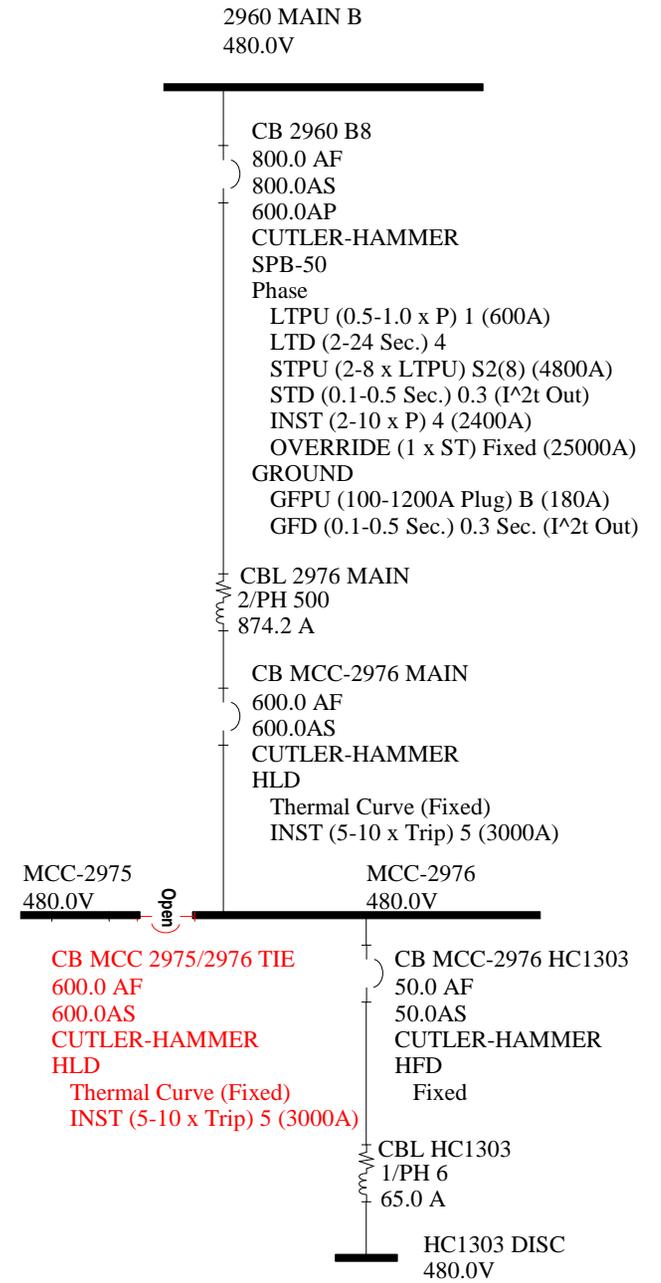
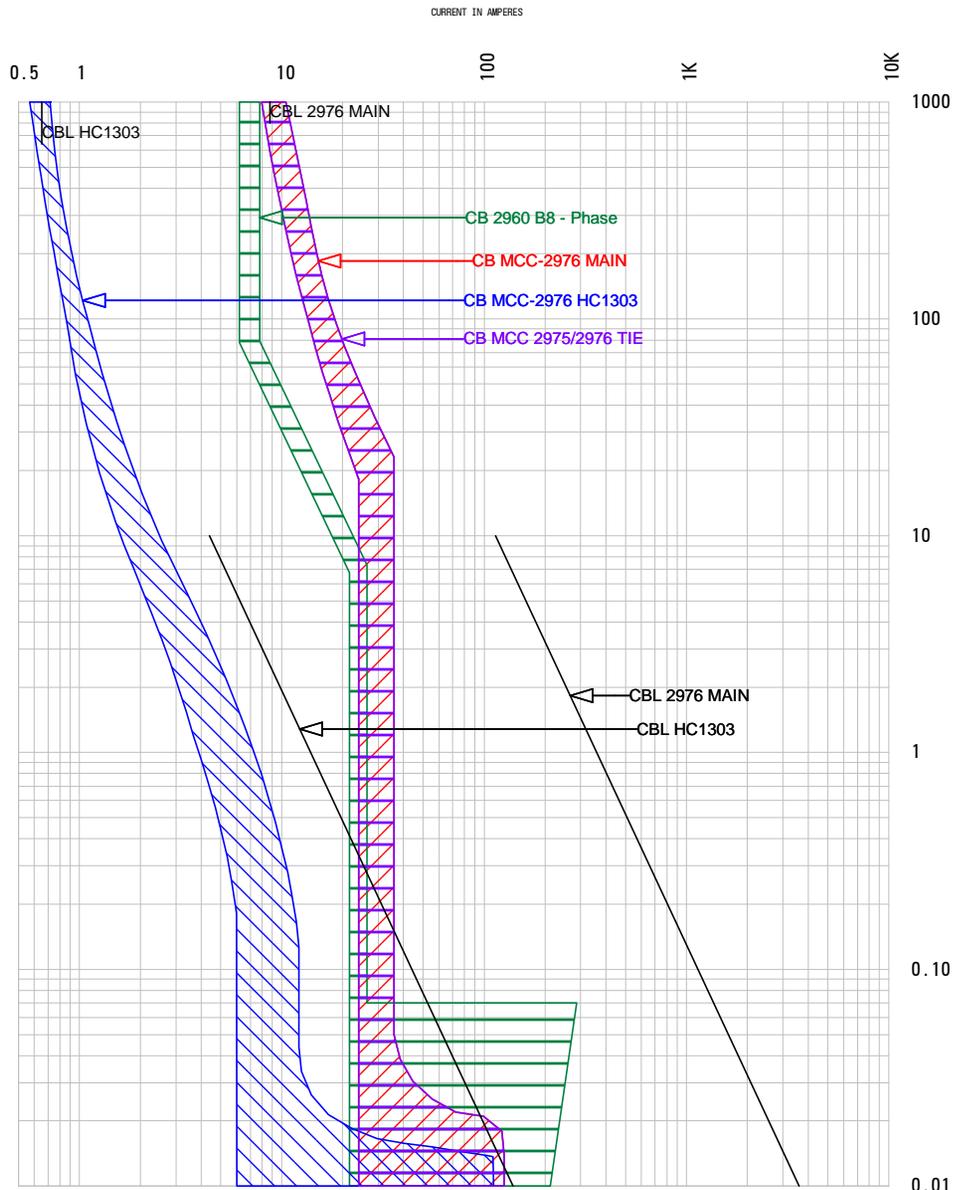
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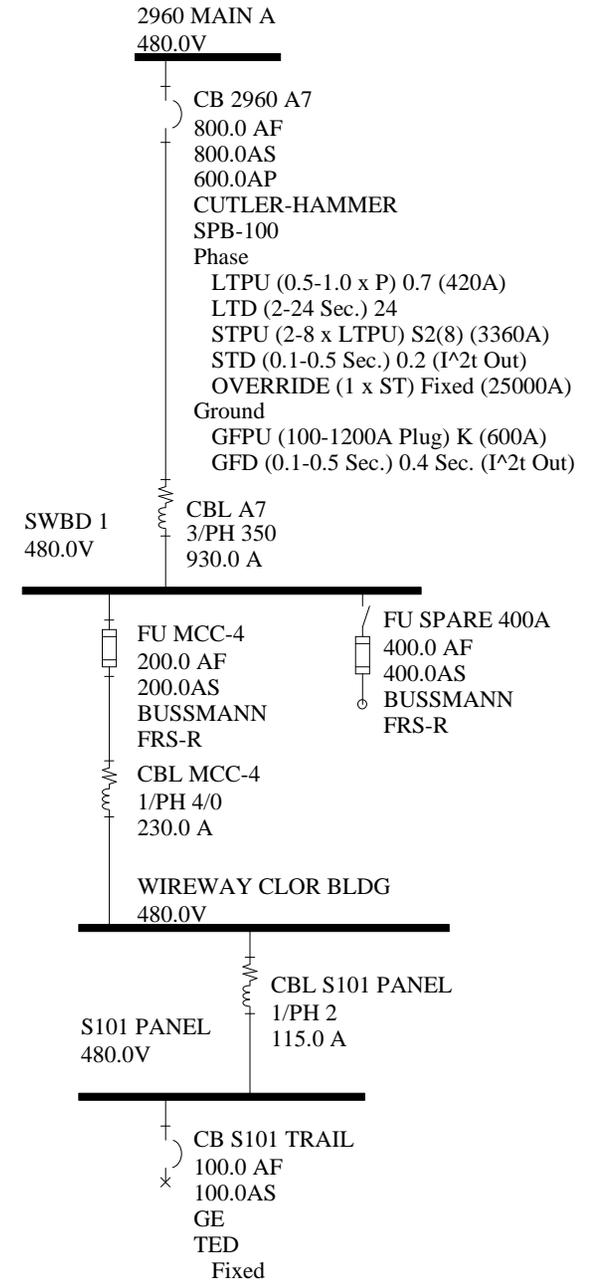
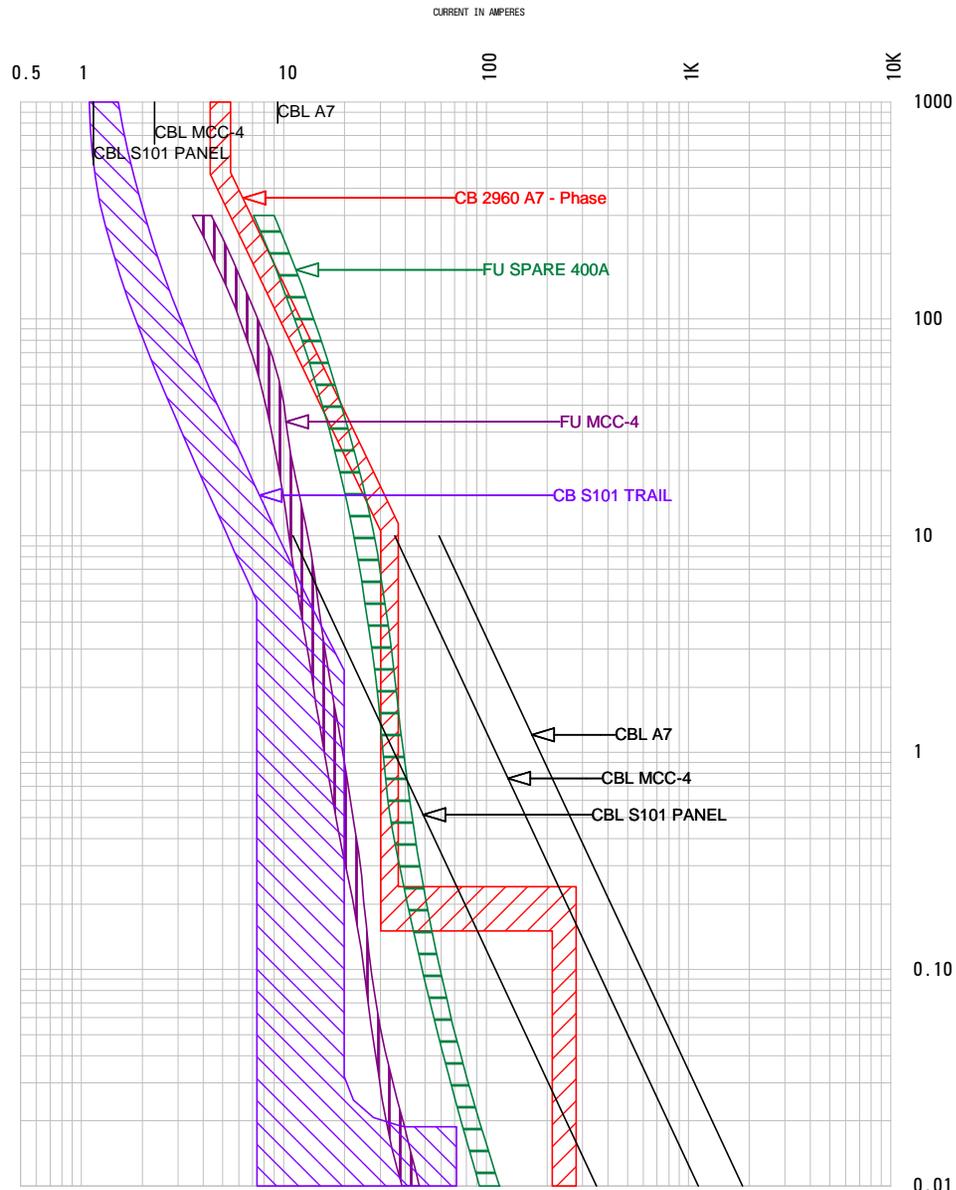
Actual Current=Displayed Current x 100 at 480 V



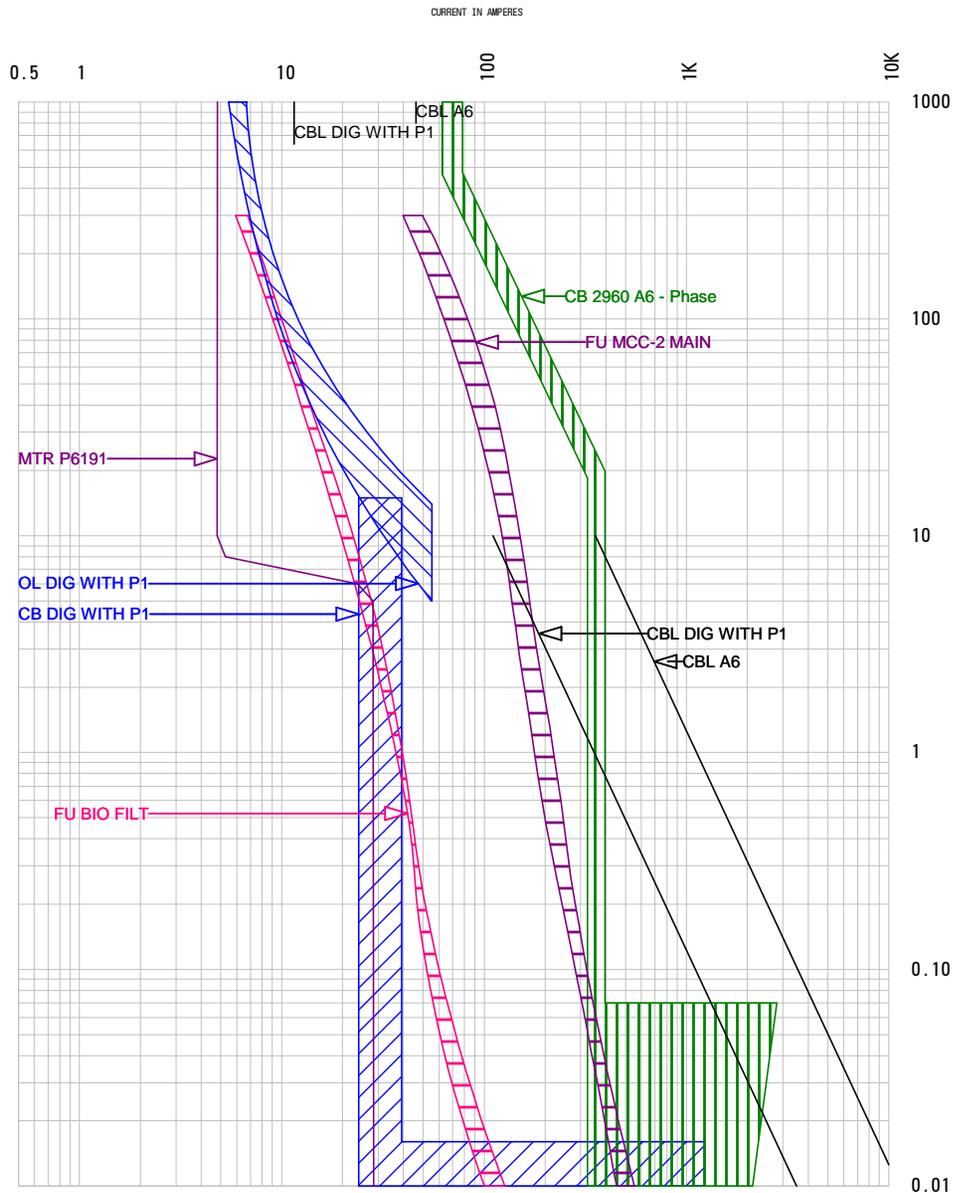
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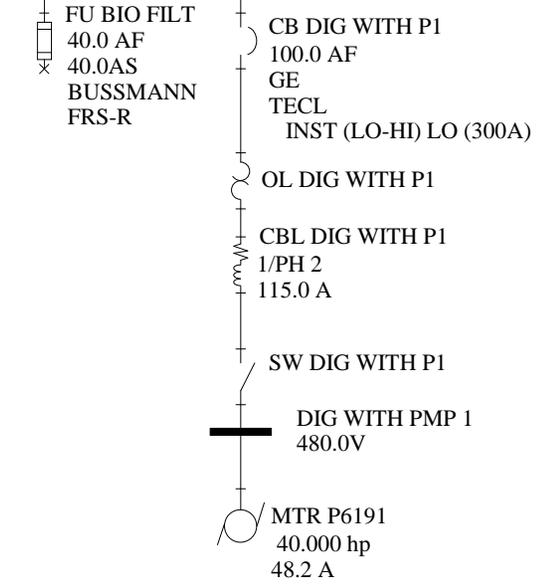
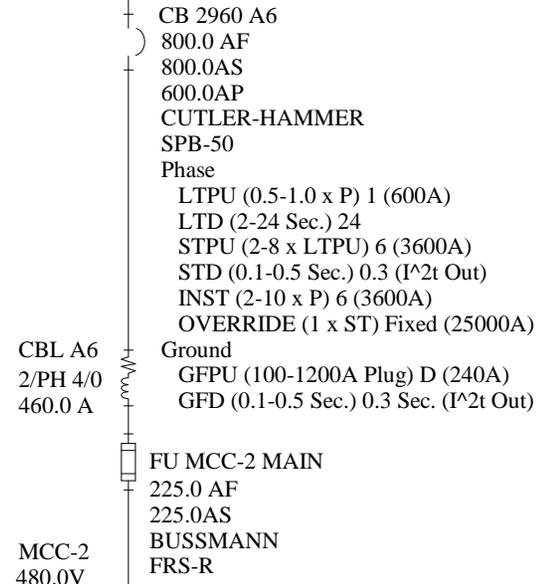
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Actual Current=Displayed Current x 100 at 480 V

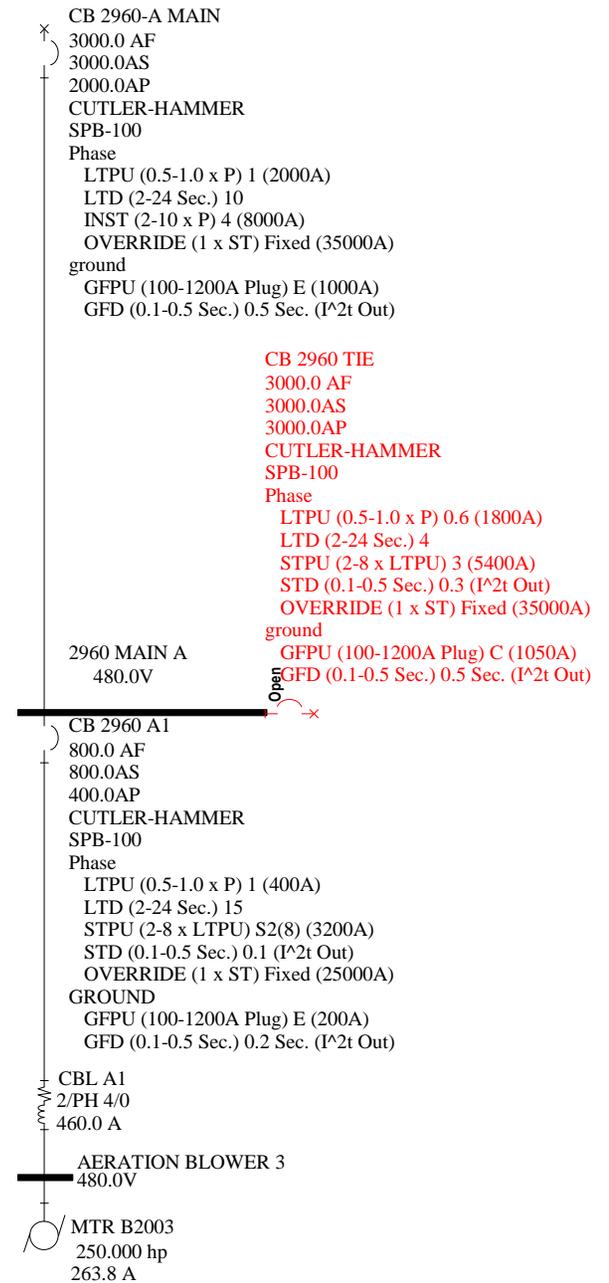
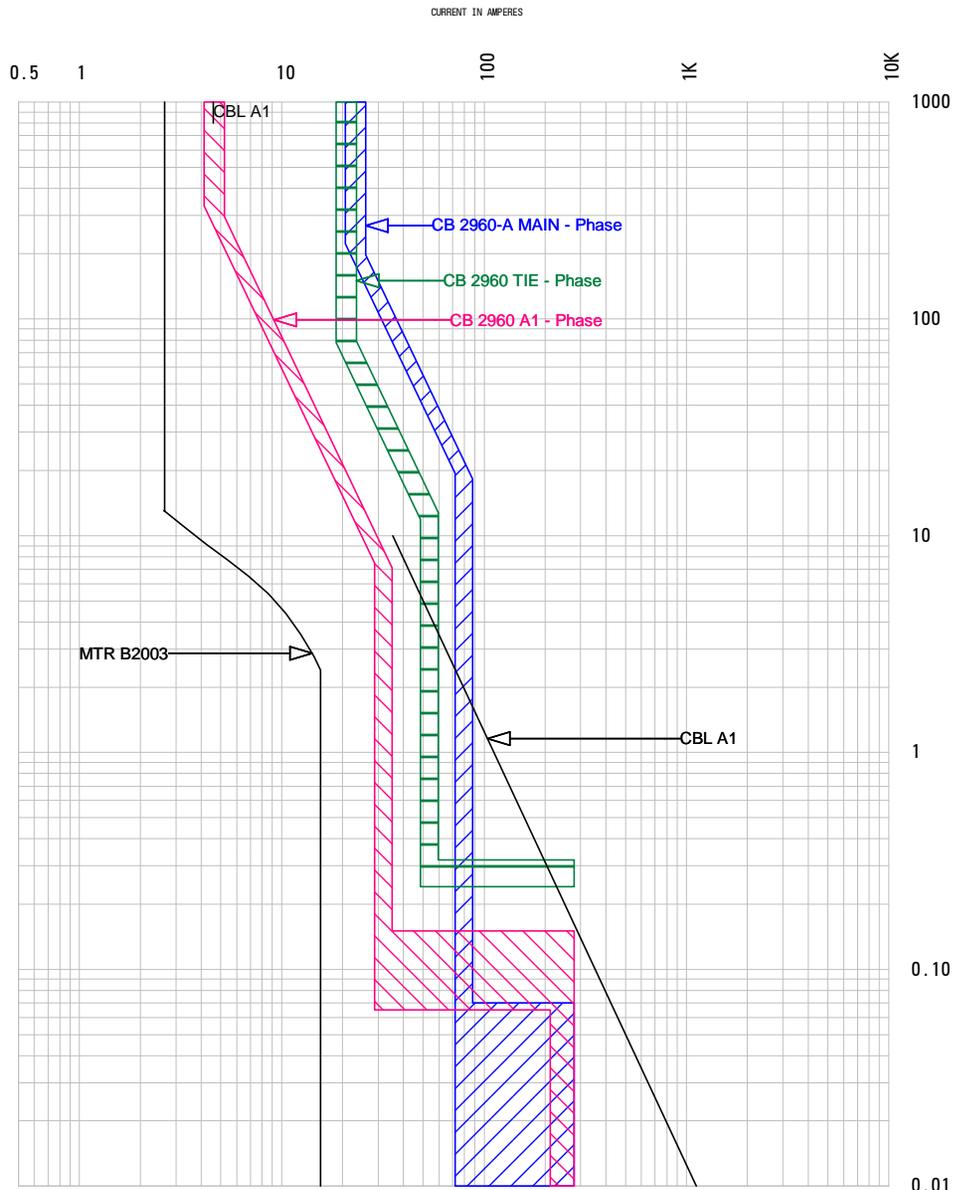


2960 MAIN A
480.0V

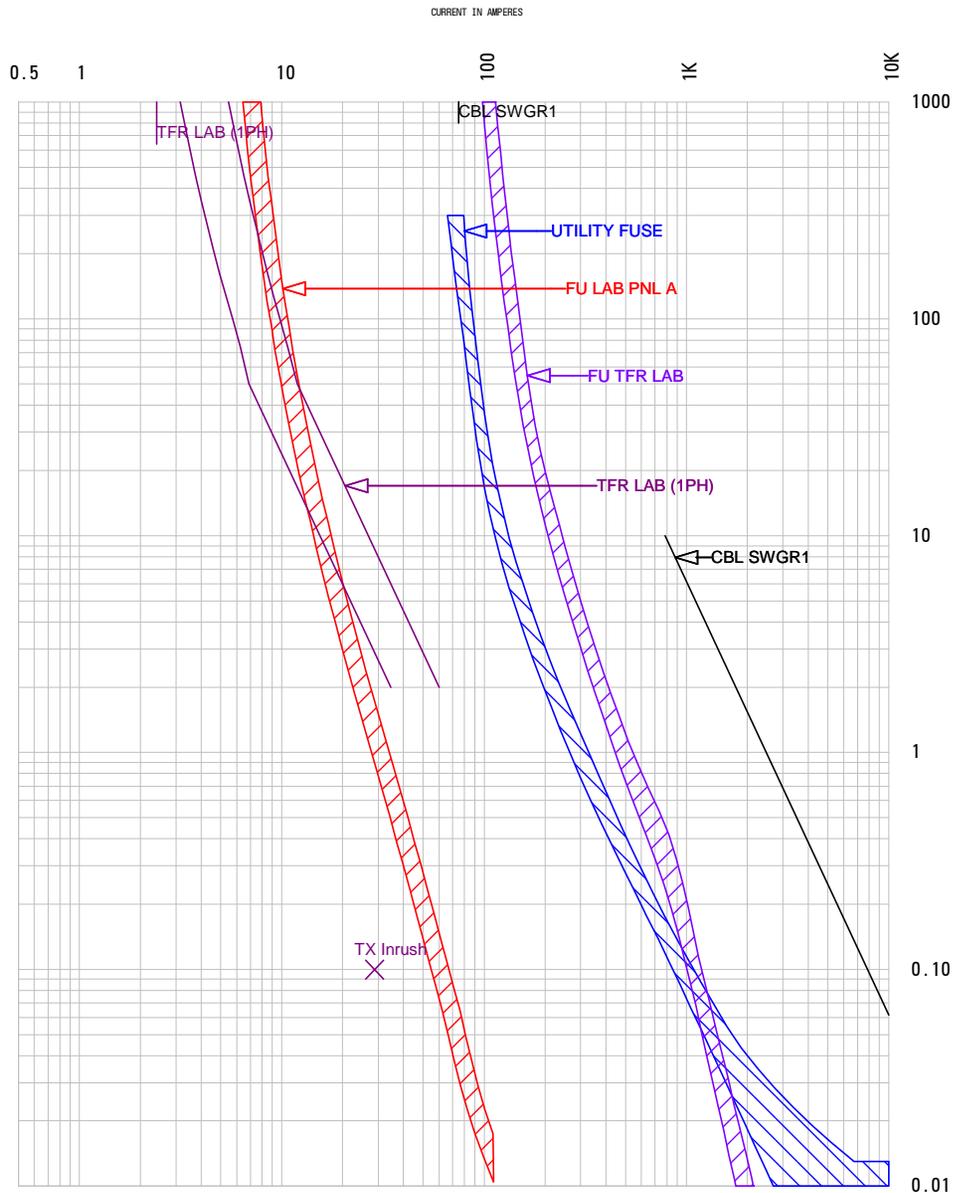


Actual Current=Displayed Current x 10 at 480 V

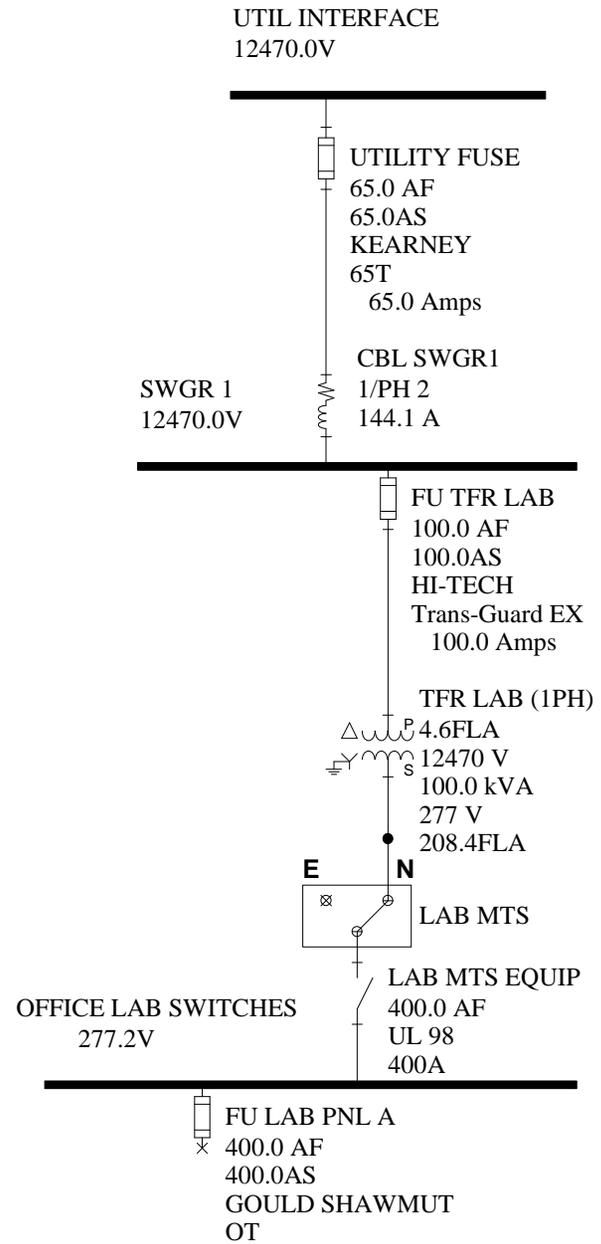


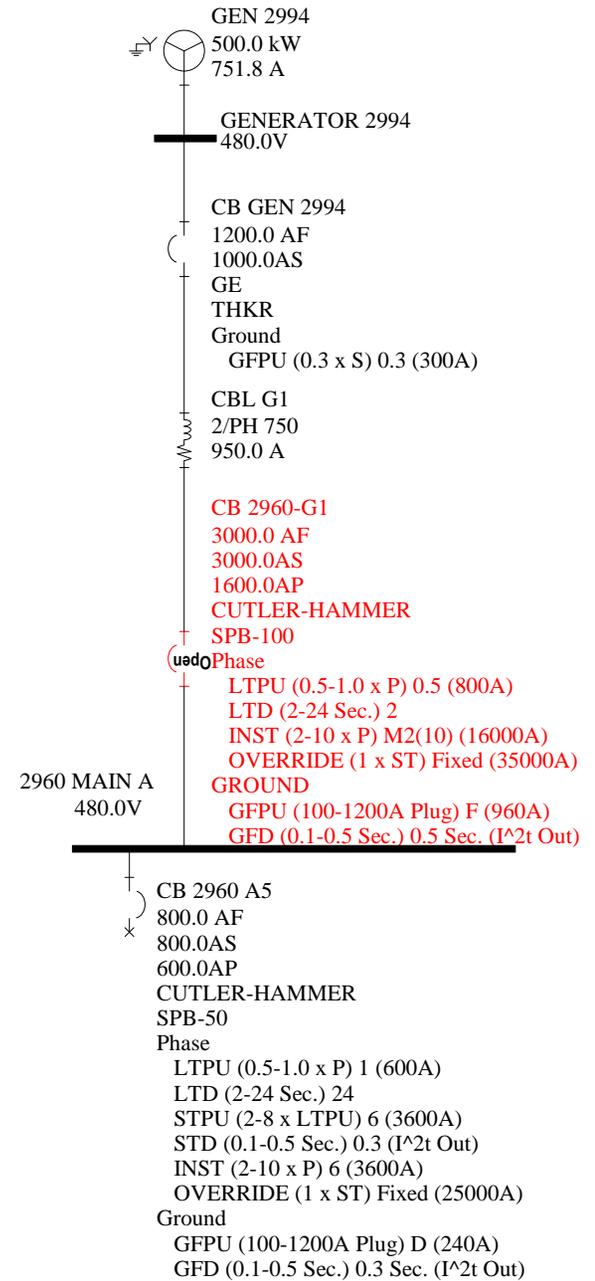
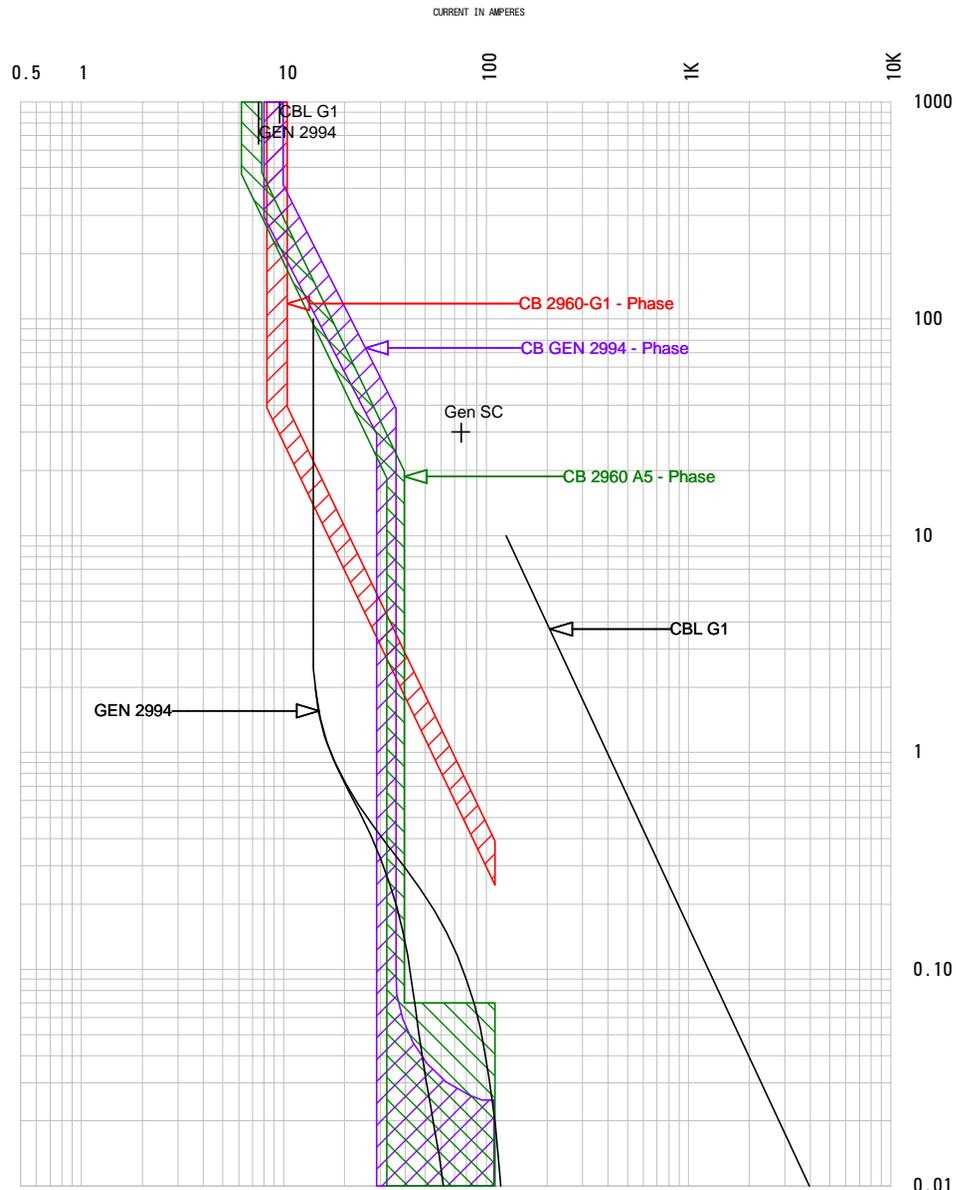


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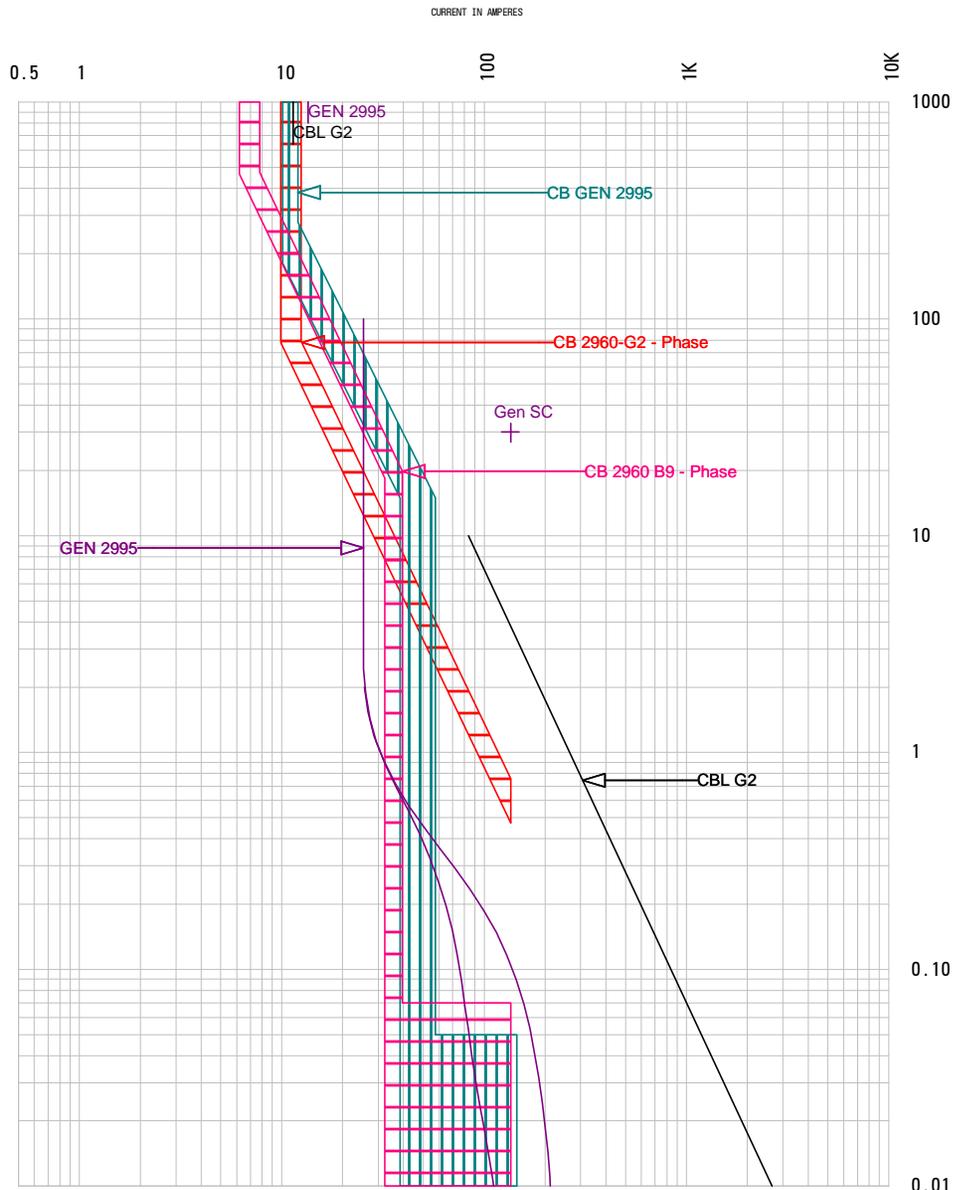


Actual Current=Displayed Current x 100 at 240 V

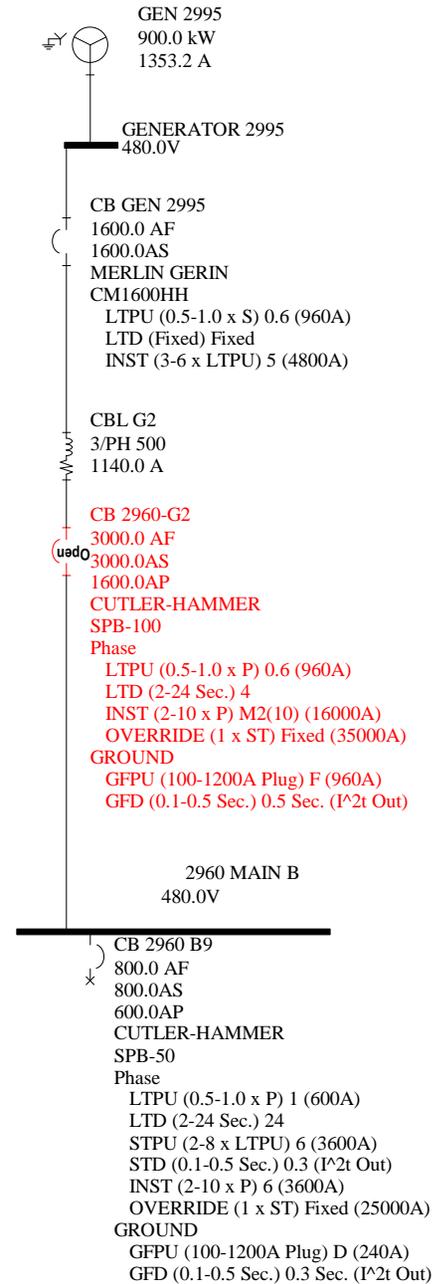


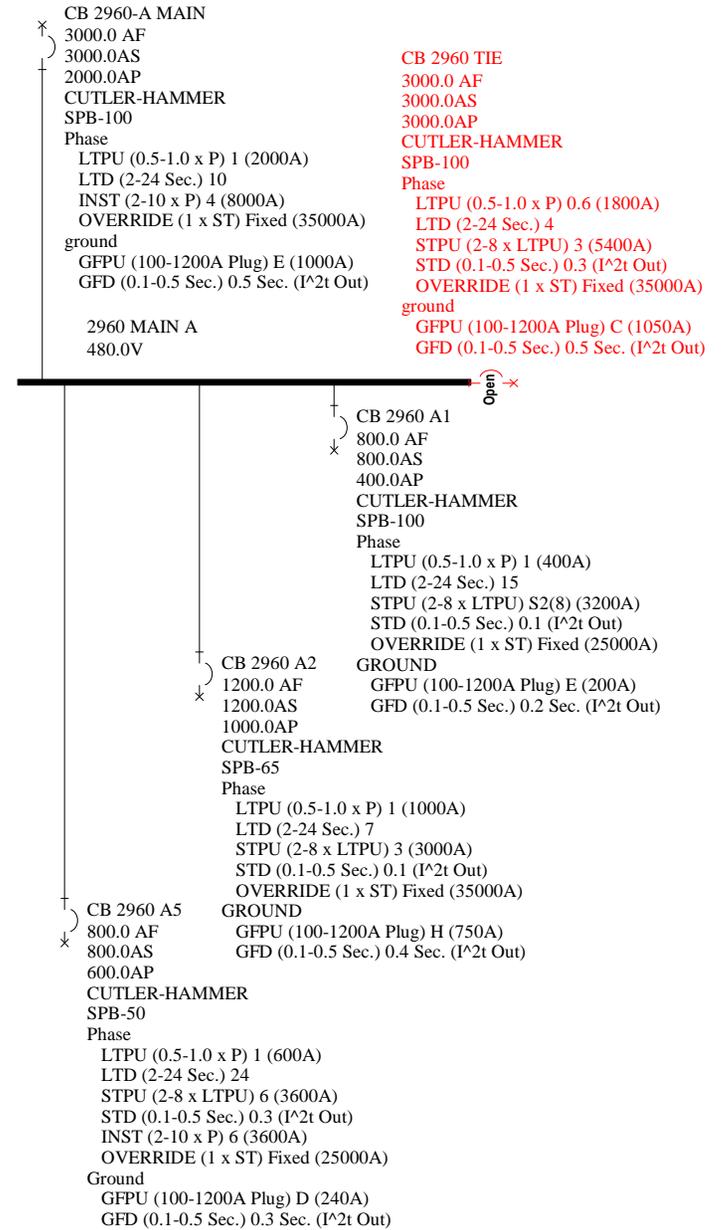
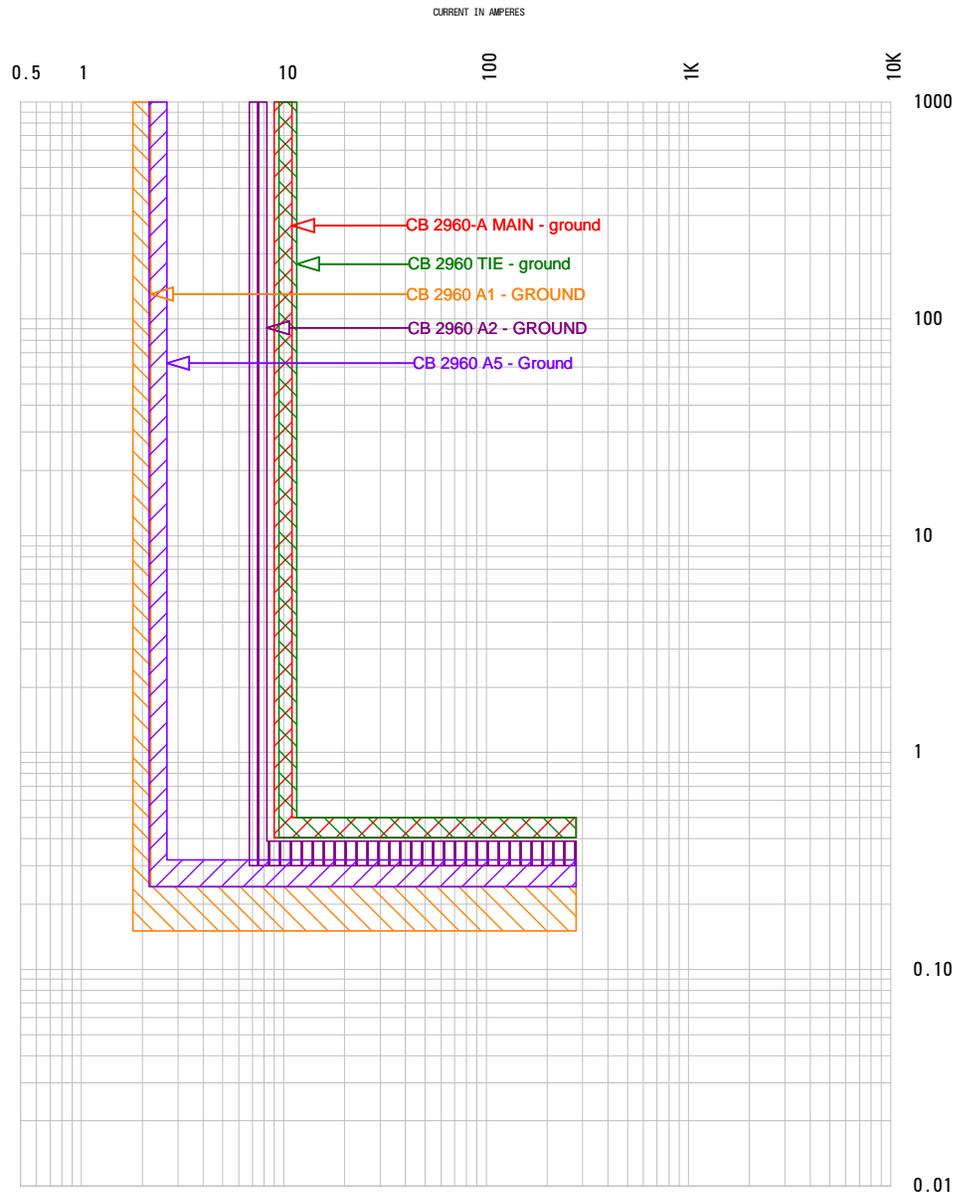


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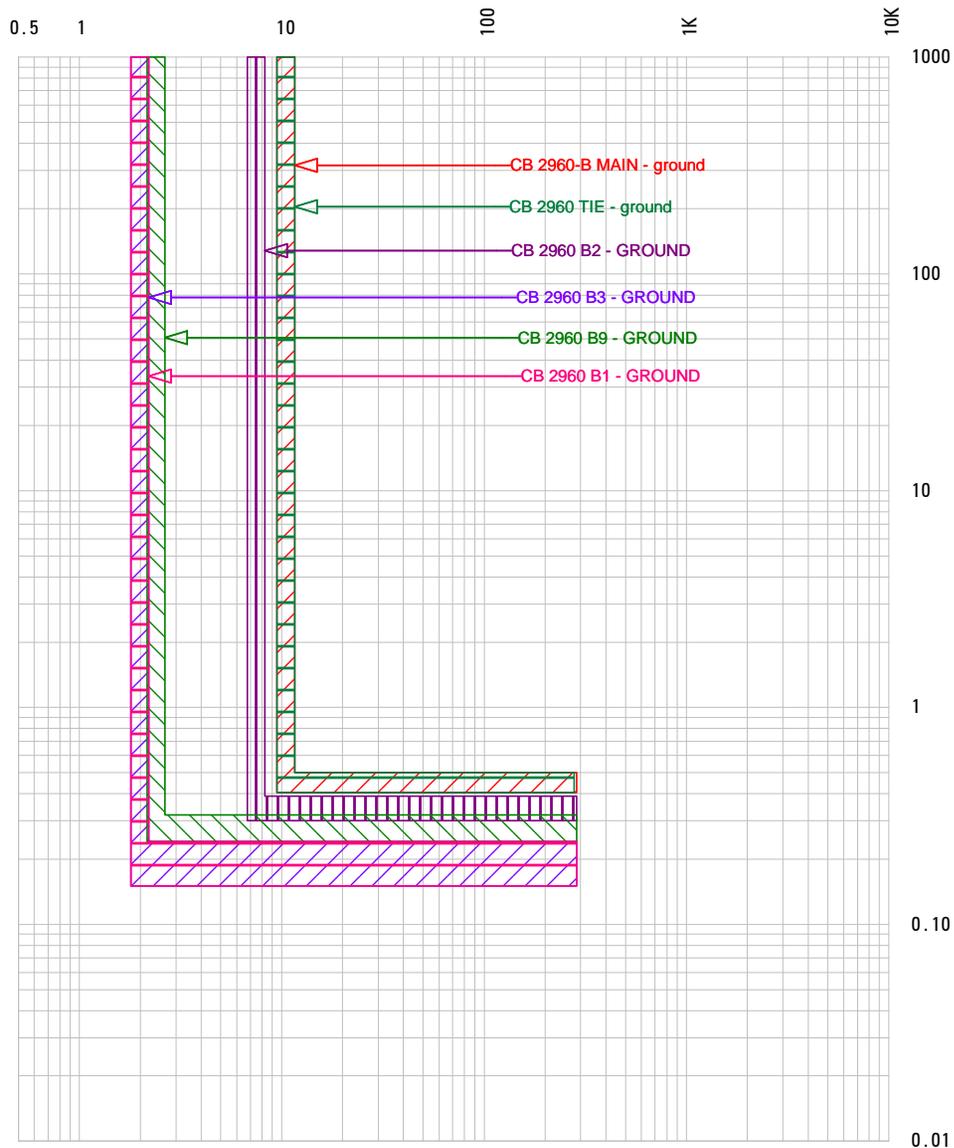
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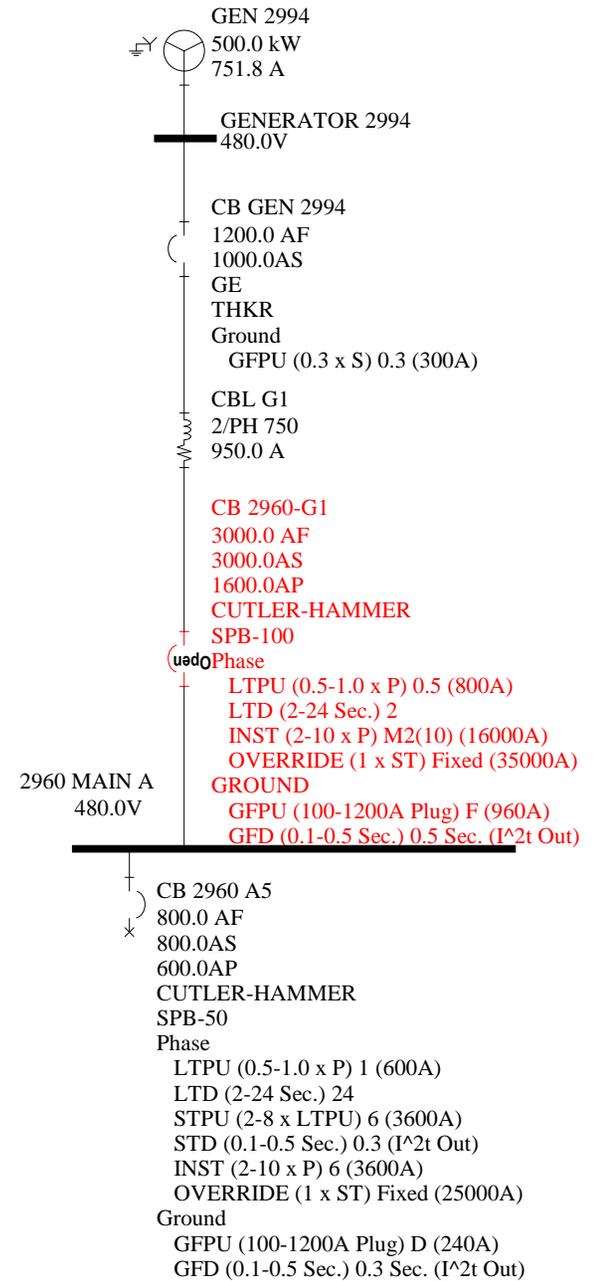
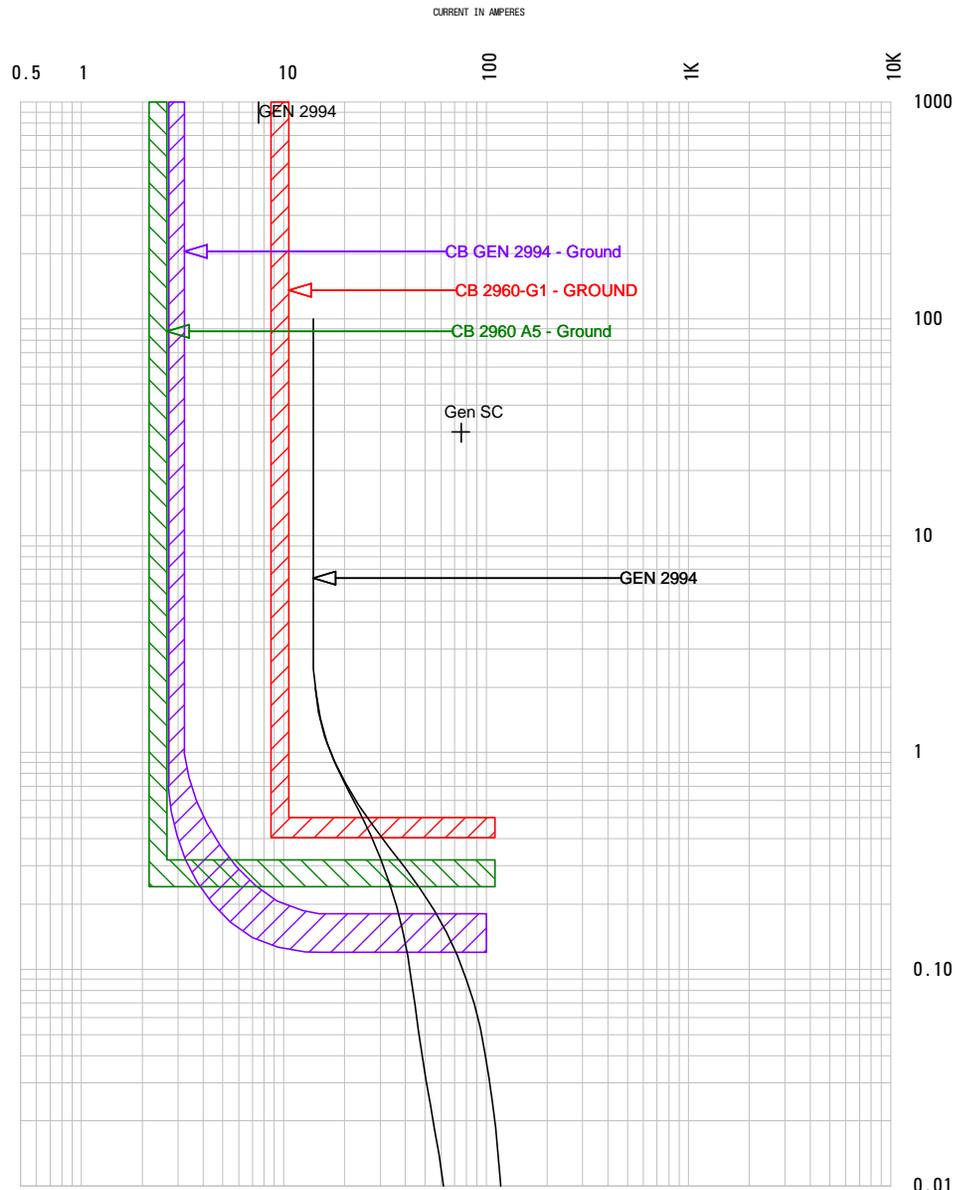
Actual Current=Displayed Current x 100 at 480 V

CURRENT IN AMPERES

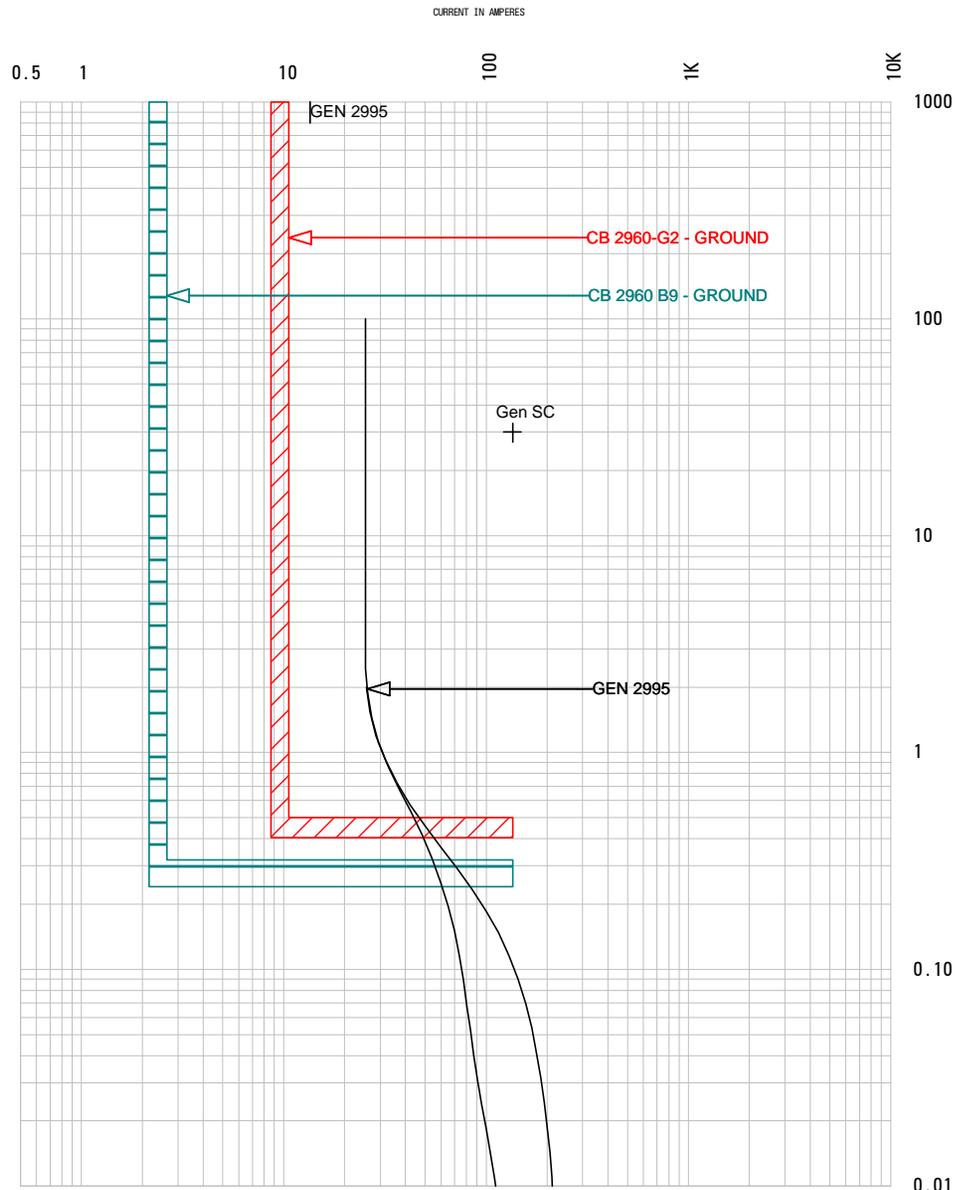


Breaker	Specifications
CB 2960-B MAIN	3000.0 AF 3000.0AS 3000.0AP CUTLER-HAMMER SPB-100M Phase LTPU (0.5-1.0 x P) 0.8 (2400A) LTD (2-24 Sec.) 4 INST (2-10 x P) 4 (12000A) OVERRIDE (1 x ST) Fixed (51000A) ground GFP (100-1200A Plug) C (1050A) GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)
CB 2960 TIE	3000.0 AF 3000.0AS 3000.0AP CUTLER-HAMMER SPB-100 Phase LTPU (0.5-1.0 x P) 0.6 (1800A) LTD (2-24 Sec.) 4 STPU (2-8 x LTPU) 3 (5400A) STD (0.1-0.5 Sec.) 0.3 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) ground GFP (100-1200A Plug) C (1050A) GFD (0.1-0.5 Sec.) 0.5 Sec. (I ² t Out)
CB 2960 B2	1200.0 AF 1200.0AS 1000.0AP CUTLER-HAMMER SPB-65 Phase LTPU (0.5-1.0 x P) 1 (1000A) LTD (2-24 Sec.) 7 STPU (2-8 x LTPU) 3 (3000A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (35000A) GROUND GFP (100-1200A Plug) H (750A) GFD (0.1-0.5 Sec.) 0.4 Sec. (I ² t Out)
CB 2960 B3	800.0 AF 800.0AS 400.0AP CUTLER-HAMMER SPB-100 Phase LTPU (0.5-1.0 x P) 1 (400A) LTD (2-24 Sec.) 15 STPU (2-8 x LTPU) S2(8) (3200A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (25000A) GROUND GFP (100-1200A Plug) E (200A) GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)
CB 2960 B9	800.0 AF 800.0AS 600.0AP CUTLER-HAMMER SPB-50 Phase LTPU (0.5-1.0 x P) 1 (600A) LTD (2-24 Sec.) 24 STPU (2-8 x LTPU) 6 (3600A) STD (0.1-0.5 Sec.) 0.3 (I ² t Out) INST (2-10 x P) 6 (3600A) OVERRIDE (1 x ST) Fixed (25000A) GROUND GFP (100-1200A Plug) D (240A) GFD (0.1-0.5 Sec.) 0.3 Sec. (I ² t Out)
CB 2960 B1	800.0 AF 800.0AS 400.0AP CUTLER-HAMMER SPB-100 Phase LTPU (0.5-1.0 x P) 1 (400A) LTD (2-24 Sec.) 15 STPU (2-8 x LTPU) S2(8) (3200A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (25000A) GROUND GFP (100-1200A Plug) E (200A) GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)
CB 2960 B1	800.0 AF 800.0AS 400.0AP CUTLER-HAMMER SPB-100 Phase LTPU (0.5-1.0 x P) 1 (400A) LTD (2-24 Sec.) 15 STPU (2-8 x LTPU) S2(8) (3200A) STD (0.1-0.5 Sec.) 0.1 (I ² t Out) OVERRIDE (1 x ST) Fixed (25000A) GROUND GFP (100-1200A Plug) E (200A) GFD (0.1-0.5 Sec.) 0.2 Sec. (I ² t Out)
2960 MAIN B	480.0V

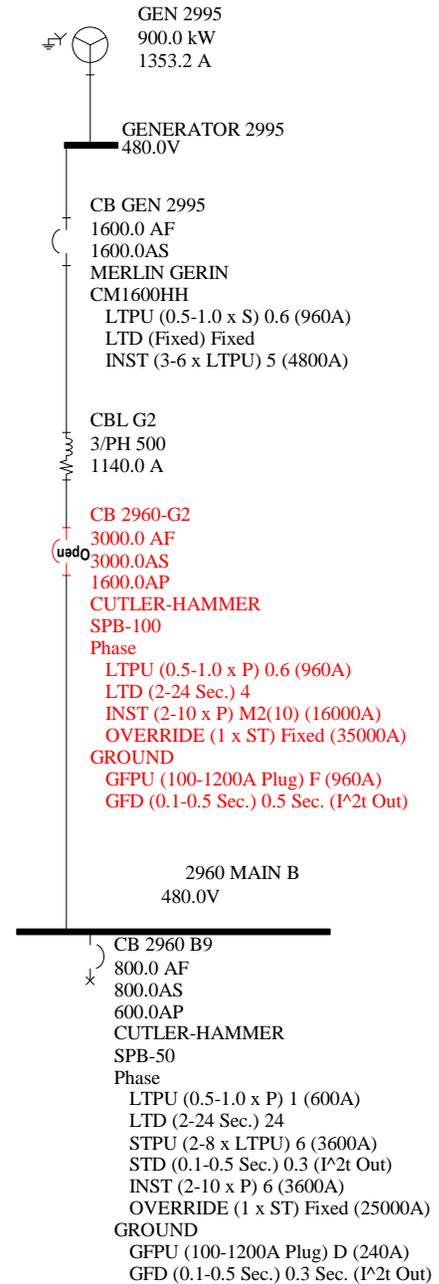
Actual Current=Displayed Current x 100 at 480 V



Actual Current=Displayed Current x 100 at 480 V



Actual Current=Displayed Current x 100 at 480 V



APPENDIX 8:ARC FLASH DATA/SUMMARY, AND SAMPLE LABELS

	 DANGER
	QUALIFIED WORKERS ONLY PPE REQUIRED
Flash Hazard Boundary – (Threshold at which burn level exceeds 1.2 cal/cm ²)	17 inch Flash Hazard Boundary
Calculated Incident Energy (at indicated working distance)	1.1 cal/cm² Flash Hazard at 18 inches
Hazard Risk Category & PPE Description (See Table 3.3.2)	Category 0 Long Sleeve Shirt & Pants, Safety Glasses, Hearing Protection, Leather Gloves
Equipment Rated Voltage	480 VAC Shock hazard when cover is removed
Required Electrical Glove Class	00 Class Glove with Leather Protectors
Shock Hazard Boundaries (based on equipment voltage rating)	42 inch Limited Approach (Fixed Circuit)
	12 inch Restricted Approach
	1 inch Prohibited Approach
Panel or Device name	Location: PNL 0
	
	Electrical Reliability Services, Inc. 10606 Bloomfield Avenue Santa Fe Springs, CA 90670 (562) 236-9555
	Job #: SAMPLE 1 Prepared on: 08/03/07 By: ERS Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements

Figure 1 : Explanation of label Fields

Figure 2: Sample Labels

⚠ DANGER
QUALIFIED WORKERS ONLY
PPE REQUIRED
130 inch Flash Hazard Boundary
31 cal/cm² Flash Hazard at 18 inches
Category 4 FR Shirt & Pants Plus Flash Suit and Hood all with combined AR of at least 40, Hardhat, Safety Glasses, Hearing Protection, Arc-Rated Gloves & Leather Work Shoes
480 VAC Shock hazard when cover is removed
00 Class Glove with Leather Protectors
42 inch Limited Approach (Fixed Circuit)
12 inch Restricted Approach
1 inch Prohibited Approach
Location: PNL 4
 Electrical Reliability Services, Inc.
10606 Bloomfield Avenue
Sante Fe Springs, CA 90670
(562) 236-9555
Job #: SAMPLE1 Prepared on: 08/03/07 By: ERS
Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements

⚠ DANGER
QUALIFIED WORKERS ONLY
PPE REQUIRED
74 inch Flash Hazard Boundary
12 cal/cm² Flash Hazard at 18 inches
Category 3 FR Shirt & Pants with FR Coverall all with combined AR of at least 25, Hardhat, Safety Glasses, Flash Suit Hood, Hearing Protection, Arc-Rated Gloves & Leather Work Shoes
480 VAC Shock hazard when cover is removed
00 Class Glove with Leather Protectors
42 inch Limited Approach (Fixed Circuit)
12 inch Restricted Approach
1 inch Prohibited Approach
Location: PNL 3
 Electrical Reliability Services, Inc.
10606 Bloomfield Avenue
Sante Fe Springs, CA 90670
(562) 236-9555
Job #: SAMPLE1 Prepared on: 08/03/07 By: ERS
Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements

⚠ DANGER
QUALIFIED WORKERS ONLY
PPE REQUIRED
49 inch Flash Hazard Boundary
6.1 cal/cm² Flash Hazard at 18 inches
Category 2 FR Shirt & Pants (AR 8), Hardhat, Safety Glasses, Faceshield (AR 8), Flash Suit Hood, Hearing Protection, Leather Gloves & Work Shoes
480 VAC Shock hazard when cover is removed
00 Class Glove with Leather Protectors
42 inch Limited Approach (Fixed Circuit)
12 inch Restricted Approach
1 inch Prohibited Approach
Location: PNL 2
 Electrical Reliability Services, Inc.
10606 Bloomfield Avenue
Sante Fe Springs, CA 90670
(562) 236-9555
Job #: SAMPLE1 Prepared on: 08/03/07 By: ERS
Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements

⚠ DANGER
HIGH ENERGIES PRESENT
ENERGIZED WORK PROHIBITED
155 inch Flash Hazard Boundary
41 cal/cm² Flash Hazard at 18 inches
Danger! ENERGIZED WORK PROHIBITED
480 VAC Shock hazard when cover is removed
Location: PNL D
 Electrical Reliability Services, Inc.
10606 Bloomfield Avenue
Sante Fe Springs, CA 90670
(562) 236-9555
Job #: SAMPLE1 Prepared on: 08/03/07 By: ERS
Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements

⚠ DANGER
QUALIFIED WORKERS ONLY
PPE REQUIRED
17 inch Flash Hazard Boundary
1.1 cal/cm² Flash Hazard at 18 inches
Category 0 Long Sleeve Shirt & Pants, Safety Glasses, Hearing Protection, Leather Gloves
480 VAC Shock hazard when cover is removed
00 Class Glove with Leather Protectors
42 inch Limited Approach (Fixed Circuit)
12 inch Restricted Approach
1 inch Prohibited Approach
Location: PNL 0
 Electrical Reliability Services, Inc.
10606 Bloomfield Avenue
Sante Fe Springs, CA 90670
(562) 236-9555
Job #: SAMPLE1 Prepared on: 08/03/07 By: ERS
Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements

⚠ DANGER
QUALIFIED WORKERS ONLY
PPE REQUIRED
25 inch Flash Hazard Boundary
2.0 cal/cm² Flash Hazard at 18 inches
Category 1 FR Shirt & Pants (AR 4), Hardhat & Safety Glasses, Faceshield (AR 4), Hearing Protection, Leather Gloves & Work Shoes
480 VAC Shock hazard when cover is removed
00 Class Glove with Leather Protectors
42 inch Limited Approach (Fixed Circuit)
12 inch Restricted Approach
1 inch Prohibited Approach
Location: PNL 1
 Electrical Reliability Services, Inc.
10606 Bloomfield Avenue
Sante Fe Springs, CA 90670
(562) 236-9555
Job #: SAMPLE1 Prepared on: 08/03/07 By: ERS
Warning: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements

Arc Flash Table (based on existing settings)

ERS # 3162884

Client: PSW Electric

Project: Central Kitsap WWTP

Bus Name	Protective Device Name	Voltage (V)	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/Delay Time (sec)	Ground	Equip Type	Gap (mm)	Glove Class	Arc Flash Boundary (in)	Working Distance (in)	Limited Approach (in)	Restricted Approach (in)	Prohibited Approach (in)	Scenario	Incident Energy (cal/cm ²)	PPE Category
2960 MAIN A	CB 2960-G1	480	10.520	4.850	2.680	18.288	Yes	PNL	25	00	237	18	42	12	1	Gen Normal	82.07	Dangerous!
2960 MAIN A (LineSide)	UTILITY FUSE	480	24.100	24.100	11.820	2.121	Yes	PNL	25	00	241	18	42	12	1	Normal Min SC	84.33	Dangerous!
2960 MAIN A (LineSide)	UTILITY FUSE	480	32.260	22.000	10.340	2.867	Yes	PNL	25	00	277	18	42	12	1	Normal Max SC	106.06	Dangerous!
2960 MAIN A (LineSide)	CB GEN 2994	480	4.850	4.850	3.530	2.000	Yes	PNL	25	00	241	18	42	12	1	Gen Min SC	11.42	Category 3
2960 MAIN B	CB 2960-G2	480	14.320	9.520	5.040	71.452	Yes	PNL	25	00	739	18	42	12	1	Gen Normal	530.84	Dangerous!
2960 MAIN B (LineSide)	FS TFR2952	480	29.350	24.620	13.800	2.000	Yes	PNL	25	00	>999	18	42	12	1	Normal	95.60	Dangerous!
2960 MAIN B (LineSide)	CB GEN 2995	480	14.320	9.520	5.040	71.452	Yes	PNL	25	00	739	18	42	12	1	Gen Normal	530.84	Dangerous!
ACTIV SLUDGE MIXER 2	CB MCC-2972 MXR2116	480	1.030	1.030	0.940	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
ACTIV SLUDGE MIXER 4	CB MCC-2972 MXR2166	480	1.360	1.350	1.190	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.05	Category 0
ACTIVATED SLUDGE MIXER 1	CB MCC-2971 MXR2115	480	1.130	1.130	1.010	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
ACTIVATED SLUDGE MIXER 3	CB MCC-2971 MXR2165	480	1.360	1.350	1.190	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.05	Category 0
AER BLWR 1 VLVS	CB MCC-2972 CV2001	480	2.600	2.600	2.070	0.019	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.11	Category 0
AER BLWR 3 VLVS	CB MCC-2971 CV2003	480	2.210	2.210	1.810	0.019	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.10	Category 0
AERATED GRIT TANK BLOWER	CB MCC-2975 B1276	480	7.170	7.050	4.850	0.015	Yes	PNL	25	00	7	18	42	12	1	Normal Max SC	0.24	Category 0
AERATION BLOWER 1	CB 2960-G1	480	4.760	4.760	3.480	2.000	Yes	PNL	25	00	71	18	42	12	1	Gen Min SC	11.31	Category 3
AERATION BLOWER 2	CB 2960-G1	480	4.760	4.760	3.480	2.000	Yes	PNL	25	00	71	18	42	12	1	Gen Min SC	11.31	Category 3
AERATION BLOWER 3	CB 2960-G1	480	4.760	4.760	3.480	2.000	Yes	PNL	25	00	71	18	42	12	1	Gen Min SC	11.31	Category 3
AHU1281 DISC	CB MCC-2975 AHU1281	480	3.130	3.120	2.430	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.11	Category 0
AHU1285 DISC	CB MCC-2975 AHU1285	480	4.450	4.430	3.270	0.015	Yes	PNL	25	00	5	18	42	12	1	Normal Max SC	0.15	Category 0
ALUM METE PMPS	CB MCC-2983 P7210	480	1.760	1.760	1.490	0.020	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
B1061 VFD	CB MCC-2976 B1061	480	12.140	12.140	7.740	0.015	Yes	PNL	25	00	9	18	42	12	1	Normal Max SC	0.38	Category 0
B1276 VFD	CB MCC-2975 B1276	480	12.060	11.890	7.590	0.014	Yes	PNL	25	00	9	18	42	12	1	Normal Max SC	0.36	Category 0
B1277 VFD	CB MCC-2976 B1277	480	9.500	9.500	6.270	0.015	Yes	PNL	25	00	8	18	42	12	1	Normal Max SC	0.30	Category 0
B1278 VFD	CB MCC 2975 B1278	480	12.140	11.880	7.570	0.015	Yes	PNL	25	00	9	18	42	12	1	Normal Max SC	0.38	Category 0
B7192 VFD	CB MCC-2983 B7191	480	17.410	17.410	10.530	0.015	Yes	PNL	25	00	11	18	42	12	1	Normal Max SC	0.53	Category 0
BIO FILTER BLOWER	FU BIO FILT	480	1.250	1.250	0.940	0.026	Yes	PNL	25	00	3	18	42	12	1	Gen Min SC	0.07	Category 0
BL BLDG ELEC RM AHU-2901	CB MCC-2974 AHU2901	480	3.160	3.150	2.440	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.11	Category 0
BLWR RM EXH FN 1	CB MCC-2974 F2911	480	1.810	1.810	1.520	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
BLWR RM EXH FN 2	CB MCC-2974 F2912	480	2.060	2.060	1.700	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
BLWR ROOM AHU2910	CB MCC-2973 AHU2910	480	2.010	2.000	1.660	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
CENT 1 CAKE CONV	CB MCC-2981 CON7115	480	1.660	1.660	1.410	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.06	Category 0
CENT 1 CONV DR VLV	CB MCC-2981 CV7116	480	1.700	1.700	1.440	0.021	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.08	Category 0
CENT 1 FLUSH VLV	CB MCC-2981 CV7114	480	1.840	1.840	1.550	0.020	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
CENT 1 SLDG GRIND BYP VLV	CB MCC-2981 CV7111	480	2.930	2.930	2.300	0.018	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.12	Category 0
CENT 1 SLUDGE FEED PMP	CB MCC-2981 P7112	480	6.220	6.070	4.270	0.015	Yes	PNL	25	00	6	18	42	12	1	Normal Max SC	0.20	Category 0
CENT 1 SLUDGE GRIND	CB MCC-2981 GRD7111	480	2.000	1.990	1.650	0.020	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
CENT 1 SLUDGE INLET VLV	CB MCC-2981 CV7110	480	2.930	2.930	2.300	0.018	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.12	Category 0
CENT CONR AREA ACU	CB MCC-2983 ACU7213	480	7.340	7.220	4.960	0.015	Yes	PNL	25	00	7	18	42	12	1	Normal Max SC	0.24	Category 0
CENT RM HOIST	CB MCC-2983 MME7131	480	2.710	2.690	2.140	0.018	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.11	Category 0
CENTRATE PMP 1	CB MCC-2983 P7151	480	2.560	2.550	2.040	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
CENTRATE PMP 2	CB MCC-2982 P7152	480	2.560	2.540	2.030	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
CHAN 2 AIR BLWR	CB MCC-2972 B2342	480	3.020	2.990	2.340	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.10	Category 0
CHANNEL AIR BLOWER 1	CB MCC-2971 B2541	480	3.040	3.000	2.340	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.10	Category 0
CVS5011	CB MCC-2976 CVS5011	480	0.790	0.790	0.630	0.477	Yes	PNL	25	00	14	18	42	12	1	Gen Normal	0.76	Category 0
DECANT FACILITY	CB MCC-2971 DECANT	480	1.710	1.710	1.230	1.856	Yes	PNL	25	00	43	18	42	12	1	Gen Normal	4.98	Category 2
DEWAT POL-AGE TANK 2 MIX	CB MCC-2982 MXR7232	480	2.080	2.080	1.710	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
DIG WITH VLV 1	FU CV6193	480	1.570	1.570	1.350	0.010	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
DIG WITH VLV 2	FU CV6194	480	7.580	7.580	5.180	0.010	Yes	PNL	25	00	5	18	42	12	1	Normal Max SC	0.16	Category 0
DIG WITH PMP 1	CB DIG WITH P1	480	7.670	7.490	5.100	0.016	Yes	PNL	25	00	7	18	42	12	1	Normal Max SC	0.26	Category 0
DIG WITH PMP 2	CB DIG WITH P2	480	7.670	7.490	5.100	0.016	Yes	PNL	25	00	7	18	42	12	1	Normal Max SC	0.26	Category 0
DUPLEX SEAL WATER PMP 1	CB MCC-2983 P7103A	480	2.240	2.240	1.820	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.08	Category 0
DUPLEX SEAL WATER UNIT PMP 2	CB MCC-2982 P7103B	480	1.680	1.680	1.430	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.06	Category 0
DW POL AGE TANK	CB MCC-2981 CV7231	480	1.870	1.870	1.560	0.020	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
DW POLY 2 PMP	CB MCC-2982 P7242	480	1.810	1.800	1.510	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
DW POLY AGE TANK VLVS	CB MCC-2982 CV7232A&B	480	2.230	2.230	1.820	0.019	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.10	Category 0
DW POLY AGE TNK MIX	CB MCC-2981 MXR7231	480	2.140	2.130	1.750	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.08	Category 0
DW POLY FEED PMP	CB MCC-2981 P7241	480	1.860	1.840	1.540	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
EAST PRIMARY CLARIFIER	CB MCC-2971 ME1018	480	0.450	0.450	0.450	0.015	Yes	PNL	25	00	1	18	42	12	1	Normal Max SC	0.01	Category 0
ELEC RM COND UNIT	CB MCC-2973 ME2907	480	6.270	6.240	4.380	0.016	Yes	PNL	25	00	6	18	42	12	1	Normal Max SC	0.22	Category 0

Bus Name	Protective Device Name	Voltage (V)	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/Delay Time (sec)	Ground	Equip Type	Gap (mm)	Glove Class	Arc Flash Boundary (in)	Working Distance (in)	Limited Approach (in)	Restricted Approach (in)	Prohibited Approach (in)	Scenario	Incident Energy (cal/cm ²)	PPE Category
ELEC RM RET FAN	CB MCC-2973 F2908	480	3.150	3.150	2.440	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.11	Category 0
F2015 UNIDOR VENT	CB MCC-2972 F2015	480	1.240	1.210	1.080	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.05	Category 0
FILT FEED PMP 1	CB MCC-2983 P7101	480	3.820	3.760	2.830	0.015	Yes	PNL	25	00	5	18	42	12	1	Normal Max SC	0.13	Category 0
GENERATOR 2994	Max TripTime @999.0s	480	10.460	2.260	1.840	999.000	Yes	PNL	25	00	3.008	18	42	12	1	Gen Normal	5,313.78	Dangerous!
GENERATOR 2994 (LineSide)	CB 2960-G1	480	10.460	5.470	3.560	0.083	Yes	PNL	25	00	23	18	42	12	1	Gen Normal	1.83	Category 1
GENERATOR 2995	Max TripTime @999.0s	480	15.100	4.060	3.040	999.000	Yes	PNL	25	00	4.188	18	42	12	1	Gen Normal	9,143.46	Dangerous!
GRIFT PUMP 1	CB MCC-2975 P1111	480	1.240	1.220	1.090	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.05	Category 0
GRIFT PUMP 2	CB MCC-2975 P1112	480	1.180	1.160	1.040	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
GRINDER	MCC-2971 3B	480	0.380	0.380	0.320	1.481	Yes	PNL	25	00	13	18	42	12	1	Gen Normal	0.64	Category 0
GRINDER #1	FU GDR6171	480	1.920	1.920	1.600	0.010	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.05	Category 0
GRINDER #2	FU GDR6172	480	1.920	1.920	1.600	0.010	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.05	Category 0
GRIT PUMP-3	CB MCC-2976 P1121	480	1.090	1.070	0.970	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
GRIT PUMP-4	CB MCC-2976 P1122	480	1.040	1.020	0.930	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
HC1281 DISC	CB MCC-2975 HC1281	480	4.440	4.440	3.280	0.016	Yes	PNL	25	00	5	18	42	12	1	Normal Max SC	0.16	Category 0
HC1285 DISC	CB MCC-2975 HC1285	480	9.500	9.500	6.270	0.015	Yes	PNL	25	00	8	18	42	12	1	Normal Max SC	0.30	Category 0
HC1303 DISC	CB MCC-2976 HC1303	480	1.500	1.500	1.100	0.560	Yes	PNL	25	00	20	18	42	12	1	Gen Normal	1.45	Category 1
HC-2903 ELECT RM AHU HEAT COIL	CB MCC-2973 HC2903	480	2.000	2.000	1.660	0.019	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
HYP0 CIRC PMP 1	CB MCC-2981 P7310	480	2.140	2.130	1.750	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.08	Category 0
HYP0 REC PMP 2	MCC-2983 5J	480	2.640	2.630	2.100	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
MCC 2972	CB 2960-G1	480	4.800	4.800	3.510	2.000	Yes	PNL	25	00	71	18	42	12	1	Gen Min SC	11.37	Category 3
MCC 2976 (LineSide)	CB 2960-G1	480	3.900	3.900	2.490	2.000	Yes	PNL	25	00	60	18	42	12	1	Gen Min SC	8.58	Category 3
MCC 2983	CB 2960-G1	480	4.370	4.370	3.230	2.000	Yes	PNL	25	00	69	18	42	12	1	Gen Min SC	10.84	Category 3
MCC-2 (LineSide)	CB 2960 A6	480	7.830	6.630	3.830	142.990	Yes	PNL	25	00	785	18	42	12	1	Gen Normal	585.97	Dangerous!
MCC-2971 (LineSide)	CB 2960 A2	480	10.340	9.440	5.230	28.451	Yes	PNL	25	00	308	18	42	12	1	Gen Normal	126.31	Dangerous!
MCC-2972 (LineSide)	CB 2960 B2	480	27.400	26.640	15.080	0.150	Yes	PNL	25	00	55	18	42	12	1	Normal	7.43	Category 2
MCC-2973 (LineSide)	CB 2960-G1	480	4.780	4.780	3.490	2.000	Yes	PNL	25	00	71	18	42	12	1	Gen Min SC	11.34	Category 3
MCC-2973 (LineSide)	CB 2960 A4	480	30.220	30.000	16.740	0.150	Yes	PNL	25	00	56	18	42	12	1	Normal Max SC	7.65	Category 2
MCC-2974 (LineSide)	CB 2960-G1	480	4.780	4.780	3.490	2.000	Yes	PNL	25	00	71	18	42	12	1	Gen Min SC	11.34	Category 3
MCC-2975 (LineSide)	CB 2960 B8	480	11.700	10.990	7.040	0.070	Yes	PNL	25	00	22	18	42	12	1	Normal	1.70	Category 1
MCC-2981 (LineSide)	CB 2960-G1	480	4.370	4.370	3.230	2.000	Yes	PNL	25	00	69	18	42	12	1	Gen Min SC	10.84	Category 3
MCC-2982	CB 2960-G1	480	4.370	4.370	3.230	2.000	Yes	PNL	25	00	69	18	42	12	1	Gen Min SC	10.84	Category 3
MCC-2982 (LineSide)	CB 2960 B9	480	16.790	16.660	10.130	0.070	Yes	PNL	25	00	27	18	42	12	1	Normal	2.38	Category 1
MCC-2983 (LineSide)	CB 2960-G1	480	4.370	4.370	3.230	2.000	Yes	PNL	25	00	69	18	42	12	1	Gen Min SC	10.84	Category 3
MCC-2984	CB 2960-G1	480	4.330	4.330	3.210	2.000	Yes	PNL	25	00	69	18	42	12	1	Gen Min SC	10.80	Category 3
MCC4 PANEL	FU MCC-4	480	3.530	3.530	2.290	2.000	Yes	PNL	25	00	58	18	42	12	1	Gen Min SC	8.24	Category 3
MEE1100	CB MCC-2976 MEE1100	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
MEE5012 SEPTAGE PANEL	CB MCC-2975 MEE5012	277	1.200	1.200	0.850	1.870	Yes	PNL	25	00	38	18	42	Avoid Contact	Avoid Contact	Gen Min SC	4.01	Category 2
MEE7110 VFD PNL	CB 2960-G1	480	4.180	4.180	3.110	2.000	Yes	PNL	25	00	68	18	42	12	1	Gen Min SC	10.61	Category 3
NALGEAR PMP	CB MCC-2984 P7054	480	0.990	0.990	0.770	0.162	Yes	PNL	25	00	8	18	42	12	1	Gen Min SC	0.34	Category 0
NORTH TRAILER	CB S101 TRAIL	240	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
OFFICE LAB SWITCHES	FU TFR LAB	277	9.620	9.620	4.690	999.000	Yes	PNL	25	00	5.559	18	42	Avoid Contact	Avoid Contact	Normal Max SC	14,555.46	Dangerous!
P1001 VFD	CB MCC-2971 P1001	480	27.010	27.010	15.320	0.015	Yes	PNL	25	00	14	18	42	12	1	Normal Max SC	0.79	Category 0
P2514 VFD	CB MCC-2972 P2514	480	27.850	27.850	15.730	0.013	Yes	PNL	25	00	13	18	42	12	1	Normal Max SC	0.69	Category 0
P2515 VFD	CB MCC-2972 P2515	480	27.850	27.850	15.730	0.013	Yes	PNL	25	00	13	18	42	12	1	Normal Max SC	0.69	Category 0
P7112 VFD	CB MCC-2981 P7112	480	16.990	16.730	10.160	0.015	Yes	PNL	25	00	11	18	42	12	1	Normal Max SC	0.51	Category 0
P7241 VFD	CB MCC-2981 P7241	480	16.990	16.850	10.240	0.015	Yes	PNL	25	00	11	18	42	12	1	Normal Max SC	0.51	Category 0
PANEL 1990	CB PNL 1990 MAIN	277	3.360	3.360	1.830	11.415	No	PNL	25	00	180	18	42	Avoid Contact	Avoid Contact	Gen Normal	52.41	Dangerous!
PANEL 1990 (LineSide)	CB MCC-2971 TFR-1990	277	3.360	3.360	1.830	135.690	No	PNL	25	00	812	18	42	Avoid Contact	Avoid Contact	Gen Normal	619.72	Dangerous!
PANEL A	FU LAB PNL A	277	7.990	7.990	3.480	0.596	Yes	PNL	25	00	49	18	42	Avoid Contact	Avoid Contact	Normal	6.28	Category 2
PANEL B	FU LAB PNL A0	277	6.750	6.750	3.070	0.036	Yes	PNL	25	00	8	18	42	Avoid Contact	Avoid Contact	Normal Min SC	0.33	Category 0
PANEL MP	CB PNL MP	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PLATE DEWATER PRESS	CB MCC-2983 MME7100	480	2.690	2.690	2.140	0.018	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.11	Category 0
PNL 1021	CB MCC-2975 PNL1021	480	3.130	3.130	2.430	0.017	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.12	Category 0
PNL 1023	CB MCC-2976 PNL1023	480	2.210	2.210	1.800	0.018	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.10	Category 0
PNL 1025	CB MCC-2975 PNL 1025	480	3.130	3.130	2.430	0.017	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.12	Category 0
PNL 1025 (LineSide)	CB MCC-2975 PNL 1025	480	3.130	3.130	2.430	0.017	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.12	Category 0
PNL 1026	CB MCC-2975 PNL 1026	480	1.920	1.920	1.600	0.019	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
PNL 1027	CB MCC-2975 PNL1027	480	1.540	1.540	1.130	0.028	Yes	PNL	25	00	4	18	42	12	1	Gen Min SC	0.09	Category 0
PNL 1028	CB MCC 2976 PNL 1028	480	2.210	2.210	1.800	0.018	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.10	Category 0
PNL 1029	CB MCC-2975 PNL1029	480	1.920	1.920	1.600	0.019	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
PNL 1070	CB MCC-2975 PNL1070	480	0.500	0.500	0.420	0.793	Yes	PNL	25	00	11	18	42	12	1	Gen Min SC	0.45	Category 0
PNL 1071	CB MCC-2975 PNL1070	480	0.490	0.490	0.420	0.816	Yes	PNL	25	00	11	18	42	12	1	Gen Min SC	0.46	Category 0
PNL 1250 (LineSide)	CB MCC-2975 PNL-1250	480	0.900	0.900	0.720	0.405	Yes	PNL	25	00	13	18	42	12	1	Gen Min SC	0.74	Category 0
PNL 2958 (LineSide)	CB MCC-2974 PNL 2958	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2973	CB PNL 2973	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal Max SC	---	Category 1
PNL 2973 (LineSide)	CB MCC-2973 TFR-2957	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1

Bus Name	Protective Device Name	Voltage (V)	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/Delay Time (sec)	Ground	Equip Type	Gap (mm)	Glove Class	Arc Flash Boundary (in)	Working Distance (in)	Limited Approach (in)	Restricted Approach (in)	Prohibited Approach (in)	Scenario	Incident Energy (cal/cm ²)	PPE Category
PNL 2975 (LineSide)	CB MCC-2975 PNL2975	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2976	CB MCC-2976 PNL 2976	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2976 (LineSide)	CB MCC-2976 PNL 2976	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2981	MCC-2981 5F	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2981 (LineSide)	MCC-2981 5F	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2982 (LineSide)	MCC-2982 4F	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 5010	CB MCC 2976 PNL 5010	480	1.540	1.540	1.130	0.028	Yes	PNL	25	00	4	18	42	12	1	Gen Min SC	0.09	Category 0
PNL 5020	CB MCC 2976 PNL 5020	480	1.060	1.060	0.820	0.351	Yes	PNL	25	00	13	18	42	12	1	Gen Normal	0.72	Category 0
PNL 7225 DEWAT POL DIST PNL	CB MCC-2981 PNL 7225	480	1.570	1.570	1.350	0.021	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.08	Category 0
PNL C (LineSide)	FU PANEL C	240	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Gen Min SC	---	Category 1
PNL-1090 PLANT WW SMP PNL	CB MCC-2973 PNL1090	480	7.940	7.940	5.380	0.015	Yes	PNL	25	00	7	18	42	12	1	Normal Max SC	0.26	Category 0
PRESS PRES WASH	CB MCC-2981 MME7106	480	1.880	1.870	1.560	0.020	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
PRIMARY GALLERY EXH FAN	CB MCC-2976 F1302	480	0.510	0.510	0.510	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.01	Category 0
PRIMARY GALLERY SUP FAN	CB MCC-2976 F1301	480	0.460	0.450	0.450	0.015	Yes	PNL	25	00	1	18	42	12	1	Normal Max SC	0.01	Category 0
PROCESS WATER PUMP 1	CB MCC-2971 P3001	480	2.130	2.020	1.660	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.08	Category 0
PROCESS WATER PUMP 3	CB MCC-2971 P3003	480	1.830	1.830	1.300	1.350	Yes	PNL	25	00	38	18	42	12	1	Gen Min SC	4.03	Category 2
PROCESS WTR PMP 2	CB MCC-2972 P3002	480	2.060	1.950	1.610	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
RET ACT SLUDGE PMP 1	CB MCC-2971 P2511	480	0.380	0.360	0.310	1.556	Yes	PNL	25	00	13	18	42	12	1	Gen Normal	0.65	Category 0
RET ACT SLUDGE PMP 2	MCC-2971 8M	480	0.380	0.370	0.310	1.510	Yes	PNL	25	00	13	18	42	12	1	Gen Normal	0.65	Category 0
RET ACT SLUDGE PMP 3	CB MCC-2972 P2513	480	0.390	0.380	0.380	0.015	Yes	PNL	25	00	1	18	42	12	1	Gen Normal	0.01	Category 0
S101 PANEL	FU MCC-4	480	3.540	3.540	2.300	2.000	Yes	PNL	25	00	58	18	42	12	1	Gen Min SC	8.25	Category 3
S102 PANEL (LineSide)	CB S101 S102	240	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
SAN DRAIN PMP 1	CB MCC-2972 P2011	480	0.990	0.970	0.900	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
SAN DRAIN PMP 2	MCC-2972 10D	480	0.990	0.970	0.900	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
SCUM PUMP	CB MCC-2971 P1004	480	0.420	0.400	0.400	0.015	Yes	PNL	25	00	1	18	42	12	1	Gen Normal	0.01	Category 0
SCUM PUMP 1	CB MCC-2972 P1003	480	0.380	0.360	0.360	0.015	Yes	PNL	25	00	1	18	42	12	1	Gen Normal	0.01	Category 0
SEC CLAR COLL 2	CB MCC-2972 COL2520	480	0.380	0.380	0.380	0.015	Yes	PNL	25	00	1	18	42	12	1	Normal Max SC	0.01	Category 0
SECONDARY CLAR COLL 1	CB MCC-2971 COL2510	480	0.500	0.500	0.500	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.01	Category 0
SEPTAGE PMP 1	CB MCC-2983 P7161	480	2.330	2.300	1.860	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.08	Category 0
SEPTAGE PMP 2	CB MCC-2984 P7162	480	1.620	1.590	1.360	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.06	Category 0
SEPTAGE PWR CENTER	CB MCC-2975 MEE5012	480	1.580	1.580	1.150	0.031	Yes	PNL	25	00	4	18	42	12	1	Gen Min SC	0.10	Category 0
SERV AIR CMP 2 PNL	CB MCC-2984 PNL7031	480	3.600	3.530	2.690	0.017	Yes	PNL	25	00	5	18	42	12	1	Normal Max SC	0.14	Category 0
SERV AIR COMP 1 PNL	CB MCC-2983 PNL7030	480	2.450	2.420	1.950	0.018	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.11	Category 0
SLDG BLDG HT WT PMP	CB MCC-2983 P7209	480	2.730	2.730	2.160	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.10	Category 0
SLUDGE BLD LAB AREA EXH FAN	CB MCC-2983 F7205	480	2.140	2.140	1.760	0.015	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.08	Category 0
SLUDGE BLDG AHU-1	CB MCC-2983 AHU7211	480	1.040	1.030	0.940	0.015	Yes	PNL	25	00	2	18	42	12	1	Normal Max SC	0.04	Category 0
SLUDGE BLDG AHU-2	CB MCC-2983 AHU7202	480	18.340	18.290	10.980	0.015	Yes	PNL	25	00	11	18	42	12	1	Normal Max SC	0.55	Category 0
SLUDGE BLDG ELEC RM ACU	CB MCC-2983 ACU7212	480	1.380	1.380	1.030	0.033	Yes	PNL	25	00	4	18	42	12	1	Gen Min SC	0.09	Category 0
SLUDGE BLDG RM EXH FAN	CB MCC-2983 F7208	480	18.300	18.290	10.980	0.015	Yes	PNL	25	00	11	18	42	12	1	Normal Max SC	0.55	Category 0
SLUDGE CHEM RM SUP FAN	CB MCC-2983 F7207	480	2.500	2.500	2.010	0.015	Yes	PNL	25	00	4	18	42	12	1	Normal Max SC	0.09	Category 0
SLUDGE MIXING P1	FU P6013	480	3.040	3.010	2.340	0.010	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
SLUDGE MIXING P2	FU P6023	480	3.040	3.010	2.340	0.010	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.07	Category 0
SLUDGE RECIRC P1	FU P6112	480	2.050	2.040	1.680	0.010	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.05	Category 0
SLUDGE RECIRC P2	FU P6122	480	2.050	2.040	1.680	0.010	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.05	Category 0
SOUTH TRAILER	CB S101 TRAIL	240	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
SWBD 1	CB 2960 A7	480	10.130	10.110	5.630	63.260	Yes	PNL	25	00	498	18	42	12	1	Gen Normal	278.04	Dangerous!
SWGR 1	UTILITY FUSE	12,470	2.700	2.390	2.370	0.083	Yes	SWG	153	2	6	36	60	26	7	Normal	0.26	Category 0
SWGR 2950 LINE	UTILITY FUSE	12,470	2.680	2.360	2.350	0.085	Yes	SWG	153	2	6	36	60	26	7	Normal	0.26	Category 0
TANK DRAIN PUMP	CB MCC-2975 P1253	480	0.580	0.570	0.570	0.015	Yes	PNL	25	00	2	18	42	12	1	Gen Normal	0.01	Category 0
THKND SLUDGE PMP #1	FU P6011	480	2.420	2.400	1.940	0.010	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.06	Category 0
THKND SLUDGE PMP #2	FU P6021	480	2.260	2.240	1.830	0.010	Yes	PNL	25	00	3	18	42	12	1	Normal Max SC	0.05	Category 0
TX PANEL 3100	CB MCC-2973 PNL3100	440	3.600	3.600	2.250	105.940	Yes	PNL	25	00	575	18	42	12	1	Gen Normal	351.65	Dangerous!
TX PANEL 3200	CB MCC-2974 PNL3200	440	3.720	3.720	2.310	57.217	Yes	PNL	25	00	469	18	42	12	1	Gen Normal	252.06	Dangerous!
UV PWR DIST CHAN 2	CB 2960-G1	480	3.900	3.900	2.930	2.000	Yes	PNL	25	00	67	18	42	12	1	Gen Min SC	10.22	Category 3
UV PWR DIST CHAN 2 (LineSide)	CB 2960-G1	480	3.900	3.900	2.930	2.000	Yes	PNL	25	00	67	18	42	12	1	Gen Min SC	10.22	Category 3
UV PWR DIST CHNL 1	CB MCC-2973 PNL3100	480	4.130	4.130	3.080	2.000	Yes	PNL	25	00	68	18	42	12	1	Gen Min SC	10.54	Category 3
UV PWR DIST CHNL 1 (LineSide)	CB MCC-2973 PNL3100	480	4.130	4.130	3.080	2.000	Yes	PNL	25	00	68	18	42	12	1	Gen Min SC	10.54	Category 3
UVB-3110	CB MCC-2973 PNL3100	440	3.450	3.160	1.980	137.000	Yes	PNL	25	00	665	18	42	12	1	Gen Normal	446.72	Dangerous!
UVB-3120	CB MCC-2973 PNL3100	440	3.450	3.160	1.980	137.000	Yes	PNL	25	00	665	18	42	12	1	Gen Normal	446.72	Dangerous!
UVB-3121	CB MCC-2974 PNL3200	440	3.560	3.260	2.030	73.398	Yes	PNL	25	00	538	18	42	12	1	Gen Normal	315.42	Dangerous!
UVB-3210	CB MCC-2974 PNL3200	440	3.560	3.260	2.030	73.398	Yes	PNL	25	00	538	18	42	12	1	Gen Normal	315.42	Dangerous!
VFD P1002	CB MCC-2972 P1002	480	28.760	28.760	16.170	0.015	Yes	PNL	25	00	14	18	42	12	1	Normal Max SC	0.84	Category 0
VFD P2531	CB MCC-2971 P2531	480	25.110	25.110	14.400	0.013	Yes	PNL	25	00	12	18	42	12	1	Normal Max SC	0.64	Category 0
WAS PUMP 2	CB MCC-2972 P2532	480	0.360	0.360	0.300	1.586	Yes	PNL	25	00	13	18	42	12	1	Gen Min SC	0.66	Category 0
WEST PRI CLAR	CB MCC-2972 ME1019	480	0.280	0.280	0.280	0.015	Yes	PNL	25	00	1	18	42	12	1	Normal Max SC	0.00	Category 0

Arc Flash Table (based on recommended settings)

ERS # 3162884 Client: PSW Electric

Project: Central Kitsap

Bus Name	Protective Device Name	Voltage (V)	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/Delay Time (sec)	Ground	Equip Type	Gap (mm)	Glove Class	Arc Flash Boundary (in)	Working Distance (in)	Limited Approach (in)	Restricted Approach (in)	Prohibited Approach (in)	Scenario	Incident Energy (cal/cm ²)	PPE Category
2960 MAIN A (LineSide)	UTILITY FUSE	480	23.980	23.980	11.770	2.000	Yes	PNL	25	00	242	18	42	12	1	Norm Min	79.14	Dangerous!
2960 MAIN A (LineSide)	CB MCC-2994	480	4.850	4.850	3.530	2.000	Yes	PNL	25	00	242	18	42	12	1	Gen Min	11.42	Category 3
2960 MAIN B (LineSide)	FS TFR2952	480	28.700	24.530	13.800	2.000	Yes	PNL	25	00	>999	18	42	12	1	Normal	95.08	Dangerous!
2960 MAIN B (LineSide)	CB GEN 2995	480	13.520	9.300	4.960	2.000	Yes	PNL	25	00	>999	18	42	12	1	Gen Norm	16.76	Category 3
ACTIV SLUDGE MIXER 2	CB MCC-2972 MXR2116	480	1.030	1.030	0.940	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
ACTIV SLUDGE MIXER 4	CB MCC-2972 MXR2166	480	1.360	1.350	1.190	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.05	Category 0
ACTIVATED SLUDGE MIXER 1	CB MCC-2971 MXR2115	480	1.130	1.130	1.010	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
ACTIVATED SLUDGE MIXER 3	CB MCC-2971 MXR2165	480	1.360	1.350	1.190	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.05	Category 0
AER BLWR 1 VLVS	CB MCC-2972 CV2001	480	2.600	2.600	2.070	0.019	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.11	Category 0
AER BLWR 3 VLVS	CB MCC-2971 CV2003	480	2.210	2.210	1.810	0.019	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.10	Category 0
AERATED GRIT TANK BLOWER	CB MCC-2975 B1276	480	7.150	7.030	4.840	0.015	Yes	PNL	25	00	7	18	42	12	1	Norm Max	0.24	Category 0
AERATION BLOWER 1	CB 2960-G1	480	4.760	4.760	3.480	2.000	Yes	PNL	25	00	236	18	42	12	1	Gen Min	11.31	Category 3
AERATION BLOWER 2	CB 2960-G1	480	4.760	4.760	3.480	2.000	Yes	PNL	25	00	236	18	42	12	1	Gen Min	11.31	Category 3
AERATION BLOWER 3	CB 2960-G1	480	4.760	4.760	3.480	2.000	Yes	PNL	25	00	236	18	42	12	1	Gen Min	11.31	Category 3
AHU1281 DISC	CB MCC-2975 AHU1281	480	3.130	3.120	2.420	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.11	Category 0
AHU1285 DISC	CB MCC-2975 AHU1285	480	4.450	4.430	3.270	0.015	Yes	PNL	25	00	5	18	42	12	1	Norm Max	0.15	Category 0
ALUM METE PMPS	CB MCC-2983 P7210	480	1.760	1.760	1.490	0.020	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
B1061 VFD	CB MCC-2976 B1061	480	12.070	12.070	7.700	0.015	Yes	PNL	25	00	9	18	42	12	1	Norm Max	0.38	Category 0
B1276 VFD	CB MCC-2975 B1276	480	11.990	11.830	7.550	0.014	Yes	PNL	25	00	9	18	42	12	1	Norm Max	0.36	Category 0
B1277 VFD	CB MCC-2976 B1277	480	9.460	9.460	6.250	0.015	Yes	PNL	25	00	8	18	42	12	1	Norm Max	0.30	Category 0
B1278 VFD	CB MCC-2975 B1278	480	12.070	11.810	7.530	0.015	Yes	PNL	25	00	9	18	42	12	1	Norm Max	0.38	Category 0
B7192 VFD	CB MCC-2983 B7191	480	17.260	17.260	10.460	0.015	Yes	PNL	25	00	11	18	42	12	1	Norm Max	0.52	Category 0
BIO FILTER BLOWER	FU BIO FILT	480	1.250	1.250	0.940	0.026	Yes	PNL	25	00	3	18	42	12	1	Gen Min	0.07	Category 0
BL BLDG ELEC RM AHU-2901	CB MCC-2974 AHU2901	480	3.160	3.150	2.440	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.11	Category 0
BLWR RM EXH FN 1	CB MCC-2974 F2911	480	1.810	1.810	1.520	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
BLWR RM EXH FN 2	CB MCC-2974 F2912	480	2.060	2.060	1.700	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
BLWR ROOM AHU2910	CB MCC-2973 AHU2910	480	2.010	2.000	1.660	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
CENT 1 CAKE CONV	CB MCC-2981 CON7115	480	1.660	1.660	1.410	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.06	Category 0
CENT 1 CONV DR VLV	CB MCC-2981 CV7116	480	1.700	1.700	1.440	0.021	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.08	Category 0
CENT 1 FLUSH VLV	CB MCC-2981 CV7114	480	1.840	1.840	1.550	0.020	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
CENT 1 SLDG GRIND BYP VLV	CB MCC-2981 CV7111	480	2.930	2.930	2.300	0.018	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.12	Category 0
CENT 1 SLUDGE FEED PMP	CB MCC-2981 P7112	480	6.210	6.070	4.260	0.015	Yes	PNL	25	00	6	18	42	12	1	Norm Max	0.20	Category 0
CENT 1 SLUDGE GRIND	CB MCC-2981 GRD7111	480	2.000	1.990	1.650	0.020	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
CENT 1 SLUDGE INLET VLV	CB MCC-2981 CV7110	480	2.930	2.930	2.300	0.018	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.12	Category 0
CENT CONR AREA ACU	CB MCC-2983 ACU7213	480	7.330	7.210	4.950	0.015	Yes	PNL	25	00	7	18	42	12	1	Norm Max	0.24	Category 0
CENT RM HOIST	CB MCC-2983 MME7131	480	2.710	2.690	2.140	0.018	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.11	Category 0
CENTRATE PMP 1	CB MCC-2983 P7151	480	2.560	2.550	2.040	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
CENTRATE PMP 2	CB MCC-2982 P7152	480	2.550	2.540	2.030	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
CHAN 2 AIR BLWR	CB MCC-2972 B2342	480	3.020	2.990	2.340	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.10	Category 0
CHANNEL AIR BLOWER 1	CB MCC-2971 B2541	480	3.040	3.000	2.340	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.10	Category 0
CVS5011	CB MCC-2976 CVS5011	480	0.770	0.770	0.620	0.477	Yes	PNL	25	00	14	18	42	12	1	Gen Min	0.76	Category 0
DECANT FACILITY	CB MCC-2971 DECANT	480	1.720	1.720	1.240	1.856	Yes	PNL	25	00	43	18	42	12	1	Gen Norm	4.98	Category 2
DEWAT POL-AGE TANK 2 MIX	CB MCC-2982 MXR7232	480	2.080	2.070	1.710	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
DIG WITH VLV 1	FU CV6193	480	1.570	1.570	1.350	0.010	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
DIG WITH VLV 2	FU CV6194	480	7.570	7.560	5.170	0.010	Yes	PNL	25	00	5	18	42	12	1	Norm Max	0.16	Category 0
DIG WITH PMP 1	CB DIG WITH P1	480	7.660	7.470	5.090	0.016	Yes	PNL	25	00	7	18	42	12	1	Norm Max	0.26	Category 0
DIG WITH PMP 2	CB DIG WITH P2	480	7.660	7.470	5.090	0.016	Yes	PNL	25	00	7	18	42	12	1	Norm Max	0.26	Category 0
DUPLEX SEAL WATER PMP 1	CB MCC-2983 P7103A	480	2.240	2.240	1.820	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.08	Category 0
DUPLEX SEAL WATER UNIT PMP 2	CB MCC-2982 P7103B	480	1.680	1.680	1.430	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.06	Category 0
DW POL AGE TANK	CB MCC-2981 CV7231	480	1.870	1.870	1.560	0.020	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
DW POLY 2 PMP	CB MCC-2982 P7242	480	1.810	1.800	1.510	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
DW POLY AGE TANK VLVS	CB MCC-2982 CV7232A&B	480	2.230	2.230	1.820	0.019	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.10	Category 0
DW POLY AGE TNK MIX	CB MCC-2981 MXR7231	480	2.140	2.130	1.750	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.08	Category 0
DW POLY FEED PMP	CB MCC-2981 P7241	480	1.860	1.840	1.540	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
EAST PRIMARY CLARIFIER	CB MCC-2971 ME1018	480	0.450	0.450	0.450	0.015	Yes	PNL	25	00	1	18	42	12	1	Norm Max	0.01	Category 0
ELEC RM COND UNIT	CB MCC-2973 ME2907	480	6.260	6.230	4.370	0.016	Yes	PNL	25	00	6	18	42	12	1	Norm Max	0.22	Category 0
ELEC RM RET FAN	CB MCC-2973 F2908	480	3.150	3.150	2.440	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.11	Category 0
F2015 UNIDOR VENT	CB MCC-2972 F2015	480	1.240	1.210	1.080	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.05	Category 0
FILT FEED PMP 1	CB MCC-2983 P7101	480	3.820	3.750	2.830	0.015	Yes	PNL	25	00	5	18	42	12	1	Norm Max	0.13	Category 0
GENERATOR 2994	MaxTripTime @2.0s	480	10.980	2.260	1.840	2.000	Yes	PNL	25	00	>999	18	42	12	1	Gen Norm	12.28	Category 3
GENERATOR 2994 (LineSide)	CB 2960-G1	480	10.980	6.000	3.880	0.083	Yes	PNL	25	00	24	18	42	12	1	Gen Norm	1.91	Category 1
GENERATOR 2995	MaxTripTime @2.0s	480	14.550	4.060	3.040	2.000	Yes	PNL	25	00	>999	18	42	12	1	Gen Norm	21.10	Category 3
GRIFT PUMP 1	CB MCC-2975 P1111	480	1.240	1.220	1.090	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.05	Category 0
GRIFT PUMP 2	CB MCC-2975 P1112	480	1.180	1.160	1.040	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
GRINDER	MCC-2971 3B	480	0.380	0.380	0.320	1.481	Yes	PNL	25	00	13	18	42	12	1	Gen Norm	0.64	Category 0
GRINDER #1	FU GDR6171	480	1.920	1.920	1.600	0.010	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.05	Category 0
GRINDER #2	FU GDR6172	480	1.920	1.920	1.600	0.010	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.05	Category 0

Arc Flash Table (based on recommended settings)

ERS # 3162884 Client: PSW Electric

Project: Central Kitsap

Bus Name	Protective Device Name	Voltage (V)	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/Delay Time (sec)	Ground	Equip Type	Gap (mm)	Glove Class	Arc Flash Boundary (in)	Working Distance (in)	Limited Approach (in)	Restricted Approach (in)	Prohibited Approach (in)	Scenario	Incident Energy (cal/cm ²)	PPE Category
GRIT PUMP-3	CB MCC-2976 P1121	480	1.090	1.070	0.970	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
GRIT PUMP-4	CB MCC-2976 P1122	480	1.040	1.020	0.930	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
HC1281 DISC	CB MCC-2975 HC1281	480	4.430	4.430	3.270	0.016	Yes	PNL	25	00	5	18	42	12	1	Norm Max	0.16	Category 0
HC1285 DISC	CB MCC-2975 HC1285	480	9.460	9.460	6.250	0.015	Yes	PNL	25	00	8	18	42	12	1	Norm Max	0.30	Category 0
HC1303 DISC	CB MCC-2976 HC1303	480	1.390	1.390	1.040	0.560	Yes	PNL	25	00	20	18	42	12	1	Gen Min	1.43	Category 1
HC-2903 ELECT RM AHU HEAT COIL	CB MCC-2973 HC2903	480	2.000	2.000	1.660	0.019	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
HYPO CIRC PMP 1	CB MCC-2981 P7310	480	2.140	2.130	1.750	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.08	Category 0
HYPO REC PMP 2	MCC-2983 5J	480	2.640	2.630	2.100	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
MCC 2972	CB 2960-G1	480	4.800	4.800	2.980	2.000	Yes	PNL	25	00	236	18	42	12	1	Gen Min	9.53	Category 3
MCC 2983	CB 2960-G1	480	4.370	4.370	3.230	2.000	Yes	PNL	25	00	240	18	42	12	1	Gen Min	10.84	Category 3
MCC-2 (LineSide)	CB 2960-G1	480	4.050	4.050	3.030	2.000	Yes	PNL	25	00	244	18	42	12	1	Gen Min	10.46	Category 3
MCC-2971 (LineSide)	CB 2960-G1	480	4.800	4.800	2.980	2.000	Yes	PNL	25	00	236	18	42	12	1	Gen Min	9.53	Category 3
MCC-2972 (LineSide)	CB 2960 B2	480	26.830	26.070	14.810	0.150	Yes	PNL	25	00	54	18	42	12	1	Normal	7.34	Category 2
MCC-2973 (LineSide)	CB 2960-G1	480	4.780	4.780	3.490	2.000	Yes	PNL	25	00	236	18	42	12	1	Gen Min	11.34	Category 3
MCC-2973 (LineSide)	CB 2960 A4	480	29.730	29.500	16.510	0.150	Yes	PNL	25	00	55	18	42	12	1	Norm Max	7.51	Category 2
MCC-2974 (LineSide)	CB 2960-G1	480	4.780	4.780	3.490	2.000	Yes	PNL	25	00	236	18	42	12	1	Gen Min	11.34	Category 3
MCC-2975 (LineSide)	CB 2960-G1	480	3.900	3.900	2.490	2.000	Yes	PNL	25	00	246	18	42	12	1	Gen Min	8.58	Category 3
MCC-2976 (LineSide)	CB 2960-G1	480	3.900	3.900	2.490	2.000	Yes	PNL	25	00	246	18	42	12	1	Gen Min	8.58	Category 3
MCC-2976 (LineSide)	CB 2960 B8	480	11.140	10.980	7.090	0.070	Yes	PNL	25	00	22	18	42	12	1	Normal	1.63	Category 1
MCC-2981 (LineSide)	CB 2960-G1	480	4.370	4.370	3.230	2.000	Yes	PNL	25	00	240	18	42	12	1	Gen Min	10.84	Category 3
MCC-2982	CB 2960-G1	480	4.370	4.370	3.230	2.000	Yes	PNL	25	00	240	18	42	12	1	Gen Min	10.84	Category 3
MCC-2982 (LineSide)	CB 2960 B9	480	16.570	16.440	10.020	0.070	Yes	PNL	25	00	27	18	42	12	1	Normal	2.35	Category 1
MCC-2983 (LineSide)	CB 2960-G1	480	4.370	4.370	3.230	2.000	Yes	PNL	25	00	240	18	42	12	1	Gen Min	10.84	Category 3
MCC-2984	CB 2960-G1	480	4.330	4.330	3.210	2.000	Yes	PNL	25	00	241	18	42	12	1	Gen Min	10.80	Category 3
MCC4 PANEL	FU MCC-4	480	3.530	3.530	2.290	2.000	Yes	PNL	25	00	130	18	42	12	1	Gen Min	8.24	Category 3
MEE1100	CB MCC-2976 MEE1100	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
MEE5012 SEPTAGE PANEL	CB MCC-2975 MEE5012	277	1.310	1.310	0.910	1.776	Yes	PNL	25	00	37	18	42	Avoid Contact	Avoid Contact	Gen Norm	3.93	Category 1
MEE7110 VFD PNL	CB 2960-G1	480	4.180	4.180	3.110	2.000	Yes	PNL	25	00	243	18	42	12	1	Gen Min	10.61	Category 3
NALGEAR PMP	CB MCC-2984 P7054	480	0.990	0.990	0.770	0.162	Yes	PNL	25	00	8	18	42	12	1	Gen Min	0.34	Category 0
NORTH TRAILER	CB S101 TRAIL	277	1.670	1.670	1.280	2.000	Yes	PNL	25	00	239	18	42	Avoid Contact	Avoid Contact	Norm Min	7.19	Category 2
OFFICE LAB SWITCHES	FU TFR LAB	277	9.630	9.630	4.700	2.000	Yes	PNL	25	00	>999	18	42	Avoid Contact	Avoid Contact	Normal	29.15	Category 4
P1001 VFD	CB MCC-2971 P1001	480	26.650	26.650	15.150	0.015	Yes	PNL	25	00	14	18	42	12	1	Norm Max	0.78	Category 0
P2514 VFD	CB MCC-2972 P2514	480	27.460	27.460	15.540	0.013	Yes	PNL	25	00	13	18	42	12	1	Norm Max	0.69	Category 0
P2515 VFD	CB MCC-2972 P2515	480	27.460	27.460	15.540	0.013	Yes	PNL	25	00	13	18	42	12	1	Norm Max	0.69	Category 0
P7112 VFD	CB MCC-2981 P7112	480	16.850	16.590	10.080	0.015	Yes	PNL	25	00	11	18	42	12	1	Norm Max	0.51	Category 0
P7241 VFD	CB MCC-2981 P7241	480	16.760	16.710	10.170	0.015	Yes	PNL	25	00	11	18	42	12	1	Norm Max	0.51	Category 0
PANEL 1990	CB PNL 1990 MAIN	277	3.710	3.710	2.320	2.000	No	PNL	25	00	180	18	42	Avoid Contact	Avoid Contact	Norm Min	17.73	Category 3
PANEL 1990 (LineSide)	CB MCC-2971 TFR-1990	277	3.710	3.710	2.320	2.000	No	PNL	25	00	812	18	42	Avoid Contact	Avoid Contact	Norm Min	17.73	Category 3
PANEL A	FU LAB PNL A	277	7.990	7.990	3.480	0.596	Yes	PNL	25	00	49	18	42	Avoid Contact	Avoid Contact	Normal	6.28	Category 2
PANEL B	CB MCC-2972 OFF TX	277	0.950	0.950	0.840	2.000	Yes	PNL	25	00	56	18	42	Avoid Contact	Avoid Contact	Gen Norm	4.43	Category 2
PANEL MP	CB PNL MP	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PLATE DEWATER PRESS	CB MCC-2983 MME7100	480	2.690	2.690	2.140	0.018	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.11	Category 0
PNL 1021	CB MCC-2975 PNL1021	480	3.130	3.130	2.430	0.017	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.12	Category 0
PNL 1023	CB MCC-2976 PNL1023	480	2.210	2.210	1.800	0.018	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.10	Category 0
PNL 1025	CB MCC-2975 PNL 1025	480	3.130	3.130	2.430	0.017	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.12	Category 0
PNL 1026	CB MCC-2975 PNL 1026	480	1.920	1.920	1.600	0.019	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
PNL 1027	CB MCC-2975 PNL1027	480	1.540	1.540	1.130	0.028	Yes	PNL	25	00	4	18	42	12	1	Gen Min	0.09	Category 0
PNL 1028	CB MCC 2976 PNL 1028	480	1.810	1.810	1.520	0.020	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
PNL 1070	CB MCC-2975 PNL1070	480	0.510	0.510	0.430	0.793	Yes	PNL	25	00	11	18	42	12	1	Gen Norm	0.46	Category 0
PNL 1250 (LineSide)	CB MCC-2975 PNL-1250	480	0.960	0.940	0.740	0.405	Yes	PNL	25	00	14	18	42	12	1	Gen Norm	0.75	Category 0
PNL 2958 (LineSide)	CB MCC-2974 PNL 2958	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2973	CB PNL 2973	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Norm Max	---	Category 1
PNL 2973 (LineSide)	CB MCC-2973 TFR-2957	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2975 (LineSide)	CB MCC-2975 PNL2975	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2976	CB MCC-2976 PNL 2976	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2976 (LineSide)	CB MCC-2976 PNL 2976	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2981	MCC-2981 5F	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2981 (LineSide)	MCC-2981 5F	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 2982 (LineSide)	MCC-2982 4F	208	---	---	---	---	Yes	PNL	25	00	19	18	42	Avoid Contact	Avoid Contact	Normal	---	Category 1
PNL 5010	CB MCC 2976 PNL 5010	480	1.540	1.540	1.130	0.028	Yes	PNL	25	00	4	18	42	12	1	Gen Min	0.09	Category 0
PNL 5020	CB MCC 2976 PNL 5020	480	1.020	1.020	0.790	0.351	Yes	PNL	25	00	13	18	42	12	1	Gen Min	0.71	Category 0
PNL 7225 DEWAT POL DIST PNL	CB MCC-2981 PNL 7225	480	1.570	1.570	1.350	0.021	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.08	Category 0
PNL C	FU PANEL C	277	1.390	1.390	0.950	0.159	Yes	PNL	25	00	9	18	42	Avoid Contact	Avoid Contact	Gen Min	0.42	Category 0
PNL C (LineSide)	FU PANEL C	277	1.390	1.390	0.950	0.159	Yes	PNL	25	00	9	18	42	Avoid Contact	Avoid Contact	Gen Min	0.42	Category 0
PNL-1090 PLANT WW SMP PNL	CB MCC-2973 PNL1090	480	7.920	7.920	5.380	0.015	Yes	PNL	25	00	7	18	42	12	1	Norm Max	0.26	Category 0
PRESS PRES WASH	CB MCC-2981 MME7106	480	1.880	1.870	1.560	0.020	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
PRIMARY GALLERY EXH FAN	CB MCC-2976 F1302	480	0.510	0.510	0.510	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.01	Category 0

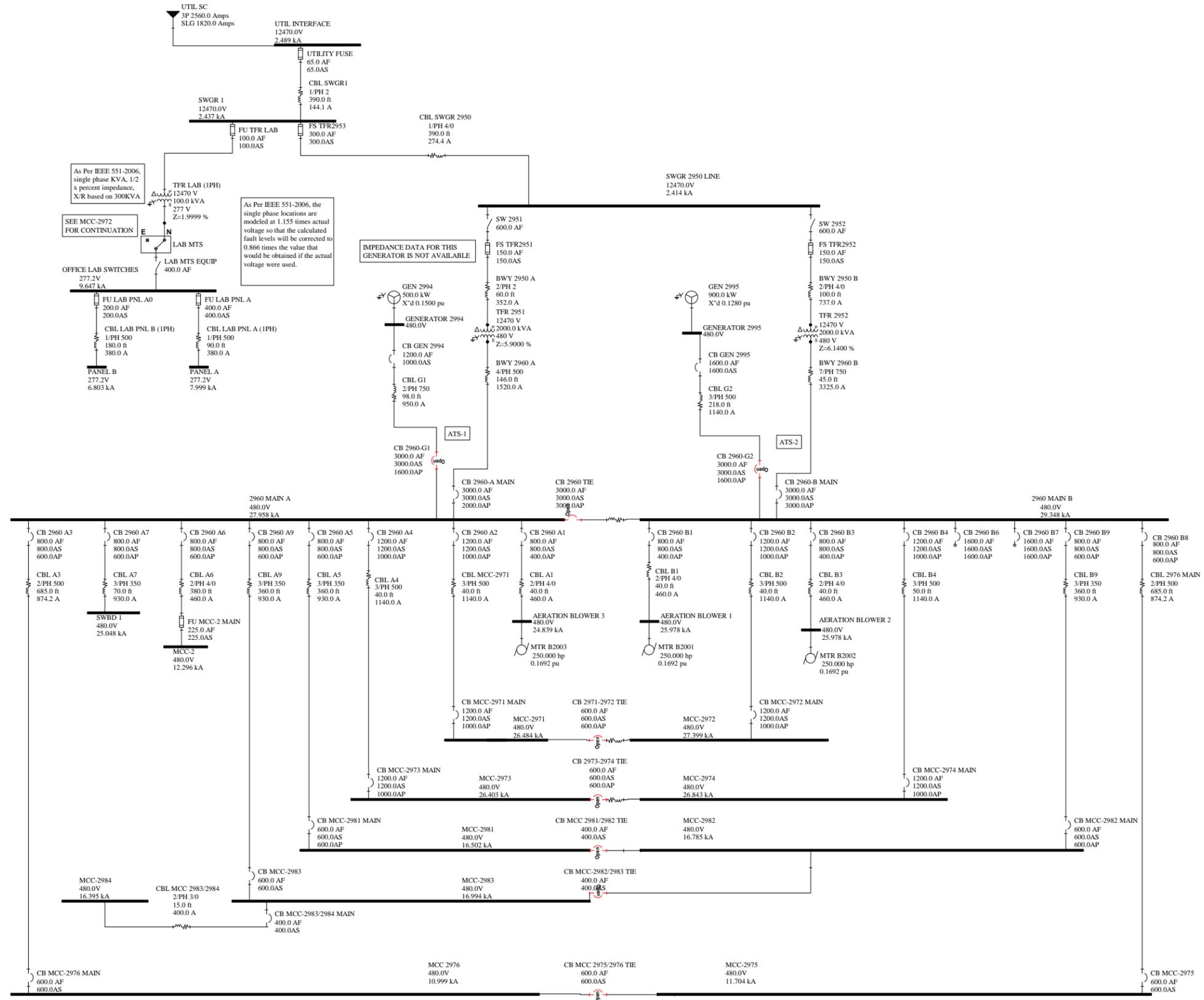
Arc Flash Table (based on recommended settings)

ERS # 3162884 Client: PSW Electric

Project: Central Kitsap

Bus Name	Protective Device Name	Voltage (V)	Bus Bolted Fault (kA)	Prot Dev Bolted Fault (kA)	Prot Dev Arcing Fault (kA)	Trip/Delay Time (sec)	Ground	Equip Type	Gap (mm)	Glove Class	Arc Flash Boundary (in)	Working Distance (in)	Limited Approach (in)	Restricted Approach (in)	Prohibited Approach (in)	Scenario	Incident Energy (cal/cm ²)	PPE Category
PRIMARY GALLERY SUP FAN	CB MCC-2976 F1301	480	0.460	0.450	0.450	0.015	Yes	PNL	25	00	1	18	42	12	1	Norm Max	0.01	Category 0
PROCESS WATER PUMP 1	CB MCC-2971 P3001	480	2.130	2.020	1.660	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.08	Category 0
PROCESS WATER PUMP 3	CB MCC-2971 P3003	480	1.830	1.830	1.300	1.350	Yes	PNL	25	00	38	18	42	12	1	Gen Min	4.03	Category 2
PROCESS WTR PMP 2	CB MCC-2972 P3002	480	2.060	1.950	1.610	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
RET ACT SLUDGE PMP 1	CB MCC-2971 P2511	480	0.380	0.360	0.310	1.556	Yes	PNL	25	00	13	18	42	12	1	Gen Norm	0.65	Category 0
RET ACT SLUDGE PMP 2	MCC-2971 8M	480	0.380	0.370	0.310	1.510	Yes	PNL	25	00	13	18	42	12	1	Gen Norm	0.65	Category 0
RET ACT SLUDGE PMP 3	CB MCC-2972 P2513	480	0.390	0.380	0.380	0.015	Yes	PNL	25	00	1	18	42	12	1	Gen Norm	0.01	Category 0
S101 PANEL	FU MCC-4	480	3.540	3.540	2.300	2.000	Yes	PNL	25	00	130	18	42	12	1	Gen Min	8.25	Category 3*
S102 PANEL	CB S102 MAIN	277	3.430	3.430	1.860	2.000	Yes	PNL	25	00	57	18	42	Avoid Contact	Avoid Contact	Gen Norm	7.35	Category 2
S102 PANEL (LineSide)	CB S101 S102	277	3.760	3.760	2.340	2.000	Yes	PNL	25	00	195	18	42	Avoid Contact	Avoid Contact	Norm Min	13.81	Category 3
SAN DRAIN PMP 1	CB MCC-2972 P2011	480	0.990	0.970	0.900	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
SAN DRAIN PMP 2	MCC-2972 10D	480	0.990	0.970	0.900	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
SCUM PUMP	CB MCC-2971 P1004	480	0.420	0.400	0.400	0.015	Yes	PNL	25	00	1	18	42	12	1	Gen Norm	0.01	Category 0
SCUM PUMP 1	CB MCC-2972 P1003	480	0.380	0.360	0.360	0.015	Yes	PNL	25	00	1	18	42	12	1	Gen Norm	0.01	Category 0
SEC CLAR COLL 2	CB MCC-2972 COL2520	480	0.380	0.380	0.380	0.015	Yes	PNL	25	00	1	18	42	12	1	Norm Max	0.01	Category 0
SECONDARY CLAR COLL 1	CB MCC-2971 COL2510	480	0.500	0.500	0.500	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.01	Category 0
SEPTAGE PMP 1	CB MCC-2983 P7161	480	2.330	2.300	1.860	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.08	Category 0
SEPTAGE PMP 2	CB MCC-2984 P7162	480	1.620	1.590	1.360	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.06	Category 0
SEPTAGE PWR CENTER	CB MCC-2975 MEE5012	480	1.050	1.050	0.810	0.627	Yes	PNL	25	00	19	18	42	12	1	Gen Norm	1.25	Category 1
SERV AIR CMP 2 PNL	CB MCC-2984 PNL7031	480	3.590	3.530	2.690	0.017	Yes	PNL	25	00	5	18	42	12	1	Norm Max	0.14	Category 0
SERV AIR COMP 1 PNL	CB MCC-2983 PNL7030	480	2.450	2.420	1.950	0.018	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.11	Category 0
SLDG BLDG HT WT PMP	CB MCC-2983 P7209	480	2.730	2.730	2.160	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.10	Category 0
SLUDGE BLD LAB AREA EXH FAN	CB MCC-2983 F7205	480	2.140	2.140	1.760	0.015	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.08	Category 0
SLUDGE BLDG AHU-1	CB MCC-2983 AHU7211	480	1.040	1.030	0.940	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.04	Category 0
SLUDGE BLDG AHU-2	CB MCC-2983 AHU7202	480	18.170	18.120	10.890	0.015	Yes	PNL	25	00	11	18	42	12	1	Norm Max	0.55	Category 0*
SLUDGE BLDG ELEC RM ACU	CB MCC-2983 ACU7212	480	1.380	1.380	1.030	0.033	Yes	PNL	25	00	4	18	42	12	1	Gen Min	0.09	Category 0
SLUDGE BLDG RM EXH FAN	CB MCC-2983 F7208	480	18.140	18.120	10.900	0.015	Yes	PNL	25	00	11	18	42	12	1	Norm Max	0.55	Category 0*
SLUDGE CHEM RM SUP FAN	CB MCC-2983 F7207	480	2.500	2.500	2.010	0.015	Yes	PNL	25	00	4	18	42	12	1	Norm Max	0.09	Category 0
SLUDGE MIXING P1	FU P6013	480	3.040	3.010	2.340	0.010	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
SLUDGE MIXING P2	FU P6023	480	3.040	3.010	2.340	0.010	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.07	Category 0
SLUDGE RECIRC P1	FU P6112	480	2.050	2.040	1.680	0.010	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.05	Category 0
SLUDGE RECIRC P2	FU P6122	480	2.050	2.040	1.680	0.010	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.05	Category 0
SOUTH TRAILER	CB S101 TRAIL	277	1.890	1.890	1.410	2.000	Yes	PNL	25	00	231	18	42	Avoid Contact	Avoid Contact	Norm Min	7.96	Category 2
SWBD 1	CB 2960 A7	480	10.650	10.640	6.910	2.000	Yes	PNL	25	00	498	18	42	12	1	Gen Norm	12.30	Category 3
SWGR 1	UTILITY FUSE	12,470	2.700	2.390	2.370	0.083	Yes	SWG	153	2	6	36	60	26	7	Normal	0.26	Category 0
SWGR 2950 LINE	UTILITY FUSE	12,470	2.670	2.360	2.350	0.085	Yes	SWG	153	2	6	36	60	26	7	Normal	0.26	Category 0
TANK DRAIN PUMP	CB MCC-2975 P1253	480	0.580	0.570	0.570	0.015	Yes	PNL	25	00	2	18	42	12	1	Norm Max	0.01	Category 0
THKND SLUDGE PMP #1	FU P6011	480	2.420	2.400	1.940	0.010	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.06	Category 0
THKND SLUDGE PMP #2	FU P6021	480	2.260	2.240	1.830	0.010	Yes	PNL	25	00	3	18	42	12	1	Norm Max	0.05	Category 0
TX PANEL 3100	CB MCC-2973 PNL3100	440	4.320	4.320	3.070	2.000	Yes	PNL	25	00	576	18	42	12	1	Norm Min	18.52	Category 3
TX PANEL 3200	CB MCC-2974 PNL3200	440	4.200	4.200	3.000	2.000	Yes	PNL	25	00	585	18	42	12	1	Normal	17.68	Category 3
UV PWR DIST CHAN 2	CB 2960-G1	480	3.900	3.900	2.930	2.000	Yes	PNL	25	00	246	18	42	12	1	Gen Min	10.22	Category 3
UV PWR DIST CHAN 2 (LineSide)	CB 2960-G1	480	3.900	3.900	2.930	2.000	Yes	PNL	25	00	246	18	42	12	1	Gen Min	10.22	Category 3
UV PWR DIST CHNL 1	CB MCC-2973 PNL3100	480	4.130	4.130	3.080	2.000	Yes	PNL	25	00	436	18	42	12	1	Gen Min	10.54	Category 3
UV PWR DIST CHNL 1 (LineSide)	CB MCC-2973 PNL3100	480	4.130	4.130	3.080	2.000	Yes	PNL	25	00	436	18	42	12	1	Gen Min	10.54	Category 3
UVB-3110	CB MCC-2973 PNL3100	440	4.090	3.750	2.690	2.000	Yes	PNL	25	00	665	18	42	12	1	Norm Min	17.64	Category 3
UVB-3120	CB MCC-2973 PNL3100	440	4.090	3.750	2.690	2.000	Yes	PNL	25	00	665	18	42	12	1	Norm Min	17.64	Category 3
UVB-3121	CB MCC-2974 PNL3200	440	3.990	3.660	2.630	2.000	Yes	PNL	25	00	676	18	42	12	1	Normal	16.88	Category 3
UVB-3210	CB MCC-2974 PNL3200	440	3.990	3.660	2.630	2.000	Yes	PNL	25	00	676	18	42	12	1	Normal	16.88	Category 3
VFD P1002	CB MCC-2972 P1002	480	28.330	28.330	15.960	0.015	Yes	PNL	25	00	14	18	42	12	1	Norm Max	0.83	Category 0
VFD P2531	CB MCC-2971 P2531	480	24.820	24.820	14.250	0.013	Yes	PNL	25	00	12	18	42	12	1	Norm Max	0.63	Category 0
WAS PUMP 2	CB MCC-2972 P2532	480	0.360	0.360	0.300	1.586	Yes	PNL	25	00	13	18	42	12	1	Gen Min	0.66	Category 0
WEST PRI CLAR	CB MCC-2972 ME1019	480	0.280	0.280	0.280	0.015	Yes	PNL	25	00	1	18	42	12	1	Norm Max	0.00	Category 0

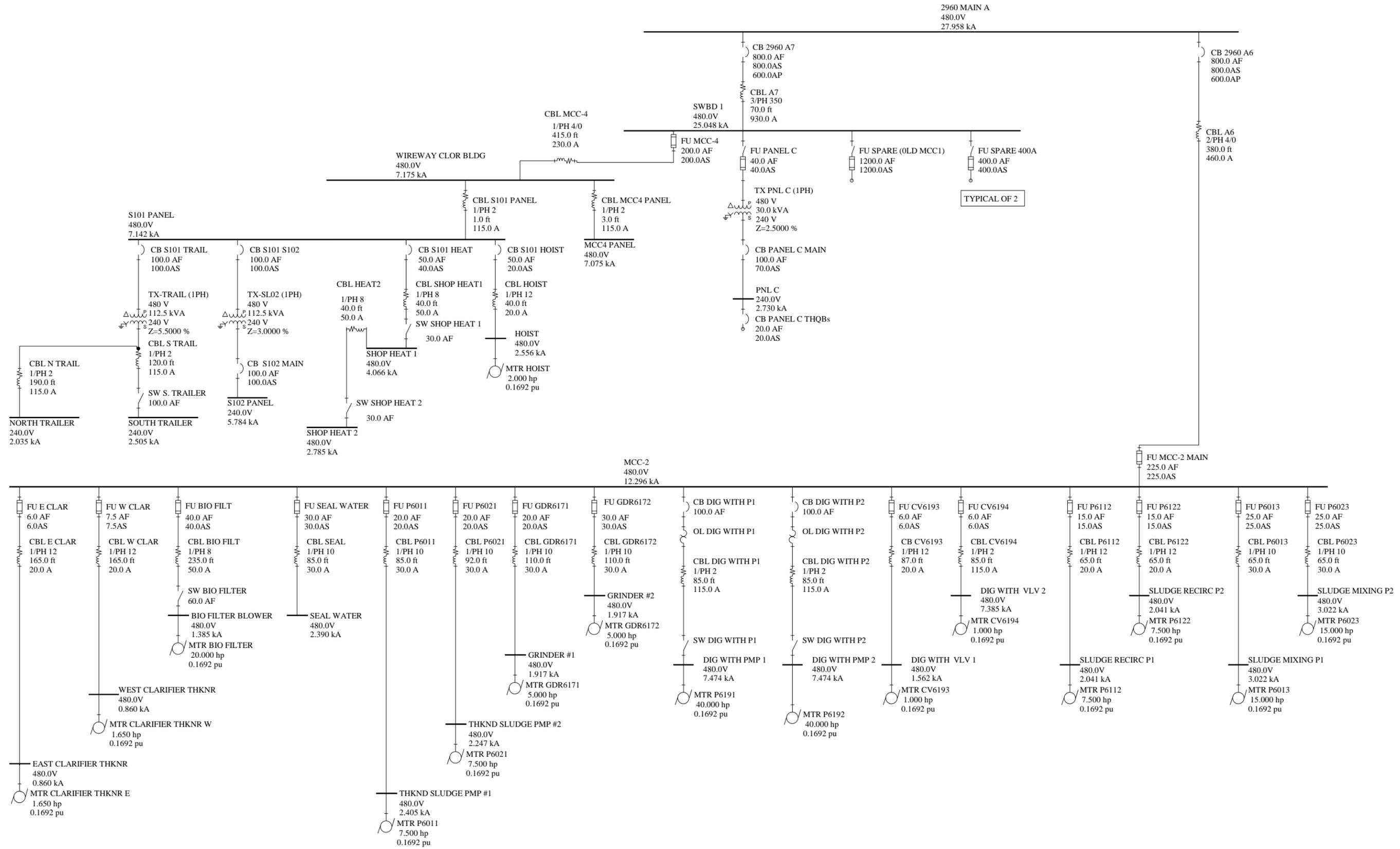
APPENDIX 9:STUDY AND IMPEDANCE DIAGRAMS



Drawing Name: SL01
Client: PSW Electric

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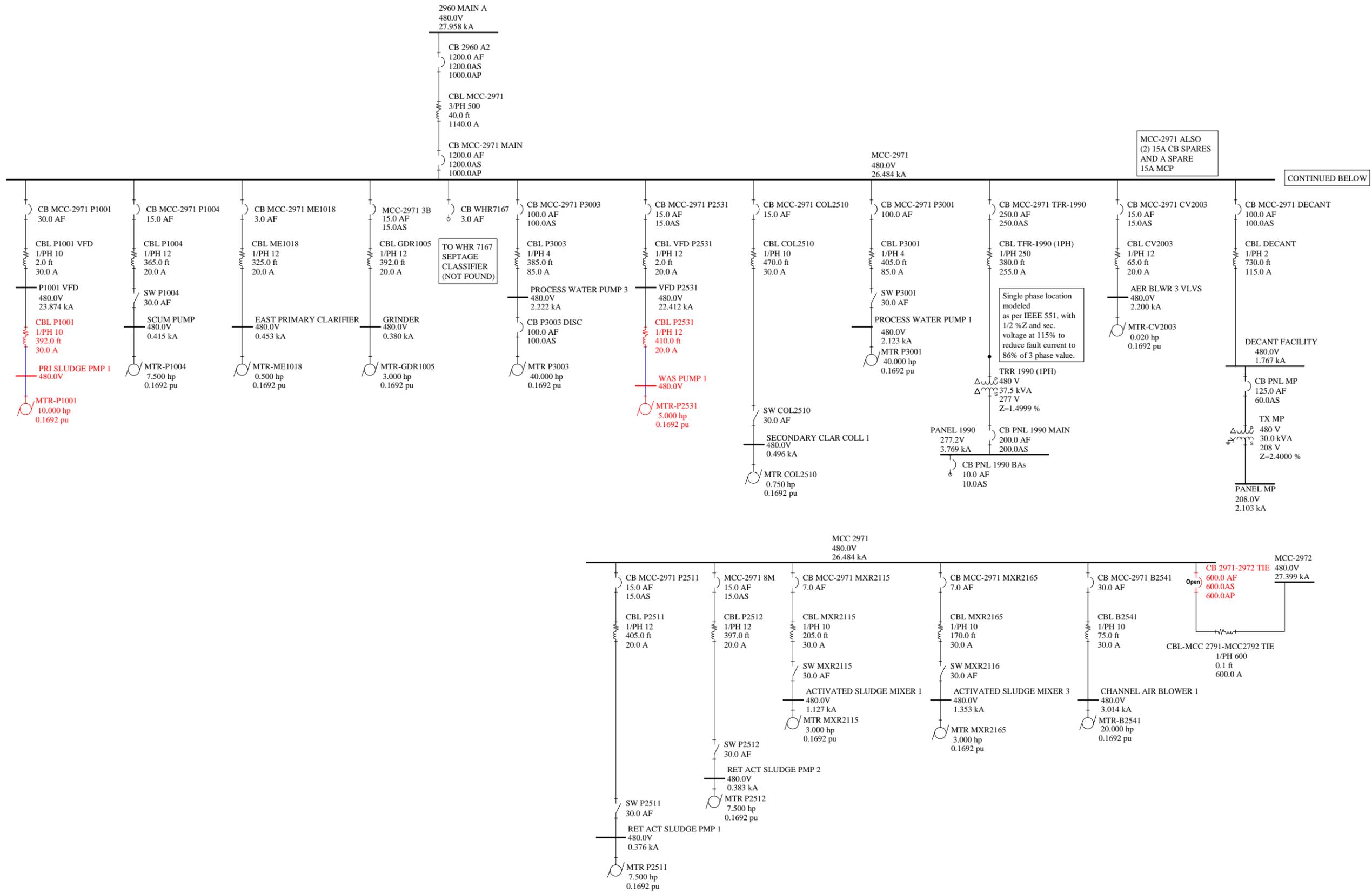
October 1, 2012
3162884

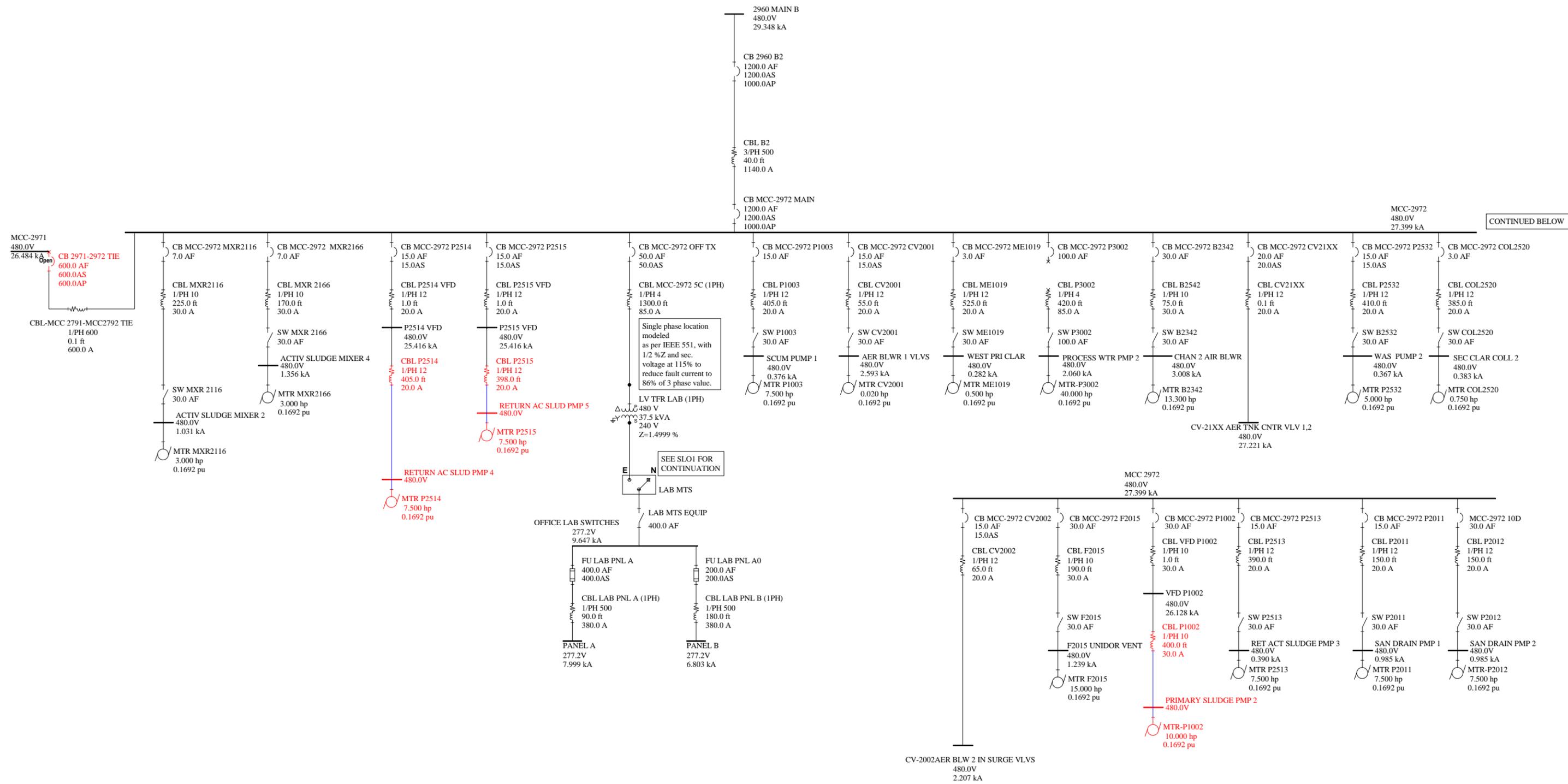


Drawing Name: SWBD 1 & MCC2
 Client: PSW Electric

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CONTINUED BELOW



Drawing Name: MCC-2972
 Client: PSW Electric

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2960 MAIN A
480.0V
27.958 kA

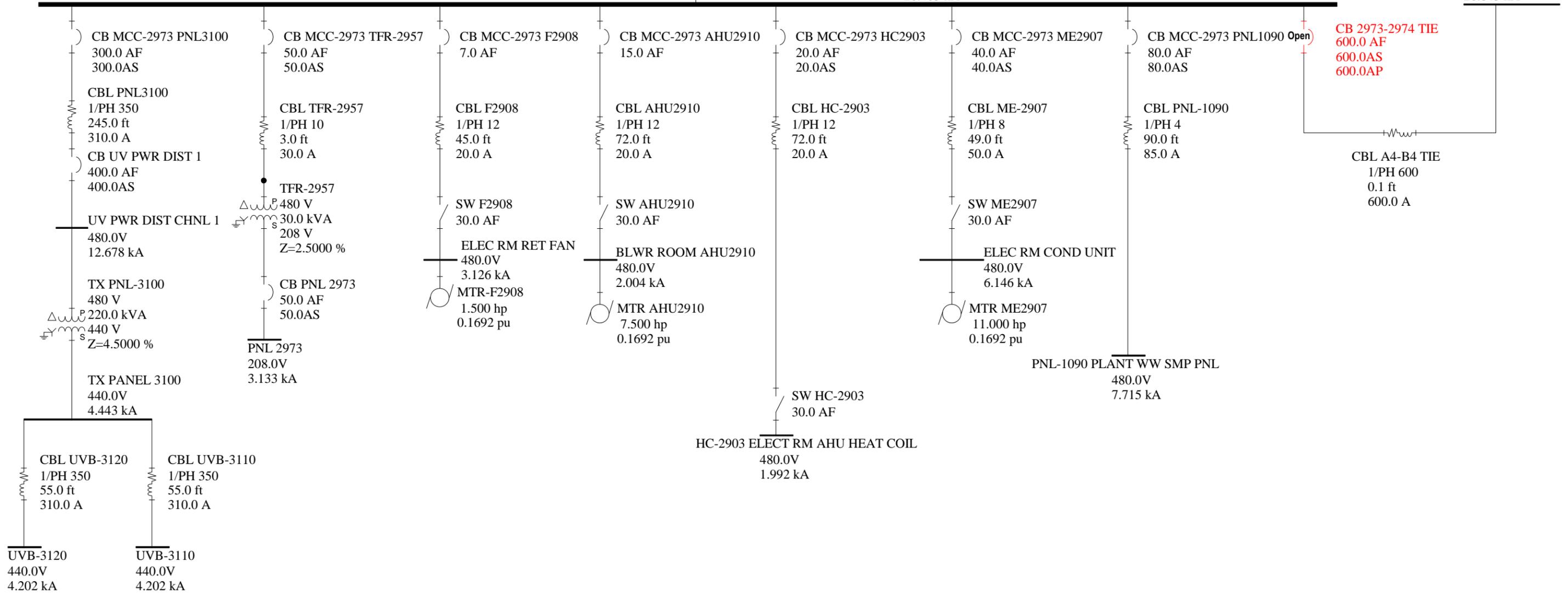
CB 2960 A4
1200.0 AF
1200.0AS
1000.0AP

CBL A4
3/PH 500
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1140.0 A

CB MCC-2973 MAIN
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1200.0AS
1000.0AP

MCC-2973
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26.403 kA

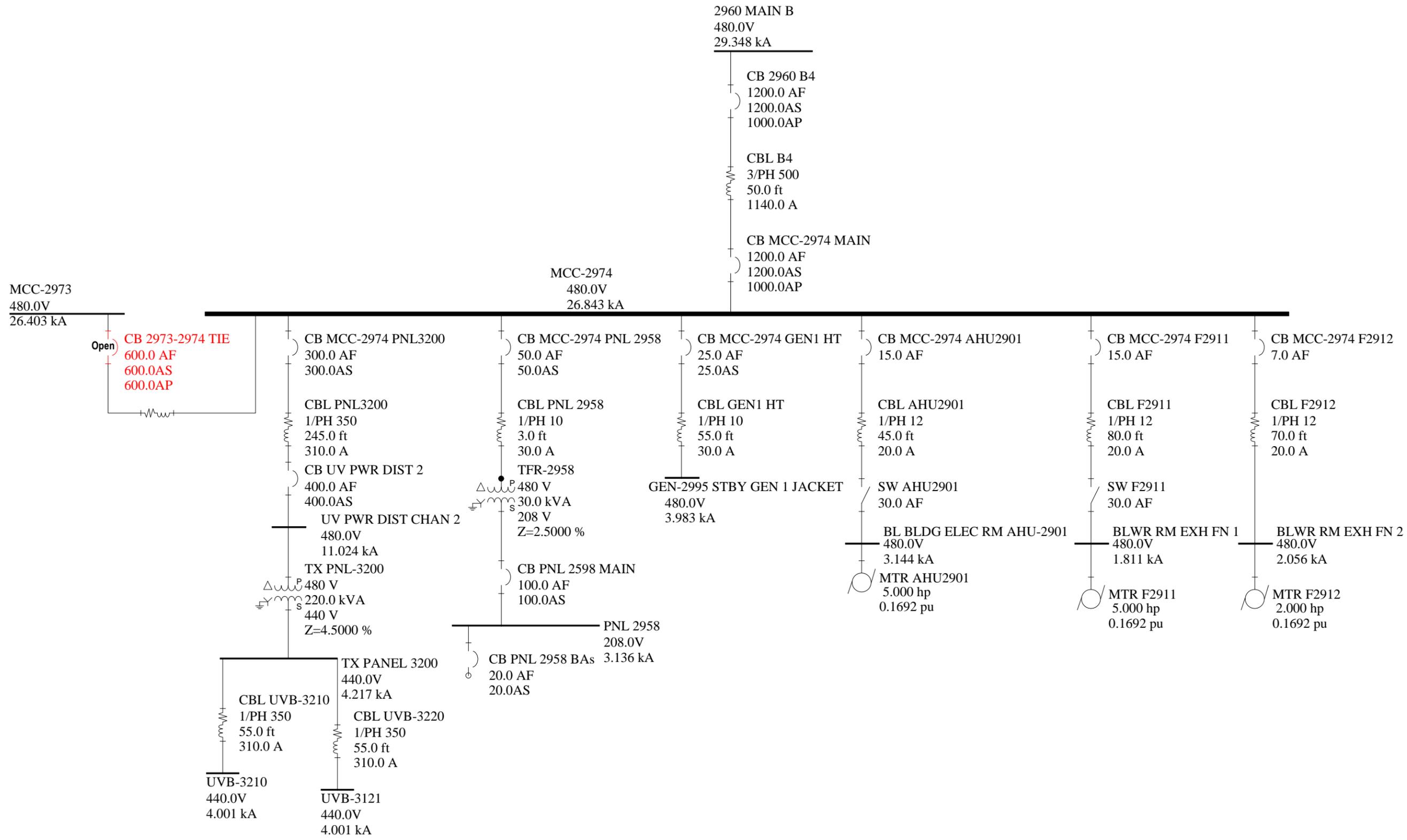
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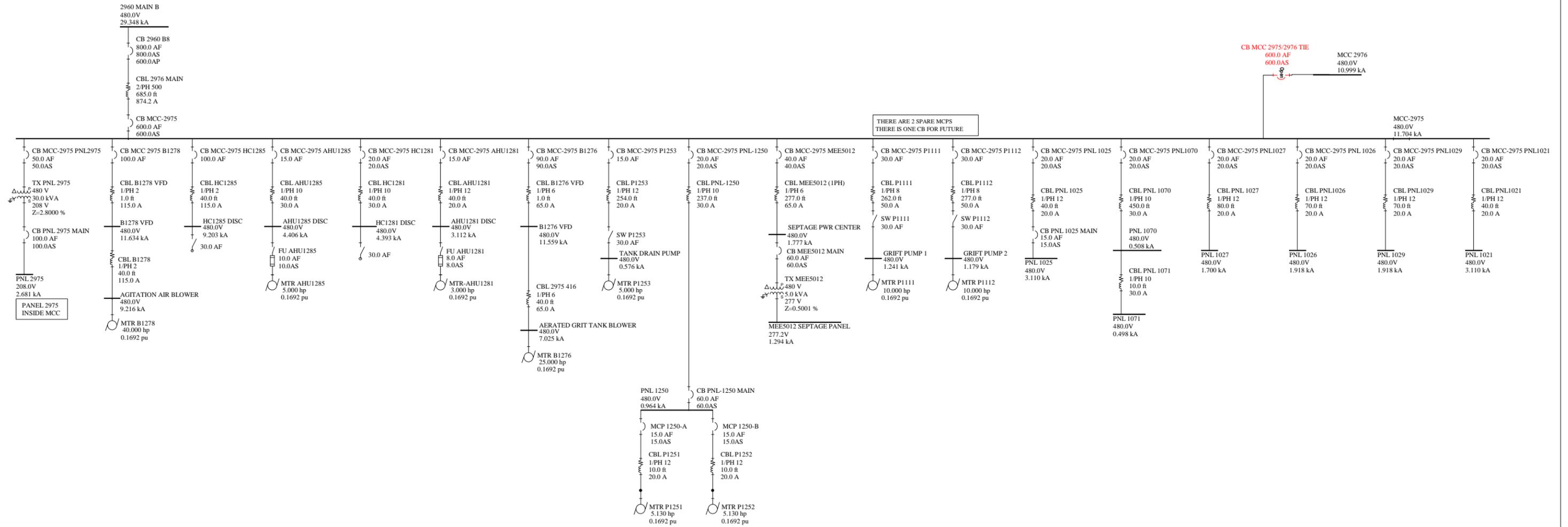


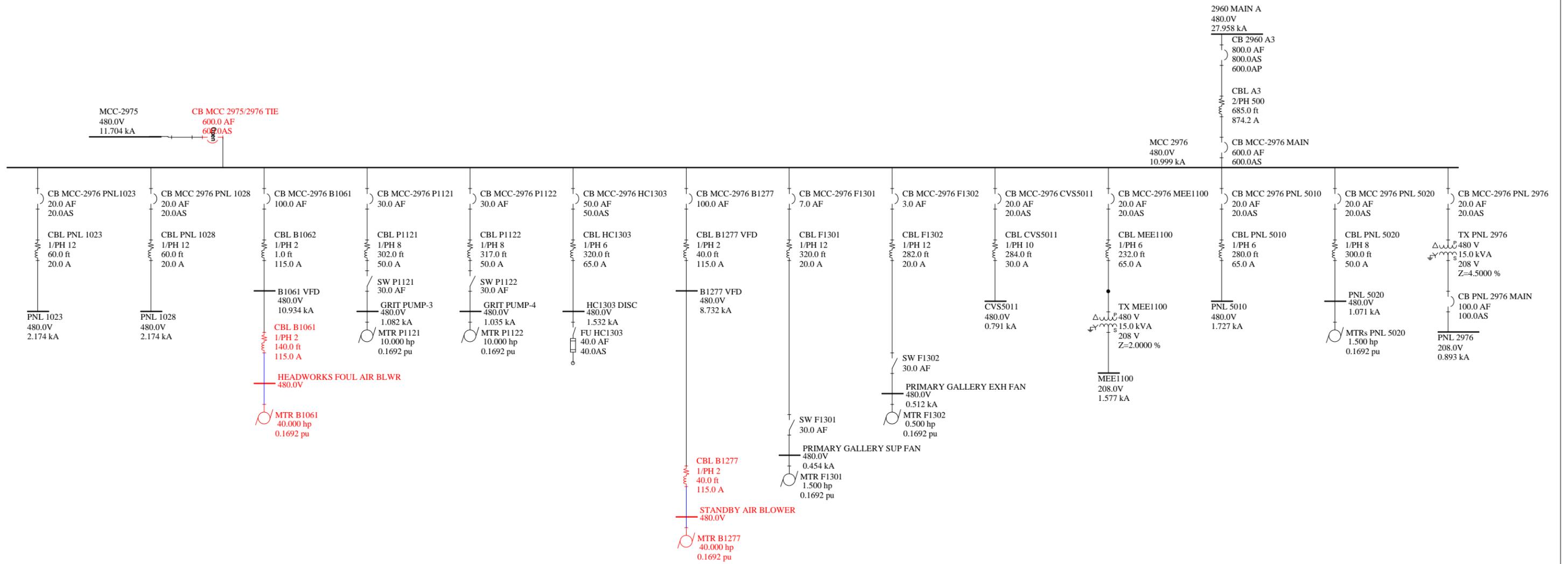
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Client: PSW Electric

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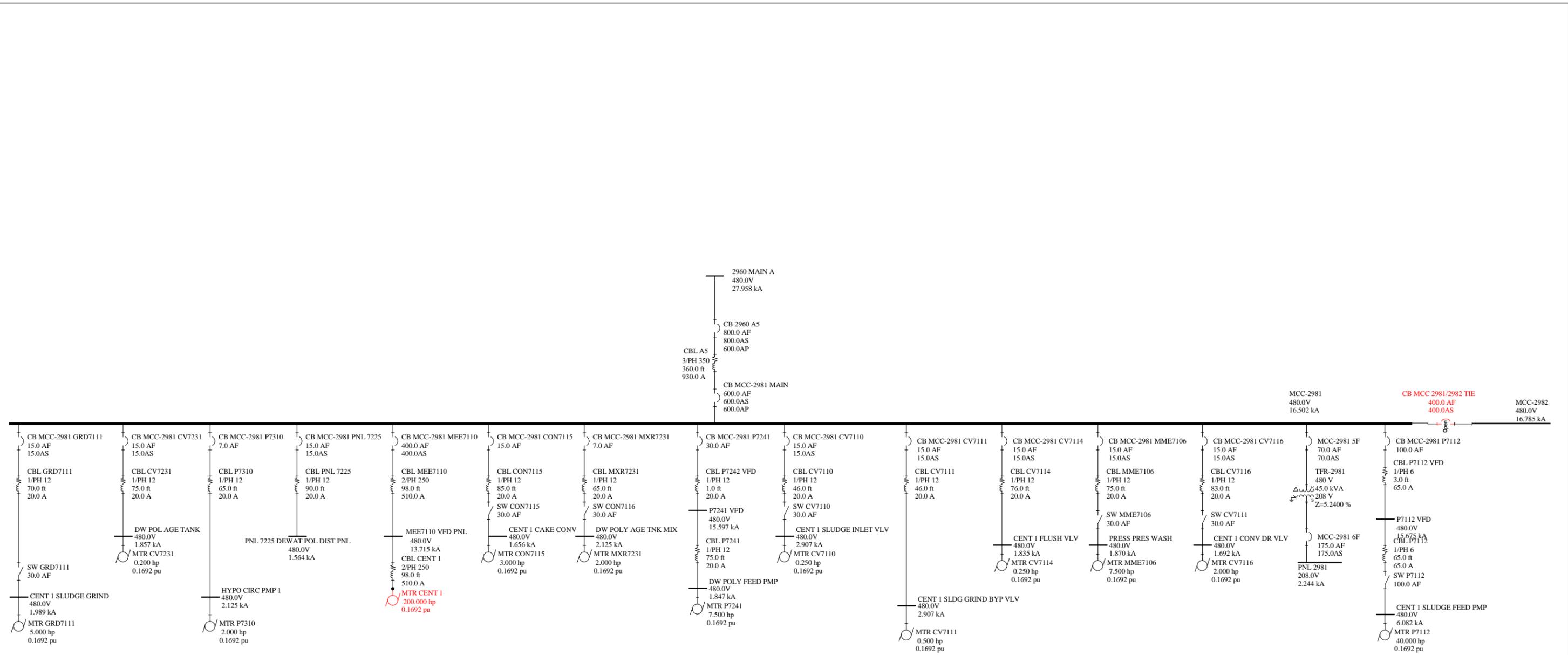


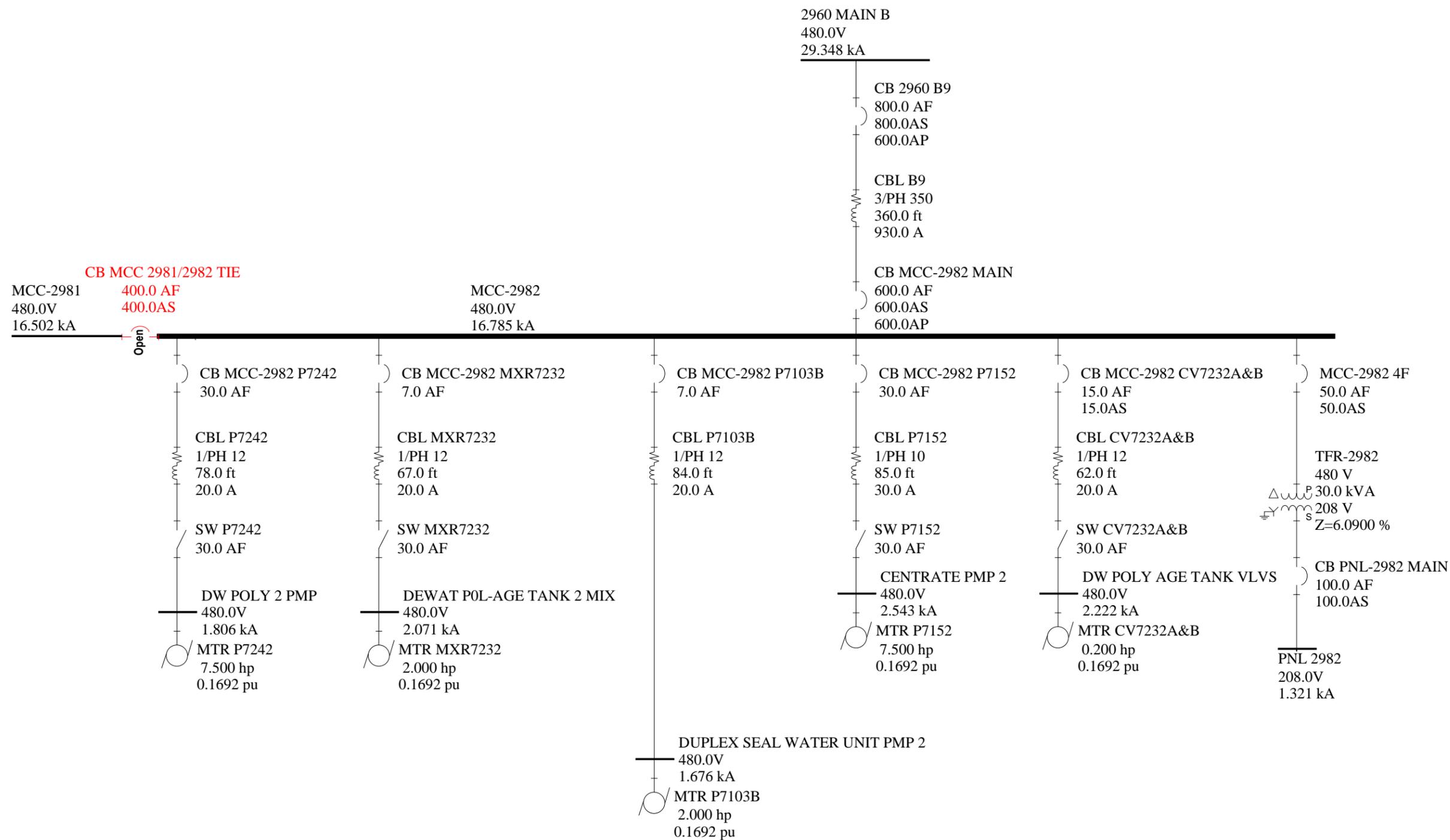


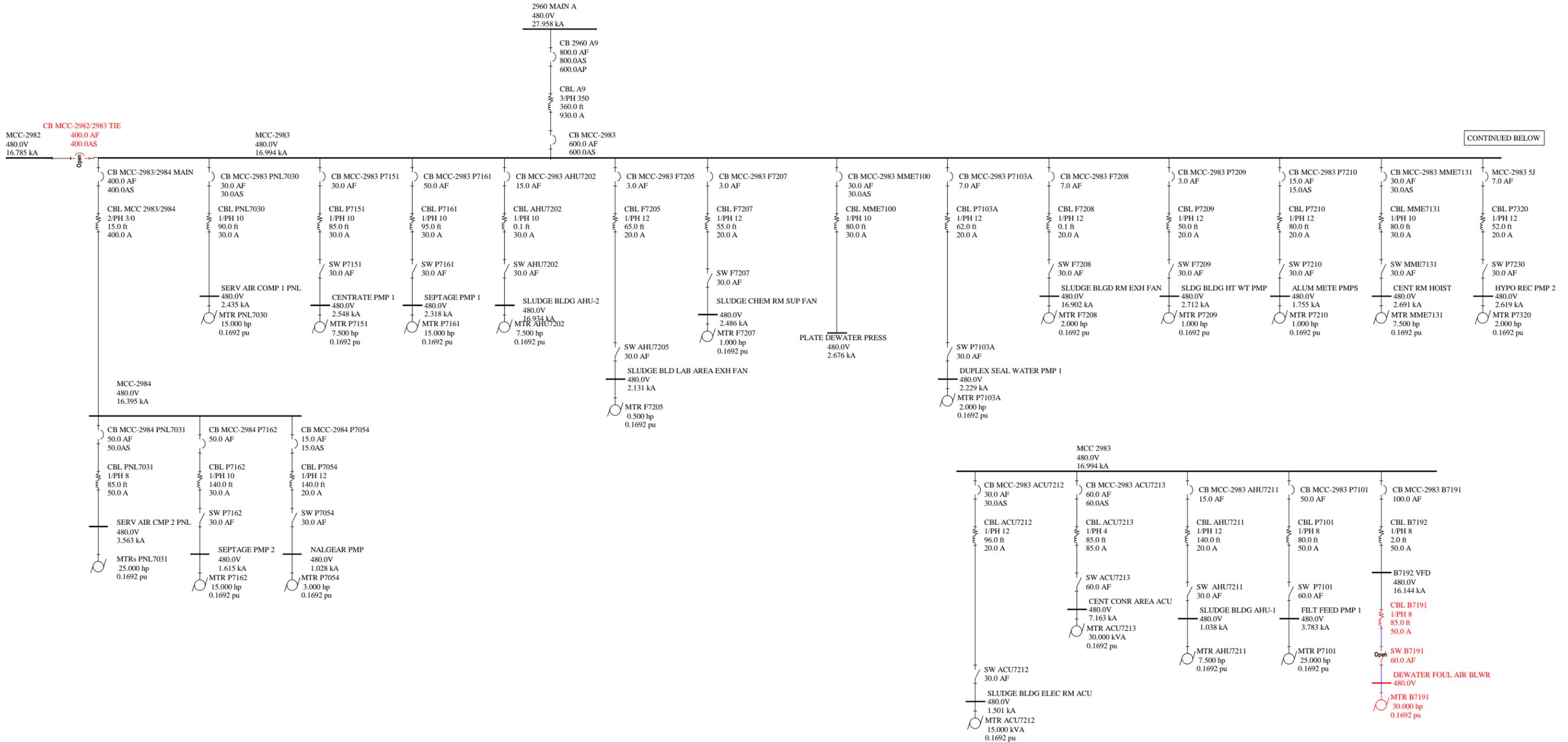
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Client: PSW Electric

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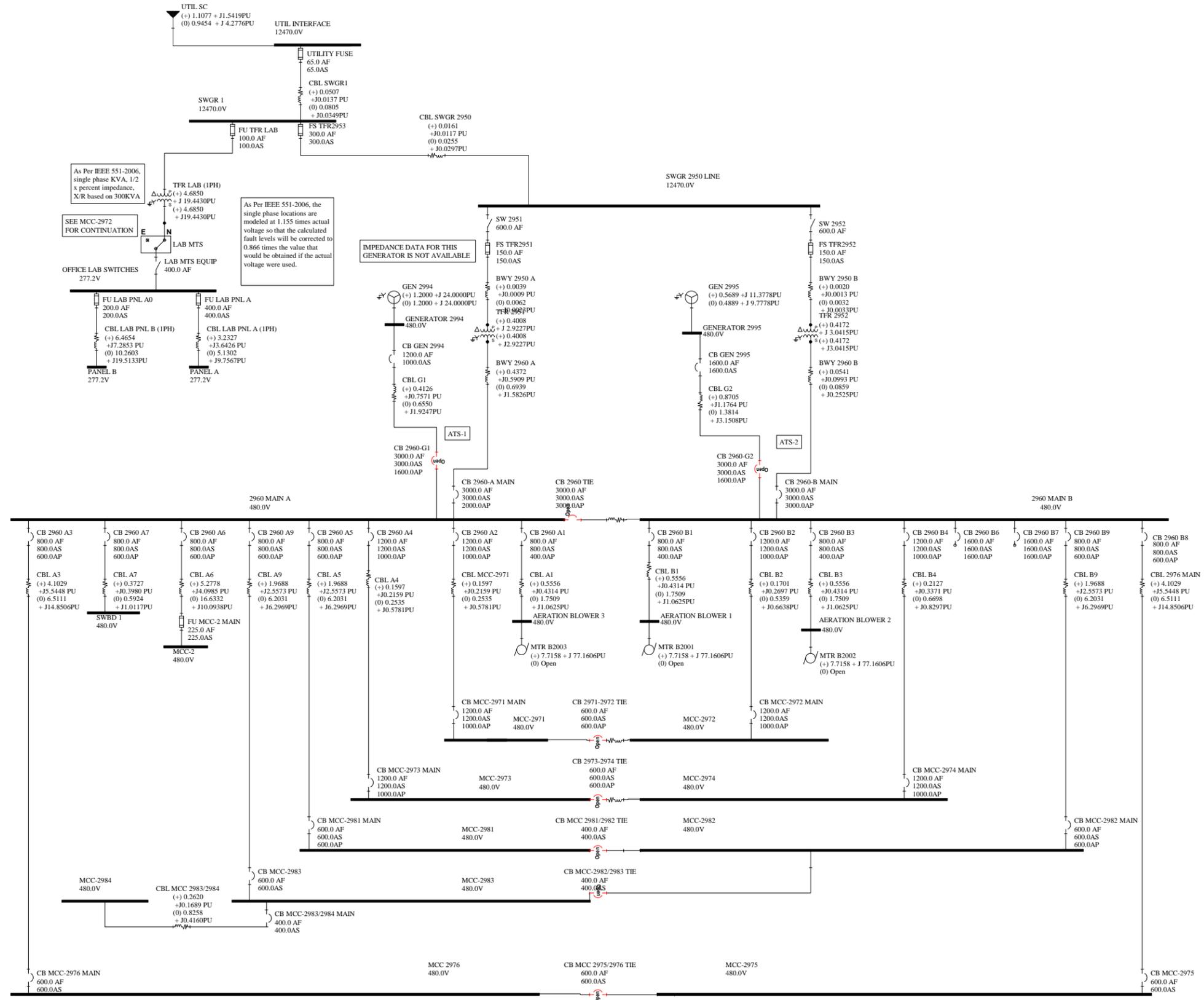
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Drawing Name: MCC-2983
Client: PSW Electric

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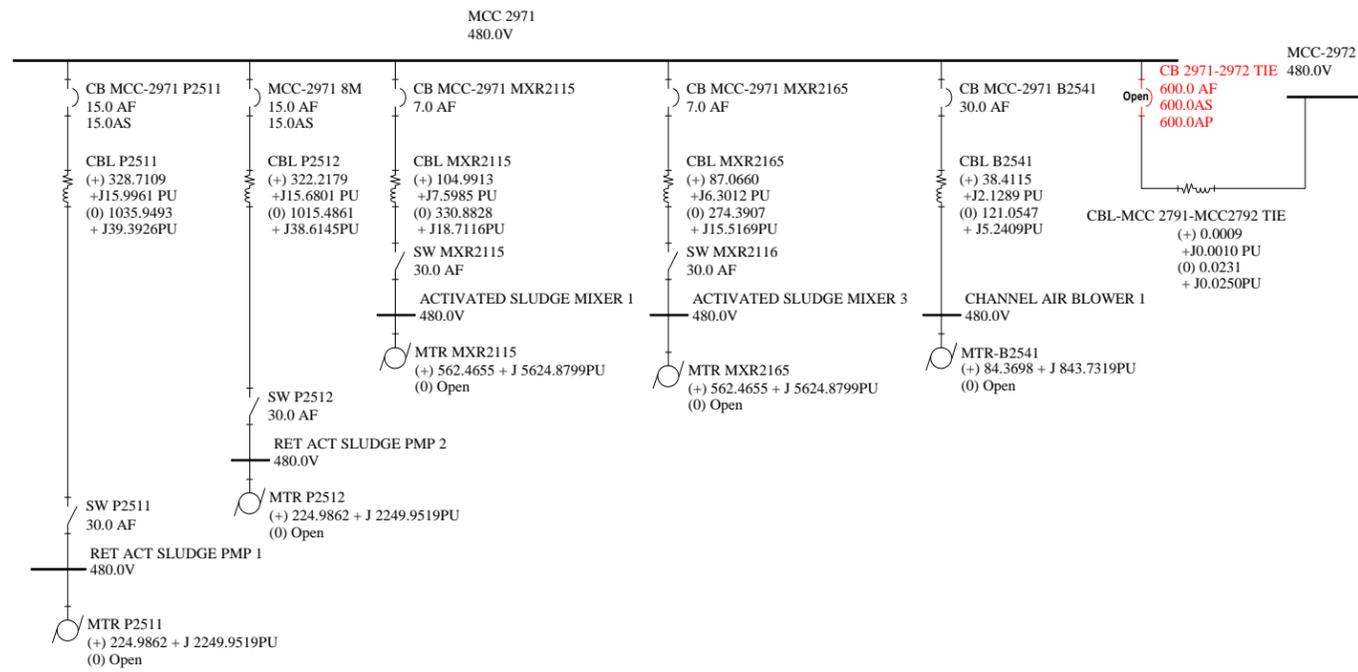
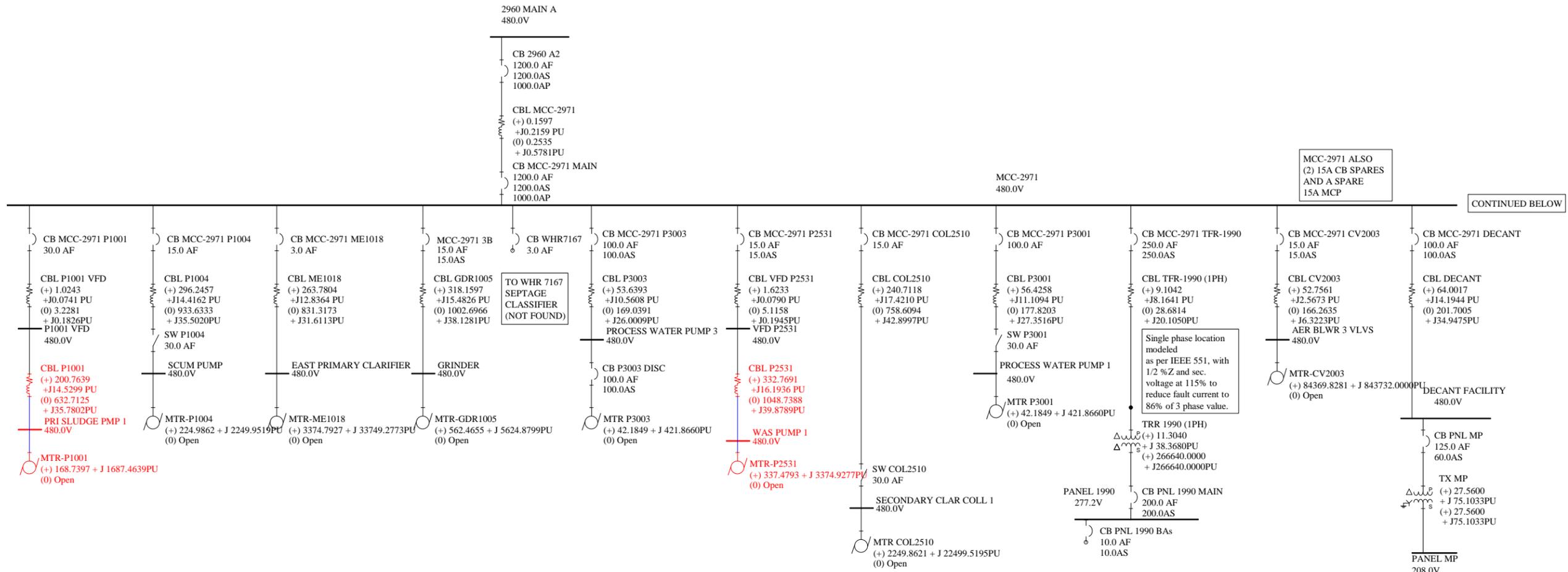


As Per IEEE 551-2006, single phase KVA, 1/2 x percent impedance, X/R based on 300KVA

SEE MCC-2972 FOR CONTINUATION

As Per IEEE 551-2006, the single phase locations are modeled at 1.155 times actual voltage so that the calculated fault levels will be corrected to 0.866 times the value that would be obtained if the actual voltage were used.

IMPEDANCE DATA FOR THIS GENERATOR IS NOT AVAILABLE



Drawing Name: MCC-2971
Client: PSW Electric

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2960 MAIN A
480.0V

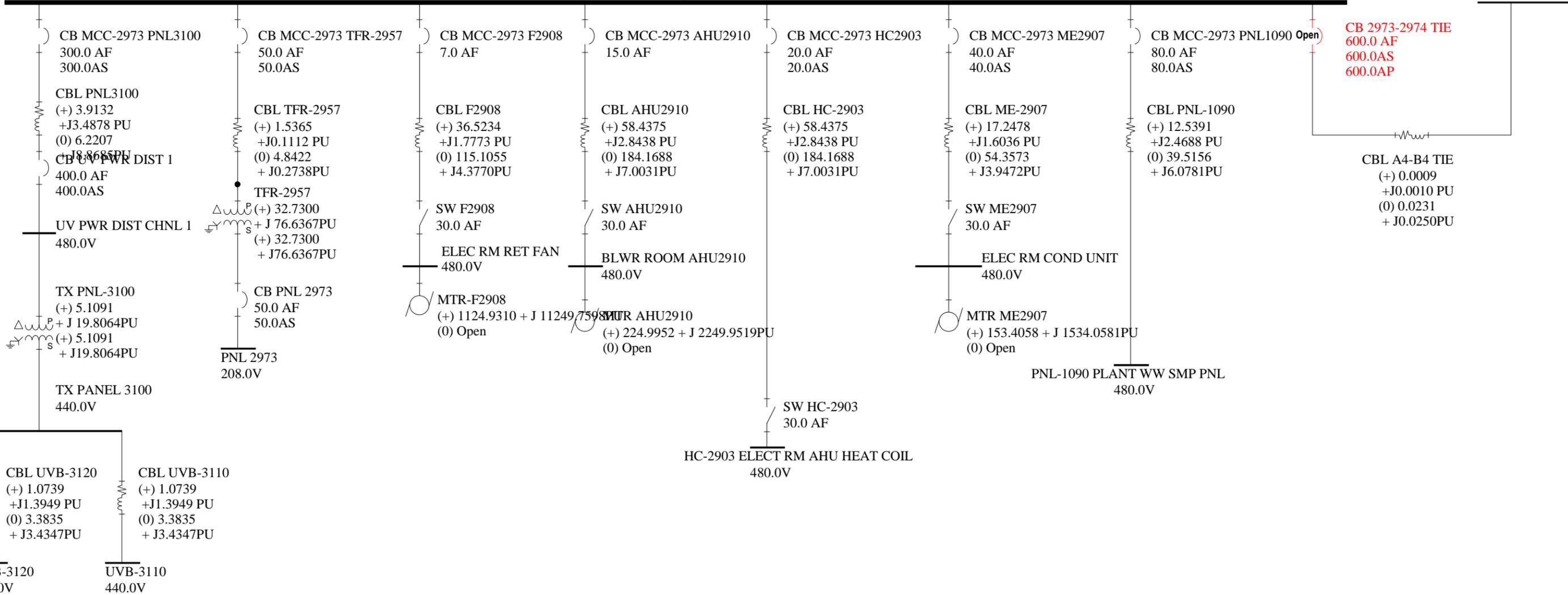
CB 2960 A4
1200.0 AF
1200.0AS
1000.0AP

CBL A4
(+) 0.1597
+J0.2159 PU
(0) 0.2535

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1200.0 AF
1200.0AS
1000.0AP

MCC-2973
480.0V

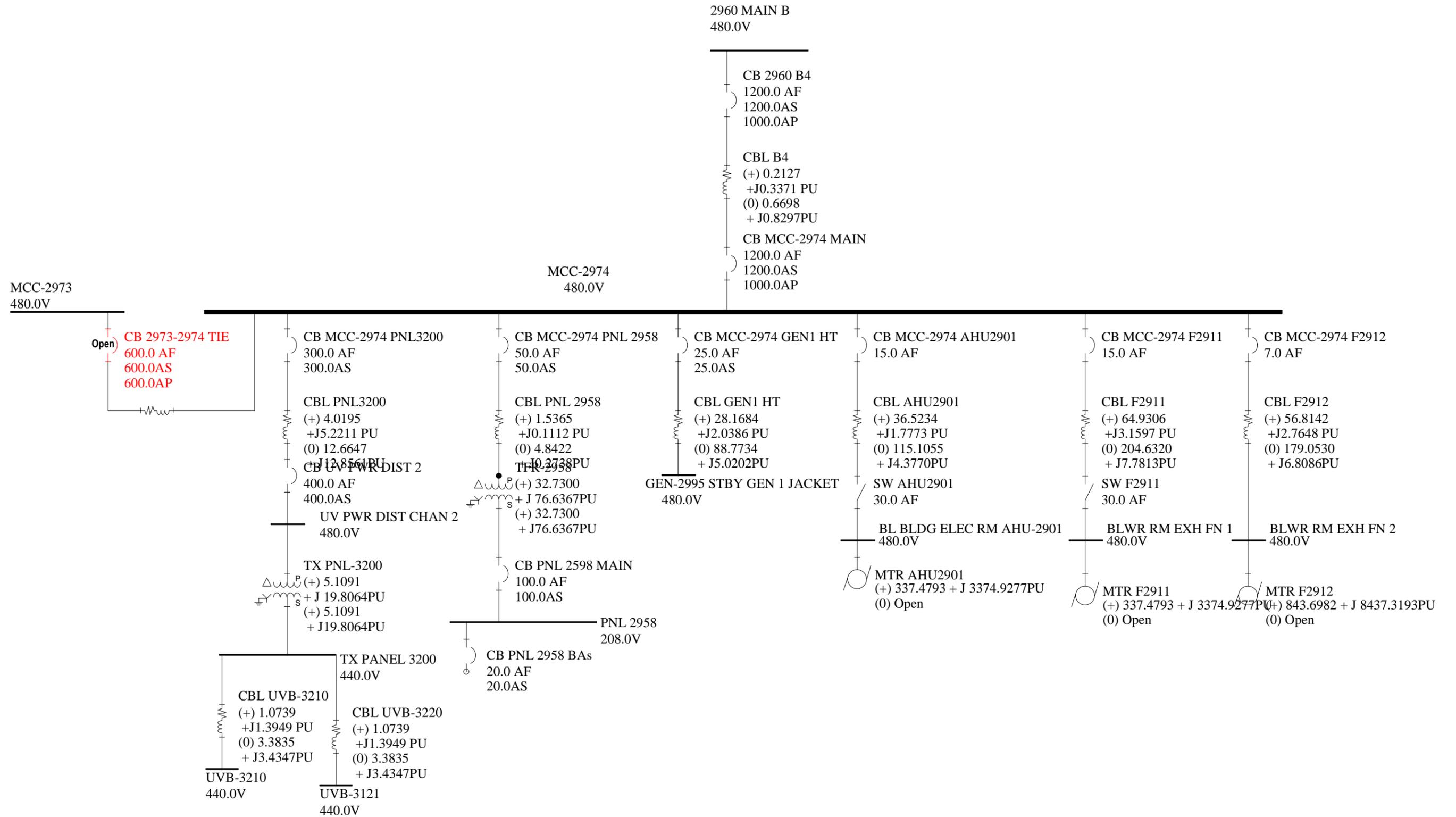
MCC-2974
480.0V

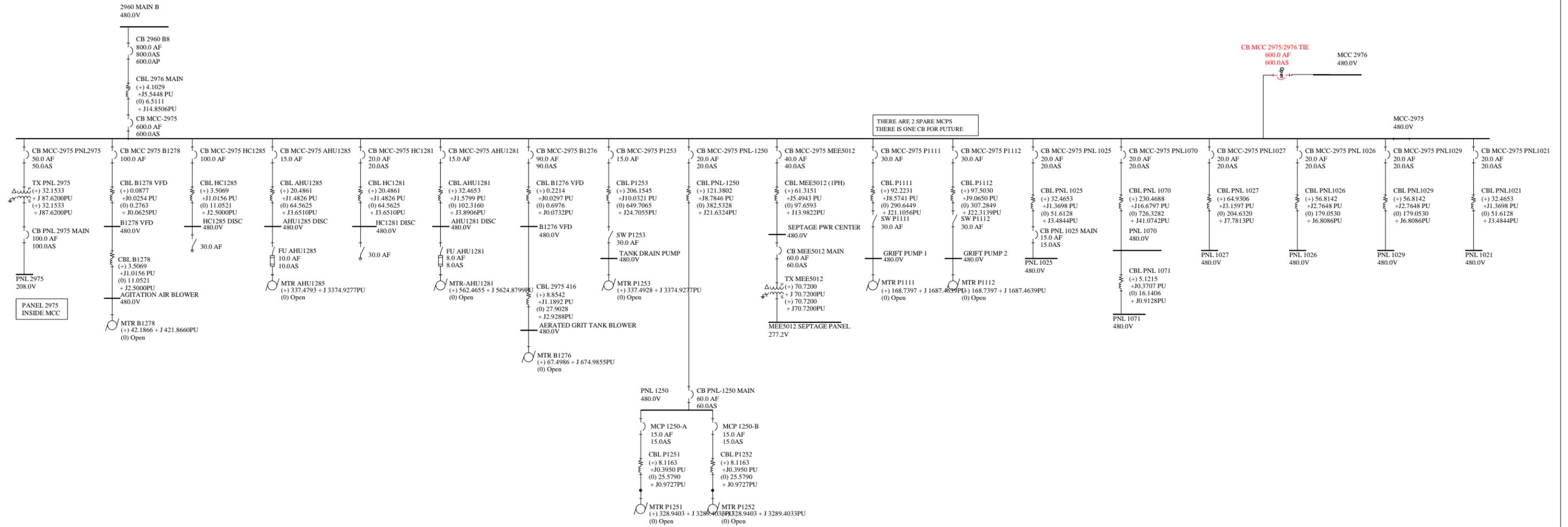


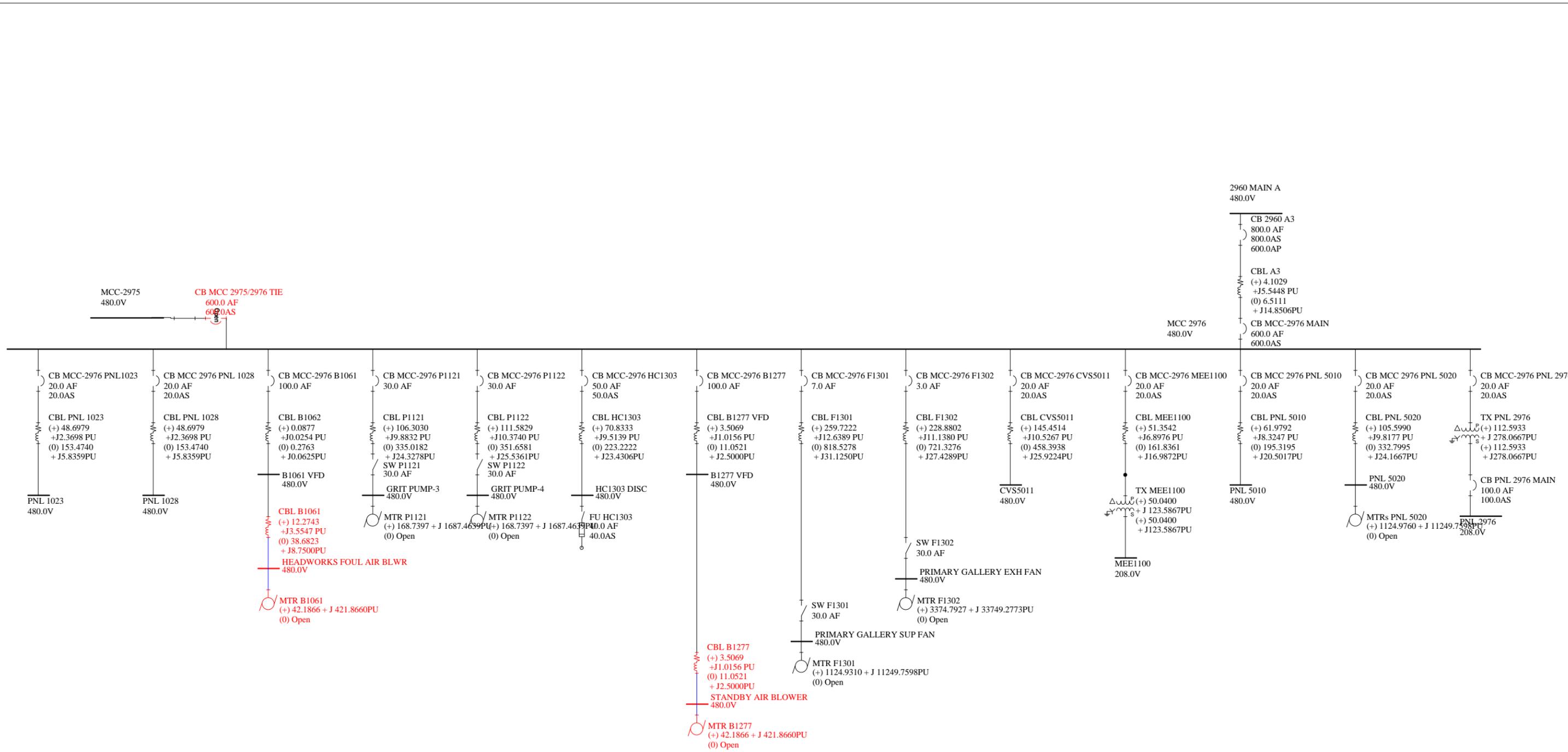
Drawing Name: mcc-2973
Client: PSW Electric

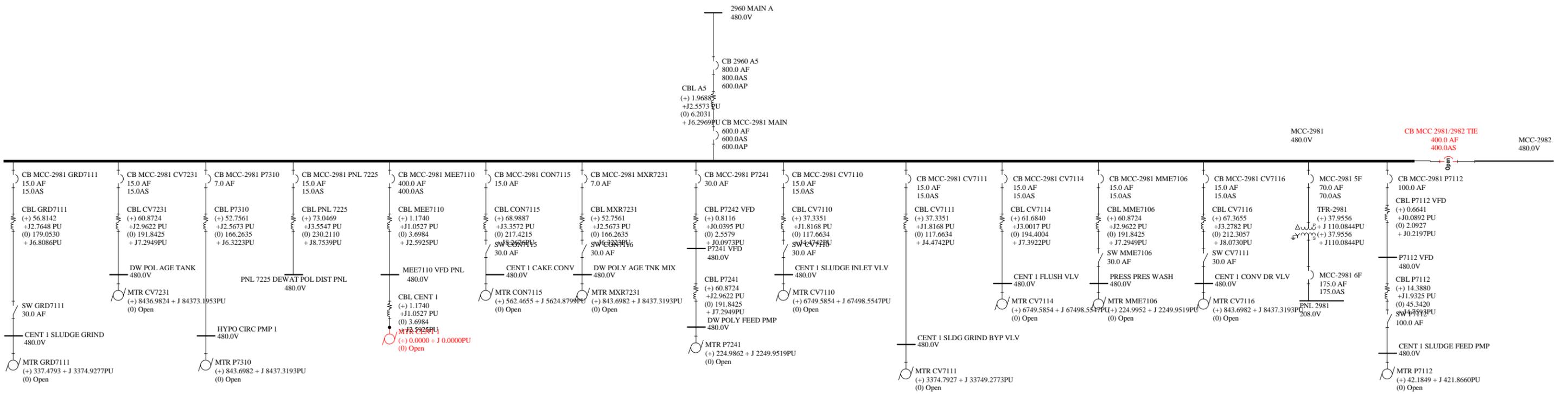
Central Kitsap WWTP Power System Studies

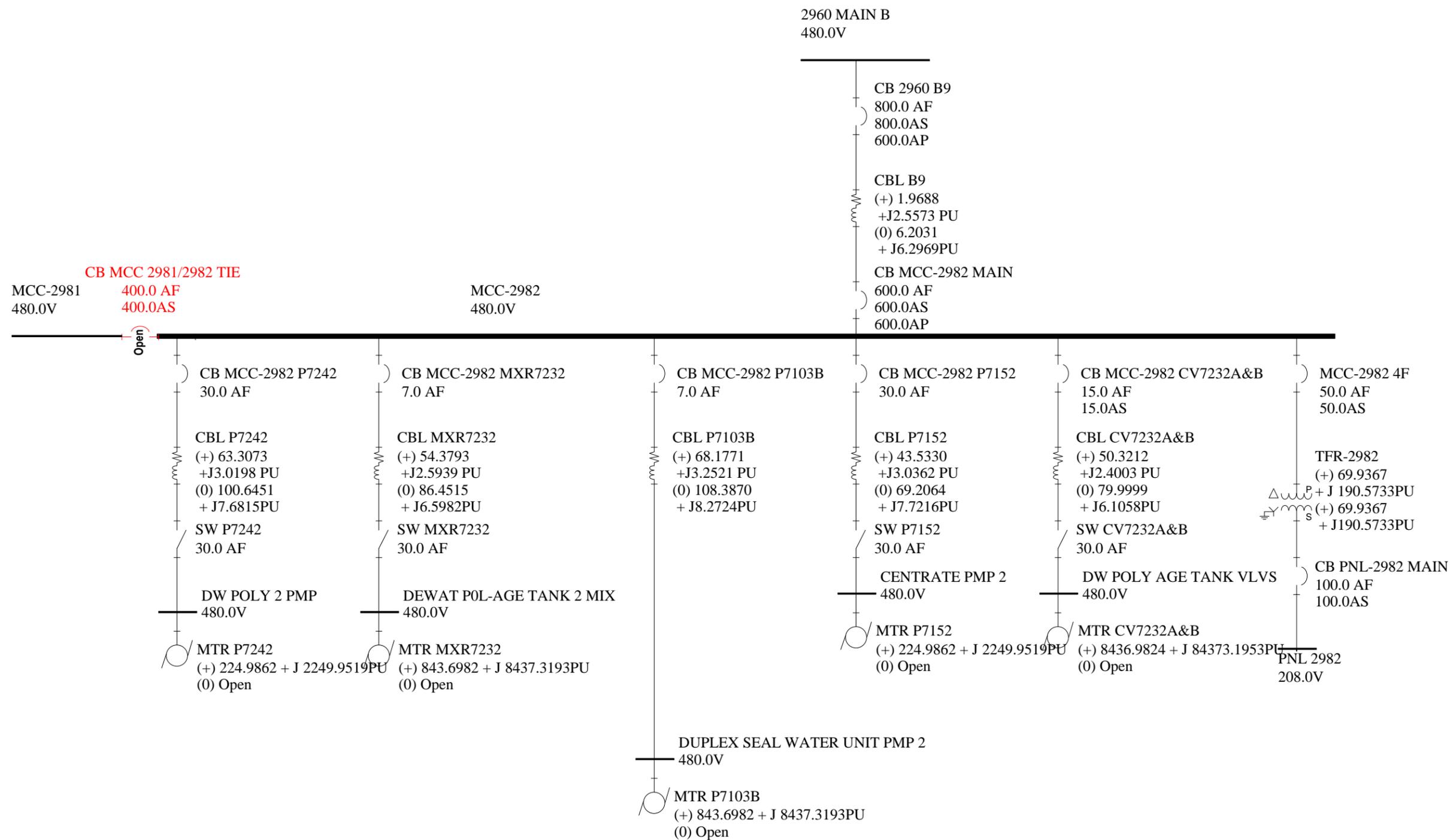
October 1, 2012
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APPENDIX 10:REVIEW COMMENTS AND RESPONSES



Appendix 10

Response to Reviewer's Comments

Comment	Reference	Review Comments	Action Taken
		The submitted study has been reviewed for completeness and compliance with specification 16431 and applicable industry standards only. No effort was made to confirm, nor is responsibility assumed, for the accuracy of calculations, results or recommendations made in the report. FOR INFORMATION ONLY.	
1	16431-3.02	16431-3.02 specifies the studies shall be signed by the professional electrical engineer responsible for the studies and registered to practice engineering in the state of WA. The submitted power system study is not signed by a professional engineer registered in WA. Submit study signed by a professional engineer registered in WA as specified. NOTE COMMENTS-RESUBMIT	Change made as requested.



Appendix 10

Response to Reviewer's Comments

Comment	Reference	Review Comments	Action Taken
2	16431-3.05.1; 16431-1.01.B; Submitted Emerson Network Power Cover Letter Dated 09/4/2012; Submitted Power System Study Section 1.1	16431-1.01.B specifies Contractors scope of work shall include Arc Flash Labels. The referenced submitted cover letter requests input as to whether the labels shall be based on "as found" settings or "recommended" settings. 16431-3.05 specifies the settings provided in the report shall provide protection and selectivity within industry standards. Submitted power study section 1.1 on page 1 states <i>recommended</i> protective device settings are consistent with applicable codes and standards. To comply with 16431-3.05 the arc flash labels shall be based on "recommended" settings. Submit Arc Flash Labels depicting the results of the Arc Flash Hazard analysis with the recommended settings applied as specified. The Contractor shall note these settings shall be limited to and based on existing equipment, for example do not submit labels which require the change of a fuse, circuit breaker or circuit breaker trip unit. NOTE COMMENTS-RESUBMIT	Change made as requested.



Appendix 10

Response to Reviewer's Comments

Comment	Reference	Review Comments	Action Taken
3	16431-3.06; Submitted Power System Study Section 4.4.2	16431-3.06 specifies the Contractor shall implement the protective device coordination study settings. The submitted power study section 4.4.2 states changes from “existing” to “recommended” settings, must be implemented prior to affixing the labels. The Contractor shall confirm the Contractor shall implement protective device coordination study settings prior to affixing the labels as specified. NOTE COMMENTS-CONFIRM	Recommended settings will be implemented once the study has been approved and arrangements for shutdowns have been made.
4	16431-1.01.B; 16431-2.01.2; 16431-3.03.A.6; 16431-3.03.B.1; Submitted Power System Study Section 3.2	The referenced specification sections and standard industry practice for power system studies as detailed in IEEE 1584 require obtaining available fault information from the Utility at the point of service to conduct the power study. Section 3.2 of the submitted power study on page 4 indicates “utility fault data were taken from a previous study...”. Review indicates the fault data used is consistent with the fault data used in the Westinghouse study performed in 1996. The use of 16 year old fault data does not comply with the referenced specifications or standard industry practice such as defined in NFPA 70E which states review/update of fault data should not exceed 5 years. The Contractor shall obtain available fault MVA and power angle or X/R ratio from the utility as specified and revise the study in accordance with the obtained values. NOTE COMENTS	Change was made as requested. See information in Appendix 3.



Appendix 10

Response to Reviewer's Comments

Comment	Reference	Review Comments	Action Taken
5*	16431-3.03; Submitted Power System Study Appendix 9; Central Kitsap WWTP 2009 Upgrade Project Contract	16431-3.03 specifies the Contractor shall be responsible to obtain and verify all data needed to perform the study. The impedance diagrams (one-lines) in the submitted power study are not consistent with previously conducted studies or Contract Drawings. The following 2 discrepancies are provided as examples though an exhaustive list was not developed.	The model was created from the data gathered at the site. The original model for the fuses at the primary of TFR 2951 were based on the data on the switch nameplate. It was verified that those fuses have been changed from 100E to 150E, and that change is reflected in the model. The original model correctly presented the circuits to the blowers. The data in this arc flash study is accurate. It may be necessary to change the contract drawings.
	Drawings; Eaton Cutler- Hammer Power System study dated 2000.	<p>Example 1: A power system study dated 2000 conducted by Eaton Cutler-Hammer and Central Kitsap WWTP 2009 Upgrade Project Contract Drawing E21 depict the fuses in SWGR 2950 both at 150A. The submitted power study on Drawing Titled SL01 depicts one of these fuses as 100A, which is consistent with an older study performed by Westinghouse in 1996.</p> <p>Example 2: A power system study dated 2000 conducted by Eaton Cutler-Hammer depict equipment fed from SWBD 2960 BUS A and BUS B respectively, which in the submitted power system study are fed from BUS B and BUS A respectively. For example the Eaton Report depicts Aeration Blower No 3 (2003) fed from BUS-A. The Contractor shall confirm that all data used in the submitted study has been field collected/verified as specified and that the data is accurate. NOTE COMMENTS-CONFIRM</p>	



Appendix 10

Response to Reviewer's Comments

Comment	Reference	Review Comments	Action Taken
6*	16431-3.01	<p>16431-3.01 specifies the Contractor perform calculations in accordance with the ANSI method of short circuit analysis. On submitted drawing SLO1 the Contractor states there is no standard for arc flash of other than 3 phase systems in reference to the Lab Transformer. No exceptions taken to the Contractors assertion that there is no industry accepted standard for single phase arc flash calculations. However, there are industry accepted practices for calculating single phase short circuit currents. IEEE Std 551 approved by ANSI 2006 in chapter 3 describes acceptable practice for modeling single phase short circuits on a 3 phase system. The method used to model the 100kVA lab transformer and subsequent short circuit calculations used do not appear consistent with the procedure described in IEEE Std 551. The Contractor shall confirm the calculations and recommendations based on the Device Evaluation report Contained in Appendix 5 which typically are based on a bolted 3 phase fault are accurate for the actual system being modeled. NOTE COMMENTS-CONFIRM</p>	<p>The methods used to expand the 3 phase model to the single phase locations was changed to conform the IEEE 551 - 2006 Chapter 3, page 68. The revised short circuit and device evaluations are accurately based on that standard.</p>



Appendix 10

Response to Reviewer's Comments

Comment	Reference	Review Comments	Action Taken
7*	16431-2.01.1	16431-2.01.1 specifies the report shall include the equipment manufacturers information used to prepare the study. Submitted power study section 3.1 page 4 equipment data used to prepare the study was obtained from ERS field gathered data. The final report submittal shall include the equipment manufacturers information in the form of cut sheets and/or field data forms used to collect the information as specified. NOTE MARKING	Cut sheets for the equipment are included in Appendix 3. Coorespondence from the utility is also contained in that appendix.

* Note: Numbers were added to make referencing simpler. These numbers do not appear in the original comments.