APPENDIX 'D' – ARC FLASH STUDY

DILLON CONSULTING

CITY OF WINNIPEG

Arc-Flash Hazard Assessment and Mitigation

Riverbend Lift Pumping Station

July 2023 – 22-3229

Revision History

ENGINEER'S SEAL

Revision History			
Rev. #	**Description**	**Date**	**By**
0	Issued for Tender	2023/07/14	C. Lange

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Tables

Appendices

Acronyms, Abbreviations, Definitions

2023 Upgrades	Refers to the Riverbend Pumping Lift Station 2023 Upgrades project
INST (Ii)	Instantaneous
LG	Line-to-Ground
Lift Station	Refers to the Riverbend Pumping Lift Station
L-L	Line-to-Line; often referenced as a line-to-line voltage
LLL	Line-to-Line-to-Line; often referenced as a three-phase fault current
LTD (tr)	Long-Time Delay
LTPU (Ir)	Long-Time Pickup
PPE	Personal Protective Equipment
SKM	SKM Power*Tools version 10.0.0.6; electrical distribution system fault analysis software
STD (tsd)	Short-Time Delay
STPU (Isd)	Short-Time Pickup
TCC	Time Current Curve
VFD	Variable Frequency Drive

Executive Summary

Dillon Consulting Limited (Dillon) has completed the Arc Flash Hazard Assessment for the Riverbend Lift Pumping Station located at 1740 Portage Avenue in Winnipeg, Manitoba per the Electrical Safety Code and Canadian Standards Association (CSA) Z462-21. This report supersedes all previous arc-flash assessments done at the Lift Station.

The Arc Flash Hazard Assessment was completed using SKM Power*Tools version 10.0.0.6. Data for the assessment was estimated from both proposed equipment datasheets and project tender drawings.

While it is preferred to have the Arc Flash Hazard level at a Class 0 level, it is industry practice to reduce the hazard to Class 1 or 2; this means an incident energy less than 8 cal/cm^2. Equipment found to have hazard levels in excess of a *Class 0 personal protective equipment (PPE)* (i.e. >= 1.2 cal/cm^2), ranked by incident energy from high to low, are:

Table 1-1: Executive Summary

Arc Fault Bus Name	Incident Energy (cal/cm^2)	PPE Level
JB-L72	8.34	Level 3
BUS_CSTE-L70.MCB	3.98	Level 1
BUS_CBL-UTIL	3.81	Level 1

The high incident energy shown for JB-L72 can be controlled through engineered and operational methods and it further discussed in the report.

In addition, the Protective Device Settings have been coordinated to ensure that down-stream faults do not trip protective devices out of sequence. An equipment duty report has also been provided.

This Arc Flash Hazard Assessment should be reviewed and updated on a regular basis, every three years as per NFPA 70E, especially if major changes are made or new equipment is installed in the lift station.

1.0 Introduction

Dillon Consulting Limited has completed the Arc Flash Hazard Assessment for the Riverbend Lift Pumping Station (Lift Station) located at 1740 Portage Avenue in Winnipeg, Manitoba. This report supersedes any previous arc-flash reports provided for the Lift Station.

The Lift Station originally constructed in 1958 has had a few minor upgrades over time but, due to aging mechanical, electrical and structural components, is now being upgraded. The 2023 Riverbend Lift Pumping Station Upgrades (2023 Upgrades) will see the replacement of the building superstructure as well as the installation of new pumps and electrical equipment.

The first component of the Arc Flash Hazard Assessment consists of a Short Circuit Study which determines the maximum fault current that would be available in the event of a three phase bolted fault at the equipment, cables, switches, protective devices and transformers within the electrical distribution system. Manitoba Hydro has provided the present day Lift Station fault levels which have been used as the basis for the available utility fault current. The 2023 Upgrades will replace the entirety of the Lift Station's electrical equipment as well as requiring a new utility service. As such, the new utility transformer and fusing has been estimated.

The second component of the Arc Flash Hazard Assessment is the Protective Device Coordination Study which determines the operation of protective devices within the electrical distribution system during fault conditions. The Protective Device Coordination Study is used to determine the time that the fault would persist before the protective device operates to clear the fault.

Data from the Short Circuit Study and the Protective Device Coordination Study are then used to determine the Arc Flash Hazard levels at each point in the electrical distribution system. The incident energy level, Personal Protective Equipment (PPE) class and Arc Flash Boundaries are calculated using the IEEE 1584-2018 method.

Finally, the equipment has been reviewed to ensure that all installed equipment has a fault capacity higher than the calculated fault current. This is shown as the Equipment Duty Report.

1.1 Electrical Modeling

The Lift Station electrical system was modeled using SKM Power*Tools version 10.0.0.6 (SKM). The SKM software was utilized in each of the short circuit, protective device coordination and arc flash studies.

Four scenarios were modeled in order to determine where a worst case fault level may occur. The following are the configurations analyzed as a part of this study.

1.1.1 Scenario 0 – Normal Operation

Scenario 0 is the base project and standard operation of the Lift Station. The Lift Station is powered by the utility with the temporary generator hook up out-of-service and the corresponding generator breaker (MCC-L71.CB-L72) open. The pumps are powered by their respective Variable Frequency Drives (VFDs).

1.1.2 Scenario 1 – Temporary Generation

Scenario 1 is the operation of the facility during a utility power failure. The utility feed has been moved to out-of-service with the main breaker (MCC-L71.MCB) open. A temporary 400 kVA generator has been connected to the Temporary Generator Connection Box (JB-L72) and the corresponding generator breaker (MCC-L71.CB-L72) has been closed. The pumps are powered by their respective VFDs.

1.1.3 Scenario 2 – Normal Operation with VFD Bypass

Scenario 2 is the standard operation of the Lift Station but with both pumps powered by their Across-The-Line Bypass Starters. The VFDs have been moved to out-of-service and disconnected.

1.1.4 Scenario 3 – Normal Operation with Infinite Bus

Scenario 3 is the standard operation of the Lift Station but with an infinite bus for the available utility fault current. Since the fault currents provided by Manitoba Hydro are accurate only at the time of study, it is best practice to model an increased fault current in addition to the base scenario. However, a higher fault current does not always lead to an increased arc-flash hazard as instantaneous trip settings can prevent arc-flash hazards due to extended overcurrent clearing times.

1.2 Single Line Diagram

The single line diagram modeled in SKM has been created from the proposed 2023 Upgrades Single Line Diagram. The data for the equipment is based on the SKM libraries and equipment datasheets. The cable lengths have been estimated from the proposed 2023 Upgrades layouts. A copy of the single line diagram created in SKM is available in Appendix A.

2.0 Scope of Study

The scope of this study is limited to the Lift Station located at 1740 Portage Avenue in Winnipeg, Manitoba. The address may also be listed as the "Intersection of Riverbend Crescent and Portage Ave, Winnipeg, MB." The following is included:

1. Preparation of an Arc Flash One Line Diagram using SKM Power*Tools;
2. Calculation of the Arc Flash Hazard Level, Arc Flash energy, Boundary conditions and PPE equipment class required at each panel;
3. Coordination of Protective Device settings;
4. Review and reporting of the equipment duty; and
5. Provide Arc Flash Labels to be installed.

2.1 Assumptions

The following assumptions were made in order to complete the studies:

- Data has been estimated from the tender drawings of the 2023 Upgrades;
- Standard approximations for industrial equipment were used where specific equipment and details were not available;
- SKM's internal database of equipment ratings and performance characteristics; and
- Single-phase 600 VAC transformers were modeled as three-phase transformers with an equivalent full load secondary current.

3.0 Short Circuit Study

The maximum short circuit currents were calculated using the Balanced-system Comprehensive Short-Circuit Study in SKM. The SKM one-line model can be found in Appendix A and the full short circuit current report results can be in Appendix C as well as summarized below.

All values were calculated on the basis of Section 2.1 – Assumptions.

3.1 Maximum Available Fault Current

The maximum available fault current from the 4.16 kV system was provided by Manitoba Hydro on May 12th, 2023. The Manitoba Hydro Fault Level document is available in Appendix B and has been summarized in Table 3-1 below.

Table 3-1: Utility Fault Level Summary

Fault Levels at Transformer Primary	Normal System Operation
Three-Phase Fault (line-to-line-to-line (LLL))	2,225 A
Single-Phase to Ground Fault (line-to-ground (LG))	1,398 A
System Impedance	POS: 3.8989 + j4.8682 Ω ZERO: 14.7769 +j9.6879 Ω

3.2 Short Circuit Fault Levels

The Table 3-2 summarizes the short circuit fault levels calculated for the Lift Station. The maximum available fault current were calculated based on Scenario 3 – Normal Operation with Infinite Bus except for JB-L72 which has been calculated from Scenario 1 – Temporary Generation. The busses are ordered from largest three-phase fault current to the smallest.

Table 3-2: Short Circuit Fault Levels

Bus Name	Voltage (L-L) [V]	Fault Current (LLL) [A]	X/R (LLL)	Fault Current (LG) [A]	X/R (LG)
BUS_CBL-UTIL	600	10,833	3.94	10,830	3.9397
BUS_CSTE-L70.MCB	600	10,148	3.03	9,654	2.491
BUS_VFD-L01	600	9,715	2.66	8,934	2.0449
BUS_VFD-L02	600	9,715	2.66	8,934	2.0449
MCC-L71	600	9,715	2.66	8,934	2.0449
BUS_HCE-L68	600	8,434	1.45	7,439	1.1875
BUS_HCE-L60	600	7,172	1.01	6,152	0.8475
BUS_XFMR-L73	600	6,887	0.94	5,877	0.7923

Bus Name	Voltage (L-L) [V]	Fault Current (LLL) [A]	X/R (LLL)	Fault Current (LG) [A]	X/R (LG)
BUS_DS-L66	600	6,022	0.73	5,301	0.6561
BUS_DS-L67	600	6,022	0.73	5,301	0.6563
BUS_SF-L67	600	5,483	0.64	4,821	0.5802
BUS_SF-L66	600	5,482	0.64	4,820	0.58
BUS_UH-L62	600	5,481	0.64	4,820	0.5797
BUS_UH-L61	600	5,016	0.57	4,409	0.52
BUS_UH-L63	600	3,251	0.35	2,867	0.3261
BUS_UH-L65	600	3,251	0.35	2,867	0.3261
BUS_UH-L64	600	2,613	0.28	2,311	0.264
JB-L72	600	2,571	19.8	2,568	19.9
BUS_C-L74	240	1,173	2.28	36	0.0279
BUS_PNL-L74	240	1,147	2.07	36	0.0281

Notes:
L-L – Line-to-Line; often referenced as a line-to-line voltage.

4.0 Protective Device Coordination

The settings of the protective devices were reviewed using the CAPTOR TCC module within the SKM software. The TCC Diagrams plotted for this report have been included in Appendix D.

All values were calculated on the basis of Section 2.1 – Assumptions.

4.1 Selective Coordination

When coordinating and selecting the overcurrent and trip settings of protective devices, life safety, equipment protection and operational coordination must be taken into account. Where a choice between the three objectives is required, life safety will take priority, followed by equipment protection and finally operations.

Seven different styles of electrical branch coordination were identified. This includes the selective coordination of the breakers, incoming utility feed and the temporary generator. Each of these has been plotted to a Time Current Curve (TCC) Diagram and included in Appendix D. In summary, the plots include the:

- Pump;
- Motor Starter;
- 600 VAC Equipment;
- 120/240 VAC Transformer;
- Incoming Utility;
- Overall Breaker Coordination; and
- Temporary Generator.

4.2 Protective Device Settings

There are seven protective devices that require custom trip settings. The trip settings are based on Scenario 0 – Normal Operation and are included in Table 4-1.

Table 4-1: Protection Settings

Device	Manufacturer Model Trip Unit	Frame	Sensor	LTPU (Ir)	LTD (tr)	STPU (Isd)	STD (tsd)	INST (Ii)
CSTE-L70.MCB	SQUARE D Powerpact LL, LSI Micrologic 5.3A	600 A	400 A	400 A	1 s	2x	0.4 s	6x

Device	Manufacturer Model Trip Unit	Frame	Sensor	LTPU (Ir)	LTD (tr)	STPU (Isd)	STD (tsd)	INST (Ii)
MCC-L71.MCB	SQUARE D Powerpact LL, LSI Micrologic 5.3A	600 A	400 A	400 A	0.5 s	1.5x	0.3 s	4x
MCC-L71.CB-L72	SQUARE D Powerpact LL, LSI Micrologic 3.3S	600 A	400 A	300 A	-	2x	-	4x
MCC-L71.CB-L01	SQUARE D Powerpact HL, LI Micrologic 3.2	150 A	100 A	90 A	2 s	-	-	4x
MCC-L71.CB-L02	SQUARE D Powerpact HL, LI Micrologic 3.2	150 A	100 A	90 A	2 s	-	-	4x
MCC-L71.MCP-L66	SQUARE D Powerpact HL Micrologic T-M	150 A	15 A	1.5 A	-	-	-	(IM) AUTO
MCC-L71.MCP-L67	SQUARE D Powerpact HL Micrologic T-M	150 A	15 A	1.5 A	-	-	-	(IM) AUTO

Notes:
LTPU (Ir) – Long-Time Pickup;
LTD (tr) – Long-Time Delay;
STPU (Isd) – Short-Time Pickup;
STD (tsd) – Short-Time Delay; and
INST (Ii) – Instantaneous.

5.0 Arc Flash Hazard Assessment Study

The Arc Flash Hazard Assessment was completed using the Arc Flash Evaluation module within the SKM software. The report was completed using the IEEE 1584-2018 calculation method and a comprehensive fault short-circuit.

- Equipment with an operating voltage at or under 240 VAC have been excluded where the bolted fault current is less than 2,000 amps per IEEE 1584-2018;
- A maximum arcing duration of two seconds was applied;
- A cleared fault threshold of 80% was applied;
- Upstream devices were checked for miss-coordination to a maximum of one level; and
- The worst case incident energies between the Scenarios has been reported.

All values were calculated on the basis of Section 2.1 – Assumptions.

The full results of the Arc Flash Hazard Assessment have been included in Appendix E and have been summarized in the following section. Based on the results of the Arc Flash analysis, Arc Flash labels have been prepared to be used on-site.

5.1 Arc Flash Results Summary

The arc flash results are based upon the maximum fault current available at each point in the station and the time required for the protective devices to trip, using the settings described in the previous section. The following is a summary of the incident energies and required PPE for each point in the Lift Station.

Table 5-1: Arc Flash Results Summary

Bus Name	Protective Device	Incident Energy [cal/cm^2]	PPE Level
BUS_CBL-UTIL	FU-UTIL	3.81	Level 1
BUS_C-L01-1	CB-L01	0.67	Level 0
BUS_C-L02-1	CB-L02	0.67	Level 0
BUS_C-L74	CB-L73	< 1.2	Level 0
BUS_CSTE-L70.MCB	FU-UTIL	3.98	Level 1
BUS_DS-L01	CB-L01	0.24	Level 0
BUS_DS-L02	CB-L02	0.24	Level 0
BUS_DS-L66	MCP-L66	0.22	Level 0
BUS_DS-L67	MCP-L67	0.22	Level 0
BUS_HCE-L60	CB-L60	0.29	Level 0
BUS_HCE-L68	CB-L68	0.40	Level 0

Bus Name	Protective Device	Incident Energy [cal/cm^2]	PPE Level
BUS_P-L01	CB-L01	0.19	Level 0
BUS_P-L02	CB-L02	0.19	Level 0
BUS_PNL-L74	CB-L73	< 1.2	Level 0
BUS_SF-L66	MCP-L66	0.19	Level 0
BUS_SF-L67	MCP-L67	0.19	Level 0
BUS_UH-L61	CB-L61	0.17	Level 0
BUS_UH-L62	CB-L62	0.19	Level 0
BUS_UH-L63	CB-L63	0.10	Level 0
BUS_UH-L64	CB-L64	0.07	Level 0
BUS_UH-L65	CB-L65	0.10	Level 0
BUS_VFD-L01	CB-L01	0.67	Level 0
BUS_VFD-L02	CB-L02	0.67	Level 0
BUS_XFMR-L73	CB-L73	0.27	Level 0
JB-L72	MaxTripTime @2.0s	8.34[1]	Level 3
MCC-L71	MCC-L71.MCB	0.67	Level 0

Notes:

[1] The arc-flash result for JB-L72 is based on a temporary 400 kVA generator connection with no upstream protective device. When the Lift Station requires to be operated under temporary generator power, a temporary generator with integrated protective device should be used. Alternately, the connection and disconnection of JB-L72 should be made when CB-L72 has been opened and the generator is powered off.

5.2 Arc Flash Labels

Arc Flash labels for the busses listed in Table 5-1 have been created and are available in Appendix F. The labels utilize SKM's custom arc flash label template "Sample 01A – Avery 5524".

6.0 Equipment Duties

Table 6-1: Equipment Duty Report, compares the interrupt ratings of equipment against the available fault current found in Table 3-2: Short Circuit Fault Levels.

Since asymmetrical fault currents can be in excess of the calculated symmetrical fault current, a 25% safety factor has been applied. The safety factor has been based on an X/R of 3.03 found in the short circuit study. The Equipment Duty Report indicates that all equipment is correctly rated for operation.

Table 6-1: Equipment Duty Report

Component Name	Equipment Category	Fault Current [kA]	Safety Factor [%]	Interrupt Rating [kA]	Duty [%]	Comments
CSTE-L70	PANEL	10.149	25%	18	-29.52%	
CSTE-L70.MCB	BREAKER	10.149	25%	50	-79.70%	
JB-L72	PANEL	2.572	25%	10	-74.28%	Scenario 1
MCC-L71	MCC	9.716	25%	42	-76.87%	
MCC-L71.MCB	LV BREAKER	10.149	25%	50	-79.70%	
CB-L01	LV BREAKER	9.716	25%	50	-80.57%	
CB-L02	LV BREAKER	9.716	25%	50	-80.57%	
CB-L60	LV BREAKER	9.716	25%	50	-80.57%	
CB-L61	LV BREAKER	9.716	25%	50	-80.57%	
CB-L62	LV BREAKER	9.716	25%	50	-80.57%	
CB-L63	LV BREAKER	9.716	25%	50	-80.57%	
CB-L64	LV BREAKER	9.716	25%	50	-80.57%	
CB-L65	LV BREAKER	9.716	25%	50	-80.57%	
CB-L68	LV BREAKER	9.716	25%	50	-80.57%	
CB-L72	LV BREAKER	2.572	25%	50	-94.86%	Scenario 1
CB-L73	LV BREAKER	9.716	25%	50	-80.57%	
MCP-L66	LV BREAKER	9.716	25%	50	-80.57%	
MCP-L67	LV BREAKER	9.716	25%	50	-80.57%	

7.0 Recommendations

Based on our analysis, we recommend the following:

1. Protective Device trip settings be set as outlined in Protective Device Coordination; and
2. Update the Utility Transformer size and impedance, Fusing and Fault Level once the updated information is available from Manitoba Hydro during the 2023 Upgrades.

In addition, a copy of this report should be available to required plant personnel, as well as to outside contractors and vendors that perform work on the electrical system.

Appendix A

Manitoba Hydro Fault Level Report

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MANITOBA HYDRO
INTEROFFICE MEMORANDUM

FROM Erik Tonsaker, P.Eng.
Professional Engineer
Distribution Engineering Department
360 Portage Ave (19), Winnipeg, MB

TO Brian Adamyk
Customer Relationship Supervisor
Customer Energy Services Department
360 Portage Ave (14), Winnipeg, MB

DATE 2023 05 12

SUBJECT UTILITY INFORMATION REQUIRED FOR – CITY OF WINNIPEG WATER AND WASTE, INTERSECTION OF RIVERBEND CRESCENT AND PORTAGE AVENUE, WINNIPEG, MB

Customer Information
Name: City of Winnipeg Water and Waste
Address: Intersection of Riverbend Crescent and Portage Ave, Winnipeg, MB

PROVINCE OF MANITOBA
E. D. TONSAKER
2023-05-12
Member
25459
REGISTERED PROFESSIONAL ENGINEER

Source Information
Station: Estella
Feeder: J203

Supply Transformer #247215 Information
kVA: 3×50
Secondary Voltage: 347/600 V
Connection: Grounded Wye – Grounded Wye
Minimum Impedance: 1.5%
Primary Protection[1]: Kearney 40 Amp T Fuses

Fault Levels at Transformer Primary[2, 3]

Switching Configuration	Voltage (kV)	LLL (Amps)	LG (Amps)	R1 (pu)	X1 (pu)	R0 (pu)	X0 (pu)
Normal System Operation[4]	4.16	2225	1398	3.8989	4.8682	14.7769	9.6879
Fully Networked Source Two Banks Paralleled	4.16	2281	1412	3.8837	4.6848	14.7769	9.6879

Impedances are per unit on a 100MVA base

Notes
1. Manitoba Hydro sources replacement fuses from various manufacturers, therefore the fuse stated above is only representative of the fuse installed
2. These values are reflective of the normal and expected maximum available fault levels at the customer location, depending on the configuration of the supply, and can be used for arc flash hazard calculation.
3. These values are valid for the system configuration at the time of this study. These fault levels and impedances can change in the future as a result of changes to the Manitoba Hydro system, including feeder reconfiguration or reconductoring, increasing the size of substation transformers and from new or reconductored subtransmission lines. While these changes are infrequent in nature, they are not uncommon and Manitoba Hydro does not communicate changes in fault level or impedance information to customers unless a new request is initiated.
4. The Normal switching configuration is intended for overcurrent protection coordination studies, power quality studies, harmonic assessment and mitigation reports, or power factor correction studies only.
5. This memo is not to be used for new equipment rating purposes.

Yours truly,

Erik Tonsaker, P.Eng.

ENGINEERS GEOSCIENTISTS MANITOBA
Certificate of Authorization
Manitoba Hydro
No. 38

Appendix B

SKM One Line Diagram

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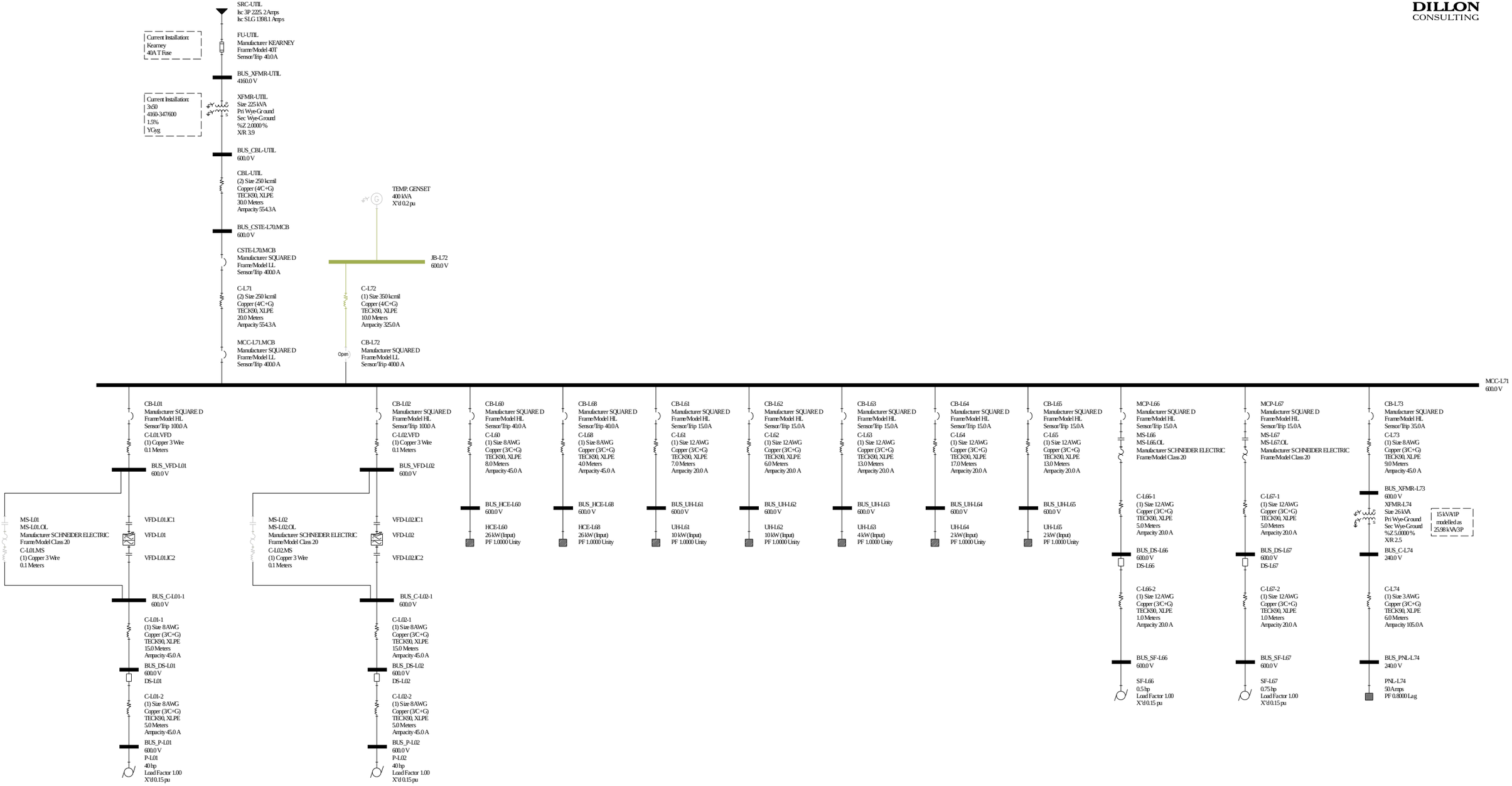

Riverbend Lift Pumping Station
2023 Upgrades
Arc Flash and Coordination Study

SKM File: 1Line001
Scenario: Base Project

Appendix C

Short Circuit Analysis Report

DILLON CONSULTING

May 25, 2023 15:35:01

ALL INFORMATION PRESENTED IS FOR REVIEW, APPROVAL
INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY
SKM DISCLAIMS ANY RESPONSIBILITY AND LIABILITY RESULTING
FROM THE USE AND INTERPRETATION OF THIS SOFTWARE.

SKM POWER*TOOLS FOR WINDOWS
SHORT CIRCUIT ANALYSIS REPORT

ALL PU VALUES ARE EXPRESSED ON A 100 MVA BASE

BUS NAME	SWING GENERATORS SOURCE NAME	VOLTAGE	ANGLE
BUS_XFMR-UTIL	SRC-UTIL	1.00	0.00

********** P R E - F A U L T V O L T A G E P R O F I L E **********

BUS# NAME	BASE VOLTS	PU VOLTS	ANGLE (D)
BUS_C-L01-1	600.00	0.0707	-45.
BUS_C-L02-1	600.00	0.0707	-45.
BUS_C-L74	240.00	1.0000	0.
BUS_CBL-UTIL	600.00	1.0000	0.
BUS_CSTE-L70.M	600.00	1.0000	0.
BUS_DS-L01	600.00	0.0707	-45.
BUS_DS-L02	600.00	0.0707	-45.
BUS_DS-L66	600.00	1.0000	0.
BUS_DS-L67	600.00	1.0000	0.
BUS_HCE-L60	600.00	1.0000	0.
BUS_HCE-L68	600.00	1.0000	0.
BUS_P-L01	600.00	0.0707	-45.
BUS_P-L02	600.00	0.0707	-45.
BUS_PNL-L74	240.00	1.0000	0.
BUS_SF-L66	600.00	1.0000	0.
BUS_SF-L67	600.00	1.0000	0.
BUS_UH-L61	600.00	1.0000	0.
BUS_UH-L62	600.00	1.0000	0.
BUS_UH-L63	600.00	1.0000	0.
BUS_UH-L64	600.00	1.0000	0.
BUS_UH-L65	600.00	1.0000	0.
BUS_VFD-L01	600.00	1.0000	0.
BUS_VFD-L02	600.00	1.0000	0.
BUS_XFMR-L73	600.00	1.0000	0.
MCC-L71	600.00	1.0000	0.

********** F A U L T A N A L Y S I S R E P O R T **********

FAULT TYPE: 3PH
MODEL INDUCTION MOTOR CONTRIBUTION: YES
MODEL TRANSFORMER TAPS: YES
MODEL TRANSFORMER PHASE SHIFT: YES

==========

BUS_C-L74 VOLTAGE BASE LL: 240.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 1173.1 / -66. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 82.367 +j 187.806 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.280

ASYM 1/2 CYCLES	RMS 2 CYCLES	INTERRUPTING AMPS 3 CYCLES	5 CYCLES	8 CYCLES
1245.4	1173.1	1173.1	1173.1	1173.1

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES

---PHASE A---	---PHASE B---	---PHASE C---
0.0000 / 0.0	0.0000 / 0.0	0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES

---PHASE A---	---PHASE B---	---PHASE C---
1173.1 / -66.3	1173.1 / 173.7	1173.1 / 53.7

BUS_C-L74 ==== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES

		---PHASE A---	---PHASE B---	---PHASE C---
BUS_XFMR-L73	600.0	0.9377 / 2.	0.9377 /-118.	0.9377 / 122.
BUS_PNL-L74	240.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.

BUS_C-L74 ========== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ==========
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES

		BRANCH NAME	VBASE LL	-PHASE A-	-PHASE B-	-PHASE C-
BUS_XFMR-L73	BUS_C-L74	XFMR-L74	600.	469.2/ -66.	469.2/ 174.	469.2/ 54.
BUS_C-L74	BUS_PNL-L74	C-L74	240.	0.0/ 0.	0.0/ 0.	0.0/ 0.

```
 BUS_CBL-UTIL   VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:  10833.1 /  -76. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    2.185 +j   8.610 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     3.940

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   12844.9     10851.5     10833.9     10833.1     10833.1

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                10833.1 / -75.8    10833.1 / 164.2     10833.1 /  44.2

 BUS_CBL-UTIL   ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   BUS_XFMR-UTIL    4160.0  1.0000 /   0.  1.0000 /-120.  1.0000 / 120.
   BUS_CSTE-L70.M    600.0  0.0001 / -52.  0.0001 /-172.  0.0001 /  68.
   BUS_CBL-UTIL   ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                               FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                              BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
BUS_XFMR-UTIL  BUS_CBL-UTIL   XFMR-UTIL       4160.   1561.3/ -76.   1561.3/ 164.   1561.3/  44.
BUS_CBL-UTIL   BUS_CSTE-L70.M CBL-UTIL         600.      7.8/ 102.      7.8/ -18.      7.8/-138.

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 BUS_CSTE-L70.M VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:  10148.0 /  -72. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    2.969 +j   9.005 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     3.033

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   11355.1     10150.6     10148.1     10148.0     10148.0

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                10148.0 / -71.8    10148.0 / 168.2     10148.0 /  48.2

 BUS_CSTE-L70.M ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.0000 / -52.  0.0000 /-172.  0.0000 /  68.
   BUS_CBL-UTIL      600.0  0.0926 / -45.  0.0926 /-165.  0.0926 /  75.
   BUS_CSTE-L70.M ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                               FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                              BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
BUS_CSTE-L70.M MCC-L71        C-L71            600.      7.8/ 102.      7.8/ -18.      7.8/-138.
BUS_CBL-UTIL   BUS_CSTE-L70.M CBL-UTIL         600.  10140.2/ -72.  10140.2/ 168.  10140.2/  48.

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```
 BUS_DS-L66      VOLTAGE BASE LL:                 600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   6021.7 /  -36. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   12.898 +j   9.433 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.731

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     6022.9      6021.7      6021.7      6021.7      6021.7

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  6021.7 / -36.2     6021.7 /-156.2      6021.7 /  83.8

 BUS_DS-L66      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.5890 / -35.  0.5890 /-155.  0.5890 /  85.
   BUS_SF-L66        600.0  0.0001 / -77.  0.0001 / 163.  0.0001 /  43.
   BUS_DS-L66     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_DS-L66     C-L66-1          600.   6019.4/ -36.   6019.4/-156.   6019.4/  84.
BUS_DS-L66      BUS_SF-L66     C-L66-2          600.      3.1/ 102.      3.1/ -18.      3.1/-138.

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 BUS_DS-L67     VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   6022.3 /  -36. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   12.895 +j   9.435 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     0.732

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    6023.5      6022.3      6022.3      6022.3      6022.3

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 6022.3 / -36.2     6022.3 /-156.2      6022.3 /  83.8

 BUS_DS-L67     ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.5889 / -35.  0.5889 /-155.  0.5889 /  85.
   BUS_SF-L67        600.0  0.0001 / -77.  0.0001 / 163.  0.0001 /  43.
   BUS_DS-L67     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_DS-L67     C-L67-1          600.   6018.9/ -36.   6018.9/-156.   6018.9/  84.
BUS_DS-L67      BUS_SF-L67     C-L67-2          600.      4.7/ 102.      4.7/ -18.      4.7/-138.

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 BUS_HCE-L60    VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   7172.5 /  -45. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    9.449 +j   9.524 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     1.008

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7186.5      7172.5      7172.5      7172.5      7172.5

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 7172.5 / -45.2     7172.5 /-165.2      7172.5 /  74.8

 BUS_HCE-L60    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.4445 / -43.  0.4445 /-163.  0.4445 /  77.
   BUS_HCE-L60    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                                FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71        BUS_HCE-L60    C-L60            600.   7172.5/ -45.   7172.5/-165.   7172.5/  75.

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 BUS_HCE-L68    VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   8434.4 /  -55. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    6.470 +j   9.397 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     1.452

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    8545.2      8434.4      8434.4      8434.4      8434.4

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 8434.4 / -55.5     8434.4 /-175.5      8434.4 /  64.5

 BUS_HCE-L68    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---      ---PHASE B---      ---PHASE C---
   MCC-L71           600.0  0.2614 / -53.  0.2614 /-173.  0.2614 /  67.
   BUS_HCE-L68    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                                FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71        BUS_HCE-L68    C-L68            600.   8434.4/ -55.   8434.4/-175.   8434.4/  65.

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 BUS_PNL-L74    VOLTAGE BASE LL:                 240.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   1146.9 /  -64. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   91.129 +j 188.920 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     2.073

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    1201.0      1146.9      1146.9      1146.9      1146.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 1146.9 / -64.2     1146.9 / 175.8      1146.9 /  55.8

 BUS_PNL-L74    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   BUS_C-L74         240.0  0.0421 / -57.  0.0421 /-177.  0.0421 /  63.
   BUS_PNL-L74    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                                FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
BUS_C-L74      BUS_PNL-L74    C-L74            240.   1146.9/ -64.   1146.9/ 176.   1146.9/  56.

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 BUS_SF-L66     VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5482.5 /  -33. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   14.779 +j   9.467 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     0.641

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    5482.8      5482.5      5482.5      5482.5      5482.5

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5482.5 / -32.6     5482.5 /-152.6      5482.5 /  87.4

 BUS_SF-L66     ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   BUS_DS-L66       600.0  0.1072 / -32.  0.1072 /-152.  0.1072 /  88.
   BUS_SF-L66     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
SF-L66          BUS_SF-L66                    600.      3.1/ -78.      3.1/ 162.      3.1/  42.
BUS_DS-L66      BUS_SF-L66     C-L66-2        600.   5480.3/ -33.   5480.3/-153.   5480.3/  87.

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 BUS_SF-L67     VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5483.1 /  -33. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   14.775 +j   9.470 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     0.641

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    5483.4      5483.1      5483.1      5483.1      5483.1

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5483.1 / -32.7     5483.1 /-152.7      5483.1 /  87.3

 BUS_SF-L67     ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   BUS_DS-L67       600.0  0.1072 / -32.  0.1072 /-152.  0.1072 /  88.
   BUS_SF-L67     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
SF-L67         BUS_SF-L67                     600.      4.7/ -78.      4.7/ 162.      4.7/  42.
BUS_DS-L67     BUS_SF-L67     C-L67-2         600.   5479.9/ -33.   5479.9/-153.   5479.9/  87.

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 BUS_UH-L61      VOLTAGE BASE LL:                  600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5015.9 /  -30. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   16.670 +j   9.494 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.570

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     5016.0      5015.9      5015.9      5015.9      5015.9

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  5015.9 / -29.7     5015.9 /-149.7      5015.9 /  90.3

 BUS_UH-L61      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---      ---PHASE B---      ---PHASE C---
   MCC-L71            600.0  0.6871 / -29.  0.6871 /-149.  0.6871 /  91.
   BUS_UH-L61      ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                                FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_UH-L61     C-L61            600.   5015.9/ -30.   5015.9/-150.   5015.9/  90.

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 BUS_UH-L62      VOLTAGE BASE LL:                  600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5481.2 /  -33. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   14.787 +j   9.462 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.640

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     5481.5      5481.2      5481.2      5481.2      5481.2

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  5481.2 / -32.6     5481.2 /-152.6      5481.2 /  87.4

 BUS_UH-L62      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---      ---PHASE B---      ---PHASE C---
   MCC-L71            600.0  0.6436 / -32.  0.6436 /-152.  0.6436 /  88.
   BUS_UH-L62      ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                                FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_UH-L62     C-L62            600.   5481.2/ -33.   5481.2/-153.   5481.2/  87.

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 BUS_UH-L63      VOLTAGE BASE LL:                  600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   3251.2 /  -19. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   27.967 +j   9.686 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.346

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     3251.2      3251.2      3251.2      3251.2      3251.2

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  3251.2 / -19.1     3251.2 /-139.1      3251.2 / 100.9

 BUS_UH-L63      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---      ---PHASE B---      ---PHASE C---
   MCC-L71            600.0  0.8271 / -18.  0.8271 /-138.  0.8271 / 102.
   BUS_UH-L63      ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                                FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_UH-L63     C-L63            600.   3251.2/ -19.   3251.2/-139.   3251.2/ 101.

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 BUS_UH-L64      VOLTAGE BASE LL:                  600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   2612.7 /  -15. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   35.498 +j   9.815 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.276

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     2612.7      2612.7      2612.7      2612.7      2612.7

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  2612.7 / -15.5     2612.7 /-135.5      2612.7 / 104.5

 BUS_UH-L64      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---      ---PHASE B---      ---PHASE C---
   MCC-L71            600.0  0.8692 / -14.  0.8692 /-134.  0.8692 / 106.
   BUS_UH-L64      ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                                FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_UH-L64     C-L64            600.   2612.7/ -15.   2612.7/-135.   2612.7/ 105.

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 BUS_UH-L65      VOLTAGE BASE LL:                  600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   3251.2 /  -19. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   27.967 +j   9.686 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.346

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     3251.2      3251.2      3251.2      3251.2      3251.2

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  3251.2 / -19.1     3251.2 /-139.1      3251.2 / 100.9

 BUS_UH-L65      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---      ---PHASE B---      ---PHASE C---
   MCC-L71            600.0  0.8271 / -18.  0.8271 /-138.  0.8271 / 102.
   BUS_UH-L65     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                               FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                              BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_UH-L65     C-L65            600.   3251.2/ -19.   3251.2/-139.   3251.2/ 101.

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```
 BUS_VFD-L01    VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   9714.8 /  -69. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    3.491 +j   9.269 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     2.655

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   10587.1      9715.5      9714.8      9714.8      9714.8

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 9714.8 / -69.4     9714.8 / 170.6      9714.8 /  50.6

 BUS_VFD-L01    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.0000 / -24.  0.0000 /-144.  0.0000 /  96.
   BUS_C-L01-1       600.0  0.0707 / -45.  0.0707 /-165.  0.0707 /  75.
   BUS_VFD-L01    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_VFD-L01    C-L01.VFD        600.   9714.8/ -69.   9714.8/ 171.   9714.8/  51.
BUS_VFD-L01     BUS_C-L01-1    VFD-L01          600.      0.0/   0.      0.0/   0.      0.0/   0.

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```
 BUS_VFD-L02    VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   9714.8 /  -69. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    3.491 +j   9.269 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     2.655

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   10587.1      9715.5      9714.8      9714.8      9714.8

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 9714.8 / -69.4     9714.8 / 170.6      9714.8 /  50.6

 BUS_VFD-L02    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.0000 / -24.  0.0000 /-144.  0.0000 /  96.
   BUS_C-L02-1       600.0  0.0707 / -45.  0.0707 /-165.  0.0707 /  75.
   BUS_VFD-L02    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_VFD-L02    C-L02.VFD        600.   9714.8/ -69.   9714.8/ 171.   9714.8/  51.
BUS_VFD-L02     BUS_C-L02-1    VFD-L02          600.      0.0/   0.      0.0/   0.      0.0/   0.

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```

```
 BUS_XFMR-L73   VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   6886.9 /  -43. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   10.194 +j   9.556 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     0.937

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    6895.3      6886.9      6886.9      6886.9      6886.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.0000 /    0.0     0.0000 /    0.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 6886.9 / -43.1     6886.9 /-163.1      6886.9 /  76.9

 BUS_XFMR-L73   ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.4802 / -41.  0.4802 /-161.  0.4802 /  79.
   BUS_C-L74         240.0  0.0000 /   0.  0.0000 /   0.  0.0000 /   0.
   BUS_XFMR-L73   ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                                FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                               BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71        BUS_XFMR-L73   C-L73            600.   6886.9/ -43.   6886.9/-163.   6886.9/  77.
BUS_XFMR-L73   BUS_C-L74      XFMR-L74         600.      0.0/   0.      0.0/   0.      0.0/   0.

-------------------------------------------------------------------------------------------
```

MCC-L71 VOLTAGE BASE LL: 600.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 9714.8 / -69. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: 3.491 +j 9.269 (PU)
THEVENIN IMPEDANCE X/R RATIO: 2.655

ASYM	RMS	INTERRUPTING AMPS		
1/2 CYCLES	2 CYCLES	3 CYCLES	5 CYCLES	8 CYCLES
10587.2	9715.6	9714.8	9714.8	9714.8

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES

---PHASE A---	---PHASE B---	---PHASE C---
0.0000 / 0.0	0.0000 / 0.0	0.0000 / 0.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES

---PHASE A---	---PHASE B---	---PHASE C---
9714.8 / -69.4	9714.8 / 170.6	9714.8 / 50.6

MCC-L71 ==== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES

		---PHASE A---	---PHASE B---	---PHASE C---
BUS_HCE-L60	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_DS-L66	600.0	0.0003 / -77.	0.0003 / 163.	0.0003 / 43.
BUS_XFMR-L73	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_CSTE-L70.M	600.0	0.0591 / -43.	0.0591 /-163.	0.0591 / 77.
BUS_VFD-L01	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_VFD-L02	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_HCE-L68	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_UH-L61	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_UH-L62	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_UH-L63	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_UH-L64	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_UH-L65	600.0	0.0000 / 0.	0.0000 / 0.	0.0000 / 0.
BUS_DS-L67	600.0	0.0005 / -77.	0.0005 / 163.	0.0005 / 43.

MCC-L71 ========== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ==========

FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES

	BRANCH NAME	VBASE LL	-PHASE A-	-PHASE B-	-PHASE C-
MCC-L71	BUS_HCE-L60	C-L60	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_DS-L66	C-L66-1	600.	3.1/ 102.	3.1/ -18.	3.1/-138.
MCC-L71	BUS_XFMR-L73	C-L73	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
BUS_CSTE-L70.M	MCC-L71	C-L71	600.	9707.1/ -69.	9707.0/ 171.	9707.1/ 51.
MCC-L71	BUS_VFD-L01	C-L01.VFD	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_VFD-L02	C-L02.VFD	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_HCE-L68	C-L68	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L61	C-L61	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L62	C-L62	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L63	C-L63	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L64	C-L64	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L65	C-L65	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_DS-L67	C-L67-1	600.	4.7/ 102.	4.7/ -18.	4.7/-138.

****

********** F A U L T A N A L Y S I S R E P O R T **********

FAULT TYPE: SLG
MODEL INDUCTION MOTOR CONTRIBUTION: YES
MODEL TRANSFORMER TAPS: YES
MODEL TRANSFORMER PHASE SHIFT: YES

==========

BUS_C-L74 VOLTAGE BASE LL: 240.0 (VOLTS)
INI. SYM. RMS FAULT CURRENT: 35.6 / -2. (AMPS/DEG)
THEVENIN EQUIVALENT IMPEDANCE: INFINITE
THEVENIN IMPEDANCE X/R RATIO: 0.028
SEQUENCE EQUIVALENT IMPEDANCE Z1: 82.367 +j 187.806 (PU)
Z2: 82.367 +j 187.806 (PU)
Z0: INFINITE

ASYM RMS INTERRUPTING AMPS
1/2 CYCLES 2 CYCLES 3 CYCLES 5 CYCLES 8 CYCLES
35.6 35.6 35.6 35.6 35.6

INI. SYM. RMS FAULTED BUS VOLTAGES (PU / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
0.0000 / 0.0 1.7072 / -150.6 1.7348 / 149.0

INI. RMS FAULTED CURRENT (AMPS / DEG)
AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
35.6 / -1.6 0.0 / 0.0 0.0 / 0.0

BUS_C-L74 ==== INI. SYM. RMS SYSTEM BUS VOLTAGES (PU / DEG) =======
FIRST BUS FROM FAULT AT TIME = 0.5 CYCLES
---PHASE A--- ---PHASE B--- ---PHASE C---
BUS_XFMR-L73 600.0 0.9981 / 0. 1.0003 /-120. 1.0001 / 120.
BUS_PNL-L74 240.0 0.0000 / 0. 1.7072 /-151. 1.7348 / 149.
BUS_C-L74 ========== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ==========
FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES

		BRANCH NAME	VBASE LL	-PHASE A-	-PHASE B-	-PHASE C-
BUS_XFMR-L73	BUS_C-L74	XFMR-L74	600.	14.3/ -2.	0.0/ 0.	0.0/ 0.
BUS_C-L74	BUS_PNL-L74	C-L74	240.	0.0/ 0.	0.0/ 0.	0.0/ 0.

```
 BUS_CBL-UTIL   VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:  10830.5 /  -76. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:    6.558 +j  25.835 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     3.940
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   2.185 +j   8.610 (PU)
                                              Z2:   2.185 +j   8.610 (PU)
                                              Z0:   2.187 +j   8.616 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   12841.7     10848.8     10831.2     10830.5     10830.5

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     1.0001 / -120.0     1.0001 /  120.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                10830.5 / -75.8       0.0 /   0.0         0.0 /   0.0

 BUS_CBL-UTIL   ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   BUS_XFMR-UTIL    4160.0  1.0000 /   0.  1.0000 /-120.  1.0000 / 120.
   BUS_CSTE-L70.M    600.0  0.0000 / -52.  1.0001 /-120.  1.0002 / 120.
   BUS_CBL-UTIL   ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
BUS_XFMR-UTIL  BUS_CBL-UTIL   XFMR-UTIL       4160.   1561.3/ -76.      0.4/ -78.      0.4/ -78.
BUS_CBL-UTIL   BUS_CSTE-L70.M CBL-UTIL         600.      5.2/ 102.      2.6/ -78.      2.6/ -78.

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 BUS_CSTE-L70.M VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   9653.8 /  -68. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   11.140 +j  27.750 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     2.491
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   2.969 +j   9.005 (PU)
                                              Z2:   2.969 +j   9.005 (PU)
                                              Z0:   5.203 +j   9.739 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                   10399.9      9654.2      9653.8      9653.8      9653.8

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.9760 / -124.3     1.0775 /  120.7

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 9653.8 / -68.1        0.0 /   0.0         0.0 /   0.0

 BUS_CSTE-L70.M ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.0000 / -48.  0.9760 /-124.  1.0775 / 121.
   BUS_CBL-UTIL      600.0  0.1661 / -45.  1.0001 /-120.  1.0001 / 120.
   BUS_CSTE-L70.M ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
BUS_CSTE-L70.M MCC-L71        C-L71            600.      5.0/ 105.      2.5/ -75.      2.5/ -75.
BUS_CBL-UTIL   BUS_CSTE-L70.M CBL-UTIL         600.   9648.8/ -68.      2.5/ -75.      2.5/ -75.

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 BUS_DS-L66      VOLTAGE BASE LL:                 600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   5300.5 /  -33. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   45.535 +j  29.877 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.656
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:  12.898 +j   9.433 (PU)
                                               Z2:  12.898 +j   9.433 (PU)
                                               Z0:  19.739 +j  11.010 (PU)

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     5300.9      5300.5      5300.5      5300.5      5300.5

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     1.0296 / -127.1     1.1023 /  124.3

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  5300.5 / -33.3        0.0 /   0.0         0.0 /   0.0

 BUS_DS-L66      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.5758 / -32.  1.0208 /-124.  1.0523 / 123.
   BUS_SF-L66        600.0  0.0000 / -75.  1.0296 /-127.  1.1023 / 124.
   BUS_DS-L66     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_DS-L66     C-L66-1          600.   5299.2/ -33.      0.9/ -75.      0.9/ -75.
BUS_DS-L66      BUS_SF-L66     C-L66-2          600.      1.8/ 104.      0.9/ -76.      0.9/ -76.

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 BUS_DS-L67     VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5300.9 /  -33. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   45.528 +j  29.880 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     0.656
                SEQUENCE EQUIVALENT IMPEDANCE Z1:  12.895 +j   9.435 (PU)
                                              Z2:  12.895 +j   9.435 (PU)
                                              Z0:  19.739 +j  11.010 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    5301.2      5300.9      5300.9      5300.9      5300.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     1.0296 / -127.1     1.1023 /  124.3

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5300.9 / -33.3       0.0 /   0.0         0.0 /   0.0

 BUS_DS-L67     ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.5757 / -32.  1.0208 /-124.  1.0523 / 123.
   BUS_SF-L67        600.0  0.0001 / -75.  1.0295 /-127.  1.1024 / 124.
   BUS_DS-L67     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_DS-L67     C-L67-1          600.   5298.8/ -33.      1.4/ -76.      1.4/ -76.
BUS_DS-L67      BUS_SF-L67     C-L67-2          600.      2.8/ 104.      1.4/ -76.      1.4/ -76.

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 BUS_HCE-L60    VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   6151.6 /  -40. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   35.800 +j  30.340 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     0.848
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   9.449 +j   9.524 (PU)
                                              Z2:   9.449 +j   9.524 (PU)
                                              Z0:  16.902 +j  11.293 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    6155.3      6151.6      6151.6      6151.6      6151.6

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     1.0218 / -129.2     1.1403 /  124.5

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 6151.6 / -40.3       0.0 /   0.0         0.0 /   0.0

 BUS_HCE-L60    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.4612 / -37.  1.0148 /-125.  1.0671 / 123.
   BUS_HCE-L60    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_HCE-L60    C-L60           600.   6151.6/ -40.      0.0/ -40.      0.0/ -40.

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 BUS_HCE-L68    VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   7438.7 /  -50. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   24.997 +j  29.684 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     1.187
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   6.470 +j   9.397 (PU)
                                              Z2:   6.470 +j   9.397 (PU)
                                              Z0:  12.058 +j  10.891 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    7476.1      7438.7      7438.7      7438.7      7438.7

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.9983 / -128.6     1.1368 /  123.2

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 7438.7 / -49.9        0.0 /   0.0         0.0 /   0.0

 BUS_HCE-L68    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.2789 / -46.  1.0020 /-126.  1.0900 / 123.
   BUS_HCE-L68    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_HCE-L68    C-L68            600.   7438.7/ -50.      0.0/ -50.      0.0/ -50.

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```
 BUS_PNL-L74    VOLTAGE BASE LL:                 240.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:     35.6 /   -2. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:  INFINITE
                THEVENIN IMPEDANCE X/R RATIO:     0.028
                SEQUENCE EQUIVALENT IMPEDANCE Z1:  91.129 +j 188.920 (PU)
                                              Z2:  91.129 +j 188.920 (PU)
                                              Z0: INFINITE

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                      35.6        35.6        35.6        35.6        35.6

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     1.7060 / -150.6     1.7338 /  149.0

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                   35.6 /  -1.6        0.0 /   0.0         0.0 /   0.0

 BUS_PNL-L74    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   BUS_C-L74         240.0  0.0020 /   6.  1.7054 /-151.  1.7332 / 149.
   BUS_PNL-L74    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
BUS_C-L74      BUS_PNL-L74    C-L74            240.     35.6/  -2.      0.0/   0.      0.0/   0.

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```
 BUS_SF-L66      VOLTAGE BASE LL:                 600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   4820.4 /  -30. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   51.803 +j  30.048 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.580
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:  14.779 +j   9.467 (PU)
                                               Z2:  14.779 +j   9.467 (PU)
                                               Z0:  22.244 +j  11.114 (PU)

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     4820.5      4820.4      4820.4      4820.4      4820.4

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     1.0348 / -126.9     1.0977 /  124.5

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  4820.4 / -30.1       0.0 /   0.0         0.0 /   0.0

 BUS_SF-L66      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---     ---PHASE B---     ---PHASE C---
   BUS_DS-L66        600.0  0.1047 / -29.  1.0324 /-126.  1.0889 / 124.
   BUS_SF-L66     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
SF-L66         BUS_SF-L66                     600.      1.8/ -76.      0.9/ 104.      0.9/ 104.
BUS_DS-L66     BUS_SF-L66     C-L66-2         600.   4819.1/ -30.      0.9/ -76.      0.9/ -76.

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```

```
 BUS_SF-L67     VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   4820.7 /  -30. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   51.795 +j  30.053 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     0.580
                SEQUENCE EQUIVALENT IMPEDANCE Z1:  14.775 +j   9.470 (PU)
                                              Z2:  14.775 +j   9.470 (PU)
                                              Z0:  22.244 +j  11.114 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    4820.8      4820.7      4820.7      4820.7      4820.7

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     1.0347 / -126.9     1.0978 /  124.5

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 4820.7 / -30.1       0.0 /   0.0         0.0 /   0.0

 BUS_SF-L67     ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   BUS_DS-L67       600.0  0.1047 / -29.  1.0324 /-126.  1.0890 / 124.
   BUS_SF-L67    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
SF-L67         BUS_SF-L67                    600.      2.8/ -76.      1.4/ 104.      1.4/ 104.
BUS_DS-L67     BUS_SF-L67     C-L67-2        600.   4818.8/ -30.      1.4/ -76.      1.4/ -76.

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 BUS_UH-L61      VOLTAGE BASE LL:                 600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   4409.0 /  -27. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   58.090 +j  30.206 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.520
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:  16.670 +j   9.494 (PU)
                                               Z2:  16.670 +j   9.494 (PU)
                                               Z0:  24.750 +j  11.218 (PU)

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     4409.0      4409.0      4409.0      4409.0      4409.0

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     1.0389 / -126.8     1.0935 /  124.6

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  4409.0 / -27.5       0.0 /   0.0         0.0 /   0.0

 BUS_UH-L61      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.6707 / -26.  1.0226 /-123.  1.0390 / 123.
   BUS_UH-L61     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71        BUS_UH-L61     C-L61            600.   4409.0/ -27.      0.0/ -27.      0.0/ -27.

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```
 BUS_UH-L62      VOLTAGE BASE LL:                 600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   4819.6 /  -30. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   51.819 +j  30.038 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.580
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:  14.787 +j   9.462 (PU)
                                               Z2:  14.787 +j   9.462 (PU)
                                               Z0:  22.244 +j  11.114 (PU)

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     4819.7      4819.6      4819.6      4819.6      4819.6

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     1.0349 / -126.9     1.0975 /  124.5

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  4819.6 / -30.1       0.0 /   0.0         0.0 /   0.0

 BUS_UH-L62      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.6284 / -29.  1.0221 /-123.  1.0449 / 123.
   BUS_UH-L62     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71        BUS_UH-L62     C-L62            600.   4819.6/ -30.      0.0/ -30.      0.0/ -30.

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```
 BUS_UH-L63      VOLTAGE BASE LL:                  600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   2867.4 /  -18. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   95.714 +j  31.217 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.326
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:  27.967 +j   9.686 (PU)
                                               Z2:  27.967 +j   9.686 (PU)
                                               Z0:  39.781 +j  11.844 (PU)

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     2867.4      2867.4      2867.4      2867.4      2867.4

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     1.0510 / -126.0     1.0771 /  125.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  2867.4 / -18.1       0.0 /   0.0         0.0 /   0.0

 BUS_UH-L63      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.8100 / -17.  1.0200 /-122.  1.0200 / 122.
   BUS_UH-L63     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71        BUS_UH-L63     C-L63            600.   2867.4/ -18.      0.0/   0.      0.0/   0.

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 BUS_UH-L64      VOLTAGE BASE LL:                 600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   2310.6 /  -15. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:  120.797 +j  31.890 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.264
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:  35.498 +j   9.815 (PU)
                                               Z2:  35.498 +j   9.815 (PU)
                                               Z0:  49.801 +j  12.261 (PU)

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     2310.6      2310.6      2310.6      2310.6      2310.6

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     1.0542 / -125.7     1.0710 /  125.1

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  2310.6 / -14.8       0.0 /   0.0         0.0 /   0.0

 BUS_UH-L64      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.8536 / -13.  1.0176 /-121.  1.0145 / 122.
   BUS_UH-L64     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_UH-L64     C-L64            600.   2310.6/ -15.      0.0/   0.      0.0/   0.

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 BUS_UH-L65      VOLTAGE BASE LL:                 600.0 (VOLTS)
                 INI. SYM. RMS FAULT CURRENT:   2867.4 /  -18. ( AMPS/DEG )
                 THEVENIN EQUIVALENT IMPEDANCE:   95.714 +j  31.217 (PU)
                 THEVENIN IMPEDANCE X/R RATIO:     0.326
                 SEQUENCE EQUIVALENT IMPEDANCE Z1:  27.967 +j   9.686 (PU)
                                               Z2:  27.967 +j   9.686 (PU)
                                               Z0:  39.781 +j  11.844 (PU)

                  ASYM    RMS   INTERRUPTING AMPS
                 1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                     2867.4      2867.4      2867.4      2867.4      2867.4

                 INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                 0.0000 /    0.0     1.0510 / -126.0     1.0771 /  125.0

                 INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                         AT TIME =     0.5 CYCLES
                 ---PHASE A---       ---PHASE B---       ---PHASE C---
                  2867.4 / -18.1       0.0 /   0.0         0.0 /   0.0

 BUS_UH-L65      ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                     FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                           ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.8100 / -17.  1.0200 /-122.  1.0200 / 122.
   BUS_UH-L65     ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                              FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                             BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71        BUS_UH-L65     C-L65            600.   2867.4/ -18.      0.0/   0.      0.0/   0.

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 BUS_VFD-L01    VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   8933.9 /  -64. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   14.195 +j  29.027 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     2.045
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   3.491 +j   9.269 (PU)
                                              Z2:   3.491 +j   9.269 (PU)
                                              Z0:   7.213 +j  10.488 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    9338.4      8933.9      8933.9      8933.9      8933.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.9740 / -126.9     1.1179 /  121.5

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 8933.9 / -63.9        0.0 /   0.0         0.0 /   0.0

 BUS_VFD-L01    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.0000 / -19.  0.9740 /-127.  1.1179 / 122.
   BUS_C-L01-1       600.0  0.0567 / -56.  0.0882 /-170.  0.0711 /  90.
   BUS_VFD-L01    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_VFD-L01    C-L01.VFD       600.   8933.9/ -64.      0.0/ -64.      0.0/ -64.
BUS_VFD-L01     BUS_C-L01-1    VFD-L01         600.      0.0/   0.      0.0/   0.      0.0/   0.

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 BUS_VFD-L02    VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   8933.9 /  -64. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   14.195 +j  29.027 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     2.045
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   3.491 +j   9.269 (PU)
                                              Z2:   3.491 +j   9.269 (PU)
                                              Z0:   7.213 +j  10.488 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    9338.4      8933.9      8933.9      8933.9      8933.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.9740 / -126.9     1.1179 /  121.5

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 8933.9 / -63.9       0.0 /   0.0         0.0 /   0.0

 BUS_VFD-L02    ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.0000 / -19.  0.9740 /-127.  1.1179 / 122.
   BUS_C-L02-1       600.0  0.0567 / -56.  0.0882 /-170.  0.0711 /  90.
   BUS_VFD-L02    ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_VFD-L02    C-L02.VFD       600.   8933.9/ -64.      0.0/ -64.      0.0/ -64.
BUS_VFD-L02     BUS_C-L02-1    VFD-L02         600.      0.0/   0.      0.0/   0.      0.0/   0.

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 BUS_XFMR-L73   VOLTAGE BASE LL:                 600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   5876.9 /  -38. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   38.500 +j  30.505 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     0.792
                SEQUENCE EQUIVALENT IMPEDANCE Z1:  10.194 +j   9.556 (PU)
                                              Z2:  10.194 +j   9.556 (PU)
                                              Z0:  18.113 +j  11.393 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    5879.0      5876.9      5876.9      5876.9      5876.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     1.0268 / -129.2     1.1400 /  124.7

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 5876.9 / -38.4        0.0 /   0.0         0.0 /   0.0

 BUS_XFMR-L73   ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
   MCC-L71           600.0  0.4957 / -35.  1.0165 /-124.  1.0625 / 123.
   BUS_C-L74         240.0  0.0000 /   0.  1.0268 /-129.  1.1400 / 125.
   BUS_XFMR-L73   ================ INI.    RMS   SYSTEM BRANCH FLOWS ( AMPS ) ================
                             FIRST BRANCH FROM FAULT AT TIME =     0.5 CYCLES
                            BRANCH NAME   VBASE LL  -PHASE A-     -PHASE B-     -PHASE C-
MCC-L71         BUS_XFMR-L73   C-L73           600.   5876.9/ -38.      0.0/ -38.      0.0/ -38.
BUS_XFMR-L73    BUS_C-L74      XFMR-L74        600.      0.0/   0.      0.0/   0.      0.0/   0.

 ------------------------------------------------------------------------------------------
```

```
MCC-L71         VOLTAGE BASE LL:                  600.0 (VOLTS)
                INI. SYM. RMS FAULT CURRENT:   8933.9 /  -64. ( AMPS/DEG )
                THEVENIN EQUIVALENT IMPEDANCE:   14.195 +j  29.027 (PU)
                THEVENIN IMPEDANCE X/R RATIO:     2.045
                SEQUENCE EQUIVALENT IMPEDANCE Z1:   3.491 +j   9.269 (PU)
                                              Z2:   3.491 +j   9.269 (PU)
                                              Z0:   7.213 +j  10.488 (PU)

                 ASYM    RMS   INTERRUPTING AMPS
                1/2 CYCLES    2 CYCLES    3 CYCLES    5 CYCLES    8 CYCLES
                    9338.4      8933.9      8933.9      8933.9      8933.9

                INI. SYM. RMS FAULTED BUS VOLTAGES ( PU / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                0.0000 /    0.0     0.9740 / -126.9     1.1179 /  121.5

                INI.    RMS   FAULTED CURRENT ( AMPS / DEG )
                        AT TIME =     0.5 CYCLES
                ---PHASE A---       ---PHASE B---       ---PHASE C---
                 8933.9 / -63.9        0.0 /   0.0         0.0 /   0.0

MCC-L71         ==== INI. SYM. RMS SYSTEM BUS VOLTAGES ( PU / DEG ) =======
                    FIRST BUS FROM FAULT    AT TIME =     0.5 CYCLES
                          ---PHASE A---     ---PHASE B---     ---PHASE C---
  BUS_HCE-L60       600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_DS-L66        600.0  0.0002 / -72.  0.9739 /-127.  1.1180 / 122.
  BUS_XFMR-L73      600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_CSTE-L70.M    600.0  0.1025 / -41.  0.9827 /-124.  1.0707 / 121.
  BUS_VFD-L01       600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_VFD-L02       600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_HCE-L68       600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_UH-L61        600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_UH-L62        600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_UH-L63        600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_UH-L64        600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_UH-L65        600.0  0.0000 /   0.  0.9740 /-127.  1.1179 / 122.
  BUS_DS-L67        600.0  0.0003 / -72.  0.9739 /-127.  1.1180 / 122.
```

MCC-L71 ========== INI. RMS SYSTEM BRANCH FLOWS (AMPS) ==========

FIRST BRANCH FROM FAULT AT TIME = 0.5 CYCLES

		BRANCH NAME	VBASE LL	-PHASE A-	-PHASE B-	-PHASE C-
MCC-L71	BUS_HCE-L60	C-L60	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_DS-L66	C-L66-1	600.	1.9/ 107.	1.0/ -73.	1.0/ -73.
MCC-L71	BUS_XFMR-L73	C-L73	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
BUS_CSTE-L70.M	MCC-L71	C-L71	600.	8929.2/ -64.	2.4/ -73.	2.4/ -73.
MCC-L71	BUS_VFD-L01	C-L01.VFD	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_VFD-L02	C-L02.VFD	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_HCE-L68	C-L68	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L61	C-L61	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L62	C-L62	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L63	C-L63	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L64	C-L64	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_UH-L65	C-L65	600.	0.0/ 0.	0.0/ 0.	0.0/ 0.
MCC-L71	BUS_DS-L67	C-L67-1	600.	2.9/ 107.	1.4/ -73.	1.4/ -73.

****

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

BUS NAME	VOLTAGE L-L	AVAILABLE FAULT CURRENT 3 PHASE	X/R	LINE/GRND	X/R
BUS_C-L74	240.	1173.1	2.3	35.63	0.0
BUS_CBL-UTIL	600.	10833.1	3.9	10830.49	3.9
BUS_CSTE-L70.M	600.	10148.0	3.0	9653.78	2.5
BUS_DS-L66	600.	6021.7	0.7	5300.53	0.7
BUS_DS-L67	600.	6022.3	0.7	5300.88	0.7
BUS_HCE-L60	600.	7172.5	1.0	6151.56	0.8
BUS_HCE-L68	600.	8434.4	1.5	7438.70	1.2
BUS_PNL-L74	240.	1146.9	2.1	35.56	0.0
BUS_SF-L66	600.	5482.5	0.6	4820.36	0.6
BUS_SF-L67	600.	5483.1	0.6	4820.73	0.6
BUS_UH-L61	600.	5015.9	0.6	4409.00	0.5
BUS_UH-L62	600.	5481.2	0.6	4819.63	0.6
BUS_UH-L63	600.	3251.2	0.3	2867.37	0.3
BUS_UH-L64	600.	2612.7	0.3	2310.60	0.3
BUS_UH-L65	600.	3251.2	0.3	2867.37	0.3
BUS_VFD-L01	600.	9714.8	2.7	8933.90	2.0
BUS_VFD-L02	600.	9714.8	2.7	8933.90	2.0
BUS_XFMR-L73	600.	6886.9	0.9	5876.91	0.8
MCC-L71	600.	9714.8	2.7	8933.91	2.0

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

Appendix D

TCC Diagrams

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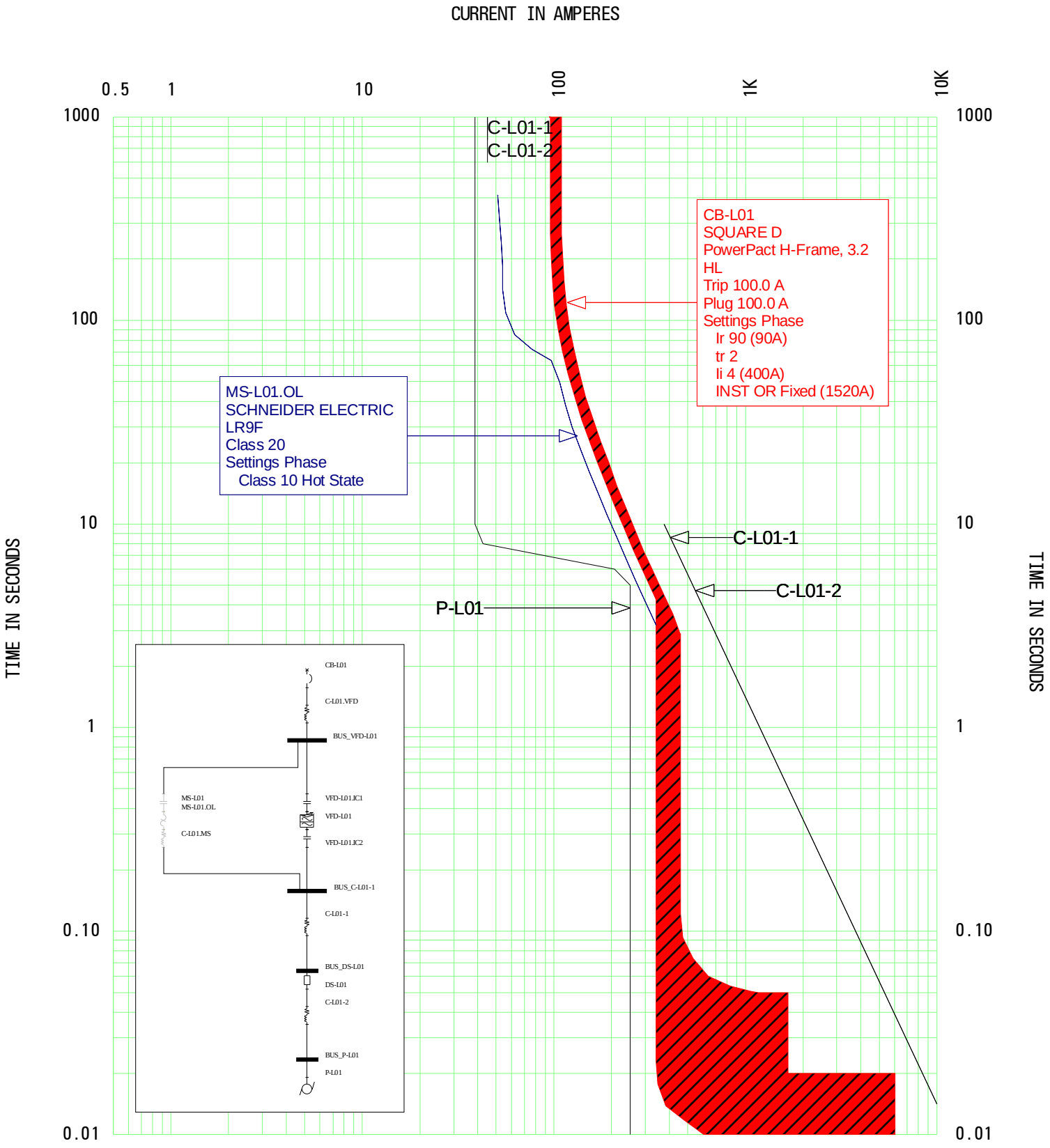
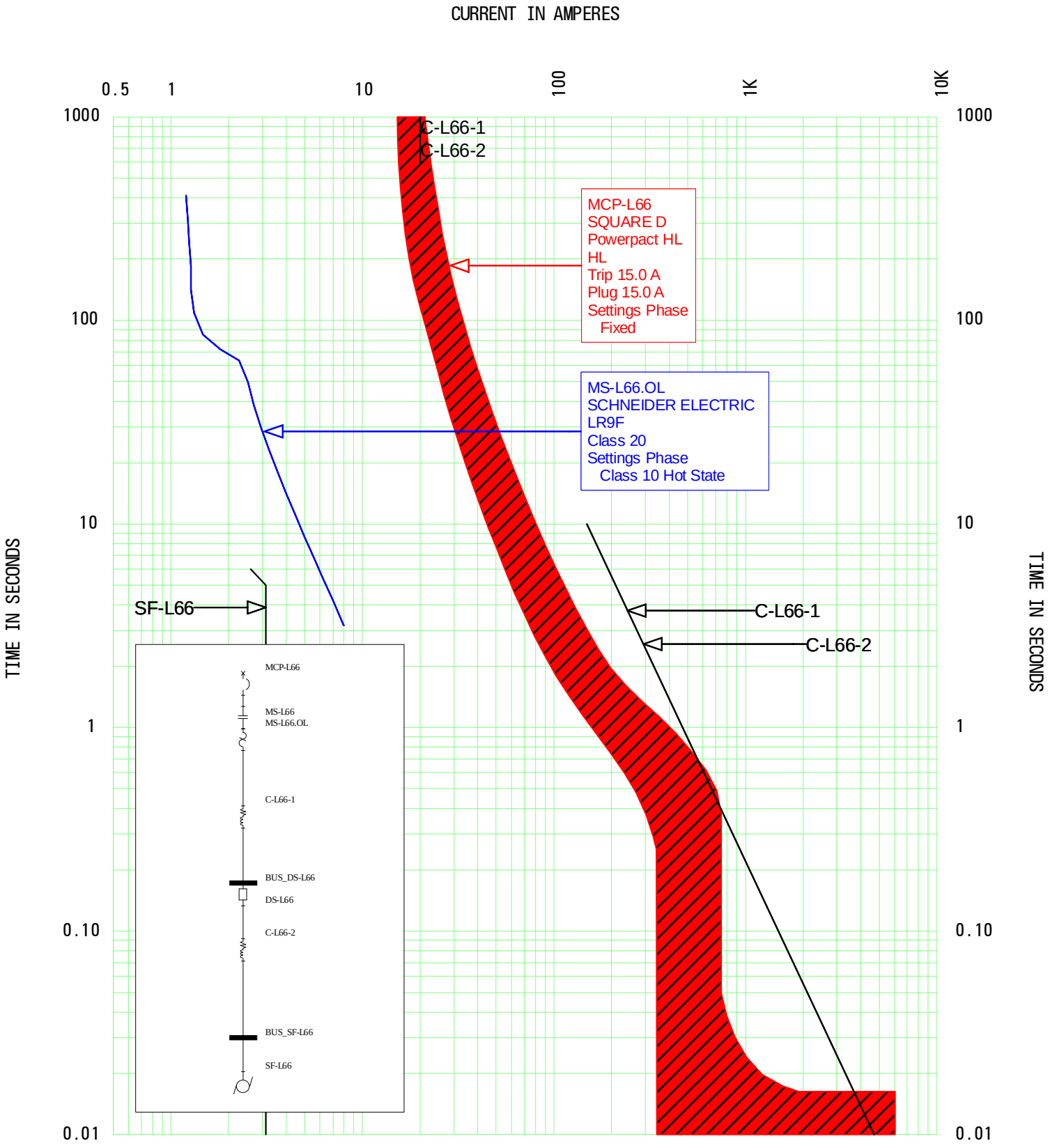


TCC Name: P-L01
Oneline: P-L01
Riverbend Lift Pumping Station

Current Scale x 1

Reference Voltage: 600

SKM Systems Analysis, Inc.

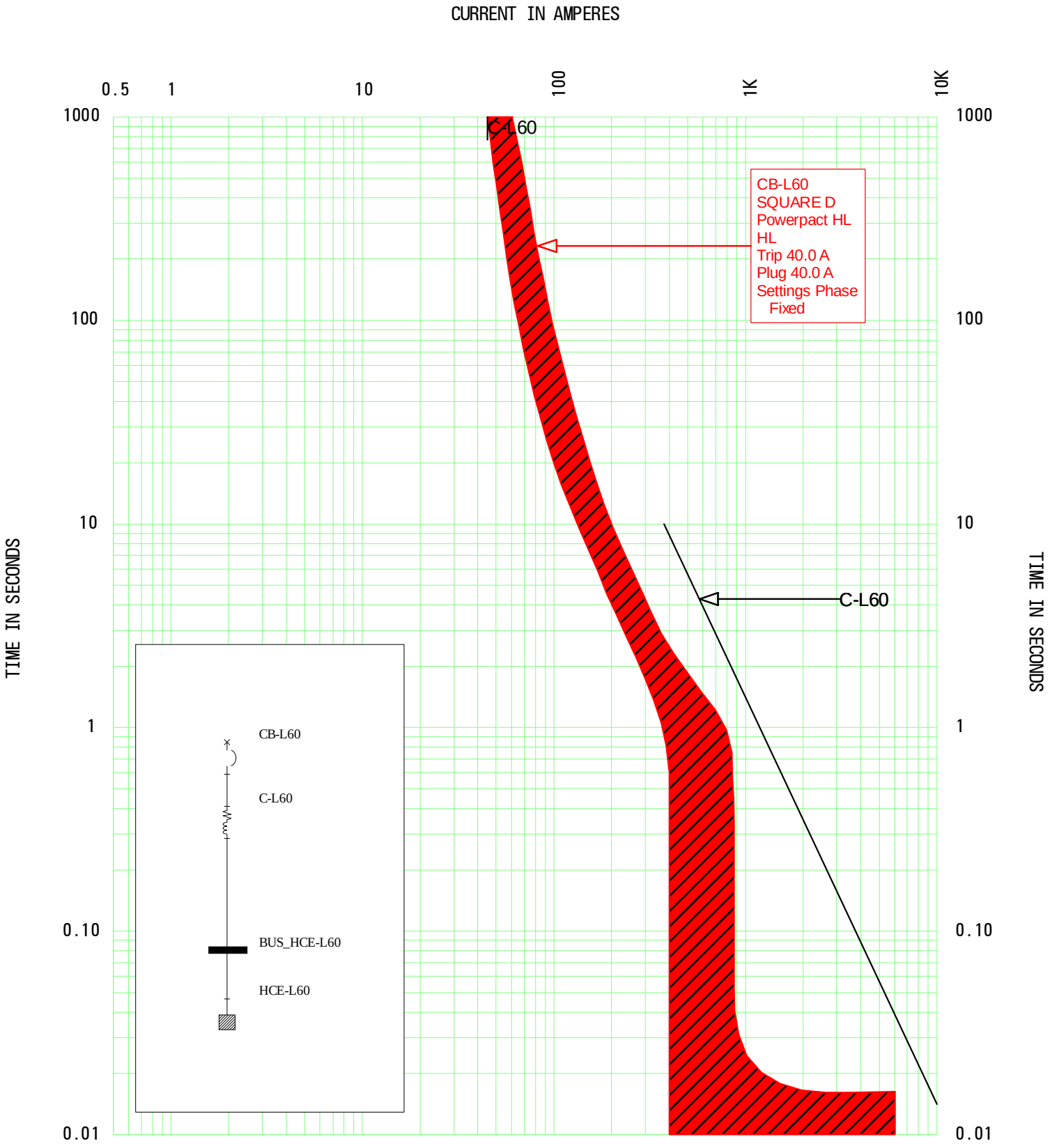


TCC Name: SF-L66
Oneline: SF-L66
Riverbend Lift Pumping Station

Current Scale x 1

Reference Voltage: 600

SKM Systems Analysis, Inc.

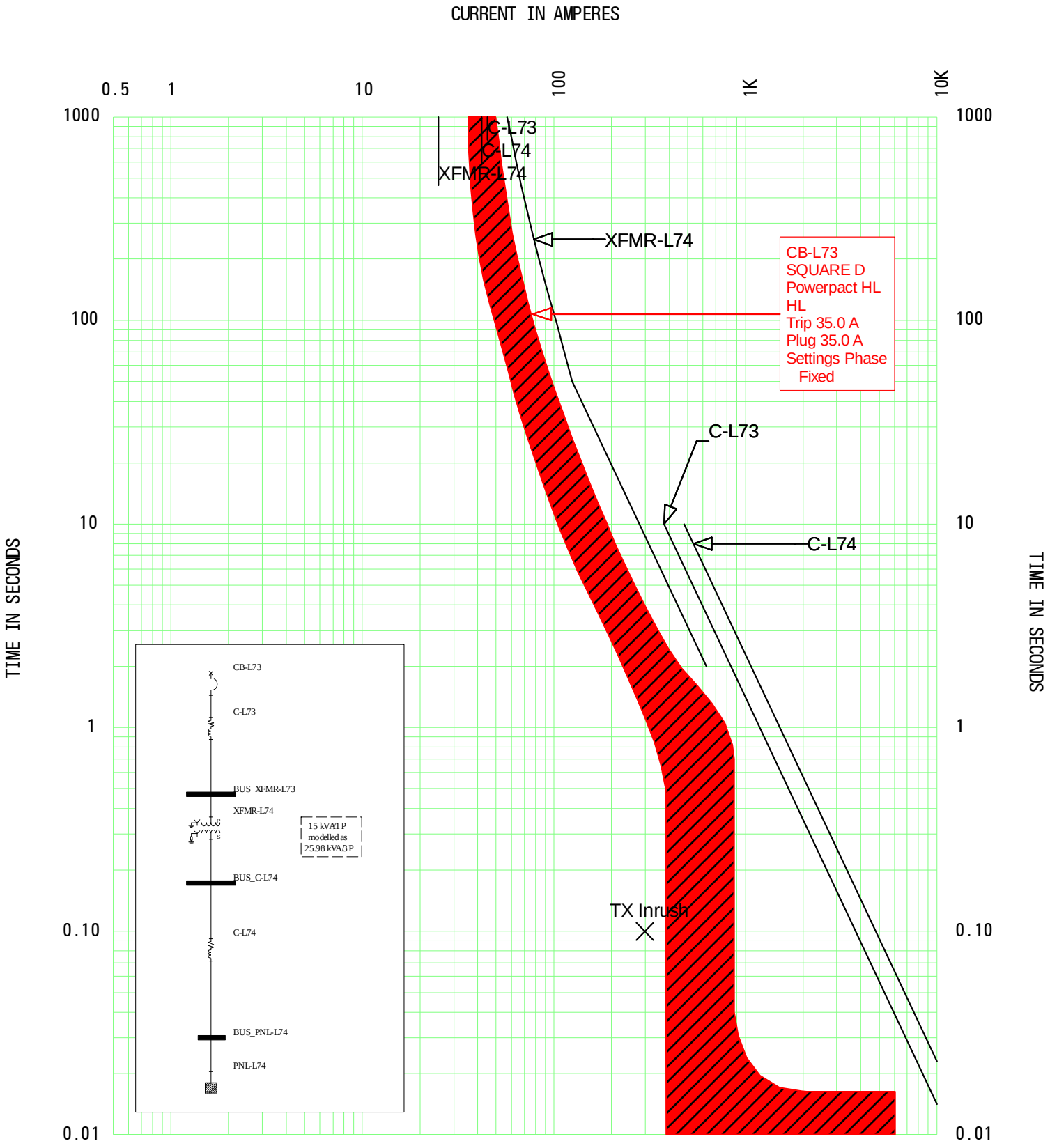


TCC Name: HCE-L60
Oneline: HCE-L60
Riverbend Lift Pumping Station

Current Scale x 1

Reference Voltage: 600

SKM Systems Analysis, Inc.

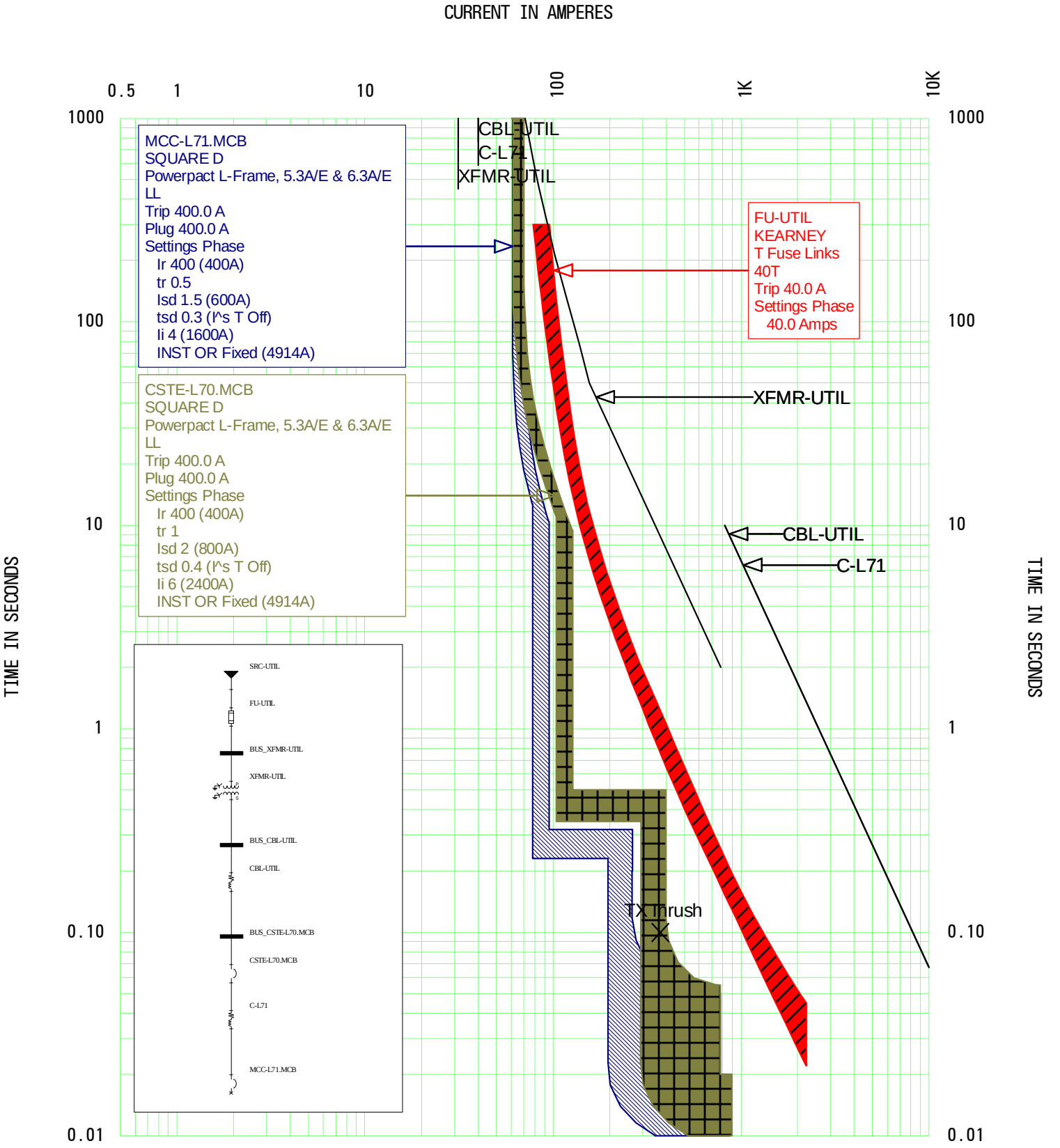


TCC Name: PNL-L74
Oneline: PNL-L74
Riverbend Lift Pumping Station

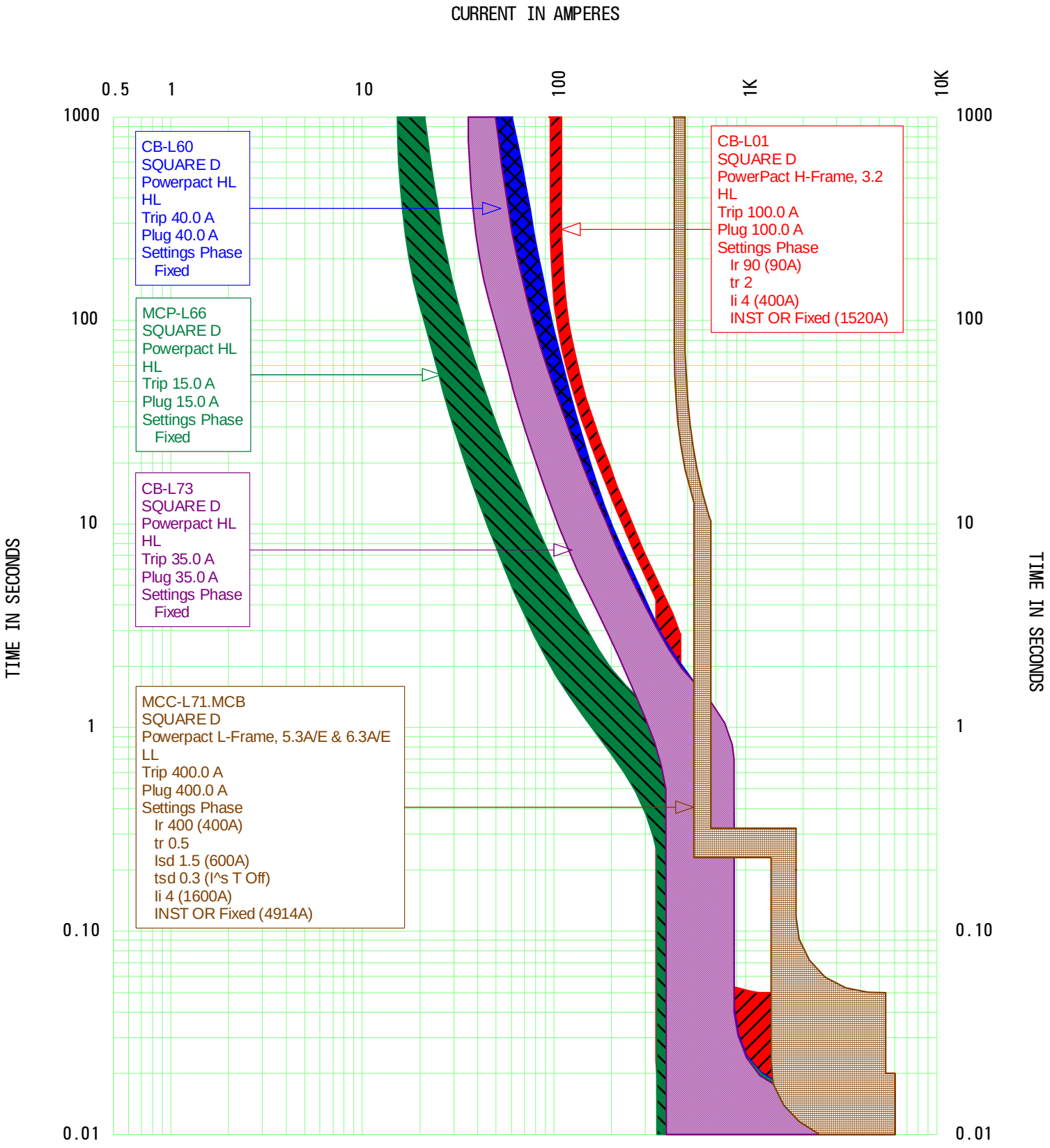
Current Scale x 1

Reference Voltage: 600

SKM Systems Analysis, Inc.



TCC Name: UTIL	Current Scale x 1	Reference Voltage: 4160
Oneline: UTIL		
Riverbend Lift Pumping Station		SKM Systems Analysis, Inc.

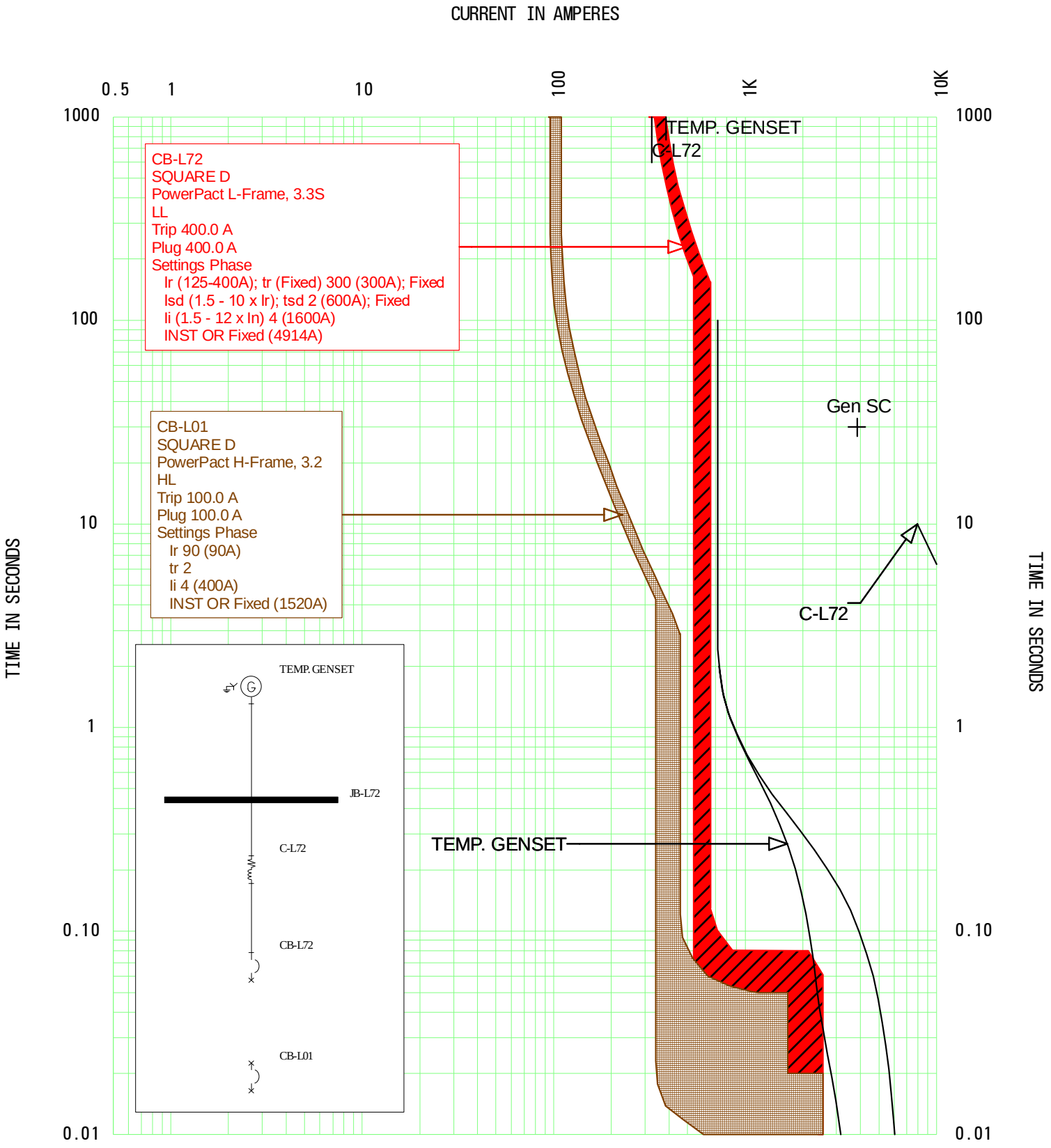


TCC Name: Breaker Coordination
Oneline:
Riverbend Lift Pumping Station

Current Scale x 1

Reference Voltage: 600

SKM Systems Analysis, Inc.



TCC Name: CB-L72 (GEN)
Oneline: CB-L72 (GEN)
Riverbend Lift Pumping Station

Current Scale x 1

Reference Voltage: 600

SKM Systems Analysis, Inc.

Appendix E

Arc Flash Analysis Report

DILLON CONSULTING

Bus Name	Protective Device Name	Bus kV	Bus Bolted Fault	Bus Arcing Fault [kA]	Prot Dev Bolted Fault	Prot Dev Arcing Fault	Trip / Delay Time [s]	Breaker Opening Time/Tol	Equip Type	Gap [mm]	Arc Flash Boundary [mm]	Working Distance [mm]	Incident Energy [cal/cm2]	PPE Level / Notes (*N)
BUS_CBL-UTIL	FU-UTIL	0.60	6.51	4.70	6.50	4.69	0.3702	0.0000	PNL	25	942	457	3.81	Level 1 (*N3) (*S0)
BUS_C-L01-1	CB-L01	0.60	17.25	14.38	17.01	14.18	0.02	0.0000	PNL	25	317	457	0.67	Level 0 (*N5) (*S2)
BUS_C-L02-1	CB-L02	0.60	17.25	14.38	17.01	14.18	0.02	0.0000	PNL	25	317	457	0.67	Level 0 (*N5) (*S2)
BUS_C-L74	CB-L73	0.24	1.14	0.49	1.14	0.49	2	0.0000	PNL	25	457	457	< 1.2	Level 0 (*N9) (*N15b) (*S0)
BUS_CSTE-L70.MCB	FU-UTIL	0.60	6.22	4.48	6.21	4.47	0.4068	0.0000	PNL	25	968	457	3.98	Level 1 (*N3) (*S0)
BUS_DS-L01	CB-L01	0.60	6.71	5.49	6.56	5.37	0.02	0.0000	PNL	25	167	457	0.24	Level 0 (*N5) (*S2)
BUS_DS-L02	CB-L02	0.60	6.71	5.49	6.56	5.37	0.02	0.0000	PNL	25	167	457	0.24	Level 0 (*N5) (*S2)
BUS_DS-L66	MCP-L66	0.60	7.49	6.15	7.49	6.15	0.0162	0.0000	PNL	25	158	457	0.22	Level 0 (*S2)
BUS_DS-L67	MCP-L67	0.60	7.49	6.15	7.49	6.15	0.0162	0.0000	PNL	25	158	457	0.22	Level 0 (*S2)
BUS_HCE-L60	CB-L60	0.60	9.77	8.09	9.77	8.09	0.0162	0.0000	PNL	25	189	457	0.29	Level 0 (*S2)
BUS_HCE-L68	CB-L68	0.60	12.96	10.80	12.96	10.80	0.0162	0.0000	PNL	25	229	457	0.40	Level 0 (*S2)
BUS_P-L01	CB-L01	0.60	5.41	4.39	5.28	4.29	0.02	0.0000	PNL	25	144	457	0.19	Level 0 (*N5) (*S2)
BUS_P-L02	CB-L02	0.60	5.41	4.39	5.28	4.29	0.02	0.0000	PNL	25	144	457	0.19	Level 0 (*N5) (*S2)
BUS_PNL-L74	CB-L73	0.24	1.11	0.48	1.11	0.48	2	0.0000	PNL	25	457	457	< 1.2	Level 0 (*N9) (*N15b) (*S0)
BUS_SF-L66	MCP-L66	0.60	6.59	5.39	6.59	5.39	0.0162	0.0000	PNL	25	145	457	0.19	Level 0 (*S2)
BUS_SF-L67	MCP-L67	0.60	6.59	5.39	6.59	5.39	0.0162	0.0000	PNL	25	145	457	0.19	Level 0 (*S2)
BUS_UH-L61	CB-L61	0.60	5.87	4.78	5.87	4.78	0.0162	0.0000	PNL	25	134	457	0.17	Level 0 (*S2)
BUS_UH-L62	CB-L62	0.60	6.59	5.39	6.59	5.39	0.0162	0.0000	PNL	25	145	457	0.19	Level 0 (*S2)
BUS_UH-L63	CB-L63	0.60	3.52	2.80	3.52	2.80	0.0162	0.0000	PNL	25	94	457	0.10	Level 0 (*S2)
BUS_UH-L64	CB-L64	0.60	2.77	2.18	2.77	2.18	0.0162	0.0000	PNL	25	80	457	0.07	Level 0 (*S2)
BUS_UH-L65	CB-L65	0.60	3.52	2.80	3.52	2.80	0.0162	0.0000	PNL	25	94	457	0.10	Level 0 (*S2)
BUS_VFD-L01	CB-L01	0.60	17.25	14.38	17.01	14.18	0.02	0.0000	PNL	25	317	457	0.67	Level 0 (*S2)
BUS_VFD-L02	CB-L02	0.60	17.25	14.38	17.01	14.18	0.02	0.0000	PNL	25	317	457	0.67	Level 0 (*S2)
BUS_XFMR-L73	CB-L73	0.60	9.17	7.58	9.17	7.58	0.0162	0.0000	PNL	25	181	457	0.27	Level 0 (*S2)
JB-L72	MaxTripTime @2.0s	0.60	2.57	2.03	2.56	2.02	2	0.0000	PNL	25	1538	457	8.34	Level 3 (*N2) (*N9) (*S1)
MCC-L71	MCC-L71.MCB	0.60	17.25	14.38	16.76	13.97	0.02	0.0000	MCC	25	317	457	0.67	Level 0 (*S2)

Level 0: No Arc-rated PPE Required	0.0 - 1.2 cal/cm^2		Worst Case:	#Level 0 = 23	(*N2) < 80% Cleared Fault Threshold
Level 1: Arc-rated long-sleeve shirt & pants or arc-rated coverall	1.2 - 4.0 cal/cm^2		(*S0) - Base Project	#Level 1 = 2	(*N3) - Arcing Current Low Tolerances Used
Level 2: Arc-rated long-sleeve shirt & pants or arc-rated coverall or arc-rated arc flash suit	4.0 - 8.0 cal/cm^2		(*S1) - Generator (No UTIL)	#Level 3 = 1	(*N5) - Miscoordinated, Upstream Device Tripped
Level 3: Arc-rated long-sleeve shirt & pants or arc-rated coverall or arc-rated arc flash suit	8.0 - 25.0 cal/cm^2		(*S2) - Base Project (VFD BYPASS)		(*N9) - Max Arcing Duration Reached
Level 4: Arc-rated long-sleeve shirt & pants or arc-rated coverall or arc-rated arc flash suit	25.0 - 40.0 cal/cm^2		(*S3) - Base Project (Infinite Bus)		(*N15b) - Apply exception if Bolted Fault Current < 2000 A (IEEE 1584 2018 Section 4.3)
Level Dangerous!: Do not work on live. No safe PPE.	40.0 - 9999.0 cal/cm^2				IEEE 1584 2018 Bus Report - Comprehensive Fault (80% Cleared Fault Threshold, mis-coordination checked

Appendix F

Arc Flash Labels

DILLON CONSULTING

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

942 mm	Arc Flash Boundary
3.81 cal/cm^2	Incident Energy at 457 mm
PPE	Arc-rated long-sleeve shirt & pants or arc-rated coverall
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_CBL-UTIL

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

457 mm	Arc Flash Boundary
< 1.2 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
240 VAC	Shock Risk when cover is removed
00	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_C-L74

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

317 mm	Arc Flash Boundary
0.67 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_C-L01-1

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

968 mm	Arc Flash Boundary
3.98 cal/cm^2	Incident Energy at 457 mm
PPE	Arc-rated long-sleeve shirt & pants or arc-rated coverall
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_CSTE-L70.MCB

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

317 mm	Arc Flash Boundary
0.67 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_C-L02-1

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

167 mm	Arc Flash Boundary
0.24 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_DS-L01

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

167 mm	Arc Flash Boundary
0.24 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_DS-L02

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

189 mm	Arc Flash Boundary
0.29 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_HCE-L60

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

158 mm	Arc Flash Boundary
0.22 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_DS-L66

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

229 mm	Arc Flash Boundary
0.40 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_HCE-L68

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

158 mm	Arc Flash Boundary
0.22 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_DS-L67

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

144 mm	Arc Flash Boundary
0.19 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_P-L01

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

144 mm	Arc Flash Boundary
0.19 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_P-L02

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

145 mm	Arc Flash Boundary
0.19 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_SF-L67

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

457 mm	Arc Flash Boundary
< 1.2 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
240 VAC	Shock Risk when cover is removed
00	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_PNL-L74

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

134 mm	Arc Flash Boundary
0.17 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_UH-L61

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

145 mm	Arc Flash Boundary
0.19 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_SF-L66

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

145 mm	Arc Flash Boundary
0.19 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_UH-L62

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

94 mm	Arc Flash Boundary
0.10 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_UH-L63

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

317 mm	Arc Flash Boundary
0.67 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_VFD-L01

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

80 mm	Arc Flash Boundary
0.07 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_UH-L64

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

317 mm	Arc Flash Boundary
0.67 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_VFD-L02

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

94 mm	Arc Flash Boundary
0.10 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_UH-L65

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

181 mm	Arc Flash Boundary
0.27 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: BUS_XFMR-L73

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

1538 mm	Arc Flash Boundary
8.34 cal/cm^2	Incident Energy at 457 mm
PPE	Arc-rated long-sleeve shirt & pants or arc-rated coverall or arc-rated arc flash suit
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: JB-L72

WARNING

Arc Flash and Shock Risk

Appropriate PPE Required

317 mm	Arc Flash Boundary
0.67 cal/cm^2	Incident Energy at 457 mm
PPE	No Arc-rated PPE Required
600 VAC	Shock Risk when cover is removed
0	Glove Class
1000 mm	Limited Approach
300 mm	Restricted Approach

Location: MCC-L71