IDEA Project No. 24549

KN229976-ARC FLASH STUDY
FF07

Fort Frontenac

Department of National Defence

Issued Date: 2025-03-14

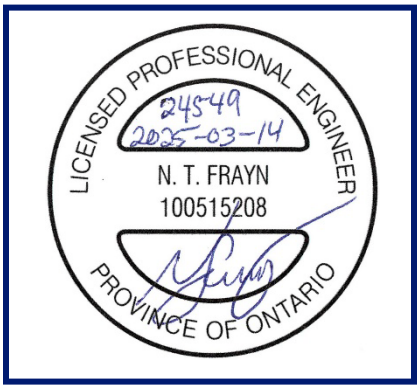
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RECORD OF REVISIONS			
REVISION	**DATE**	**BY**	**COMMENTS**
0	2025-01-10	Nicholas Frayn, P.Eng	Draft for client review
1	2025-03-14	Nicholas Frayn, P.Eng	Final Report



Disclaimer:

The arc flash values in this report have been determined through analysis conducted by IDEA Inc., following industry-recognized standards and utilizing tools that follow these standards. Improper maintenance of the electrical equipment listed within, age and condition of the equipment, modifications to the equipment, system modifications, and protective device settings could render the results of this study invalid. The results of this study assume that the equipment is operating properly as per the manufacturers' specifications. The data collected was provided by 3rd parties involved in the project, obtained onsite from the existing equipment, and when not available derived through recognized industry standards. This report is only to be used by the qualified personnel it was intended for in which IDEA Inc. has sent the original copy to, and IDEA Inc. assumes no liability or responsibility if the report is distributed or copied without consent from IDEA Inc.

Codes and Standards

- CSA C22.2:21 – Canadian Electrical Code, Part 1 (25th Edition)
- CSA Z462:24 – Workplace Electrical Safety
- IEEE 1584-208 – Guide for Performing Arc-Flash Hazard Calculations
- ANSI/IEEE C37.13 – Standard for Low Volage AC Power Breakers Used in Enclosures
- ANSI/IEEE C37.010 Standard Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current

UL 489-9 Standard for Safety for Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures

1. Executive Summary

DCC engaged IDEA Inc to perform an analysis of the existing electrical distribution system at building FF07 located at Fort Frontenac in Kingston Ontario.

The analysis intends to address the following items:

a) Perform a Short Circuit and Coordination study on both the medium voltage and low voltage systems for the building with short circuit results to be provided to confirm Short Circuit rating of the existing equipment.
b) Use the above short circuit results to provide a protective device coordination study utilizing individual time current coordination curves to provide recommended circuit breaker device settings and fuse types to limit incident energy and fault current.
c) Provide an Arc Flash Hazard Analysis as per CSA Z462-21 utilizing IEEE Std 1584 for the arc flash calculations to indicate incident energy from the medium voltage equipment down to the low voltage panels within the building. From these results and the coordination study recommended setting Arc Flash labels will be provided by the end of the project.
d) Provide the single line diagrams used to perform above studies.
e) Provide an Infrared Thermographic Scanning Report for all electrical distribution equipment from the service transformer down to all panel boards. The report will identify all equipment found to be anomalous, with current readings for this equipment provided and recommendations for correcting the equipment.
f) Provide Phase Balance Testing of the electrical distribution under normal load conditions. This will be measured at the incoming service to the building, and at each distribution panel, step down transformer, and low voltage panel board, where deemed safe to do so. Voltage drop measurements from the incoming main service down the furthest distribution equipment.

This report provides our findings associated with the existing equipment and lists the associated recommended work to be performed to bring the existing equipment up to code, reduce fault levels and incident energy to make the equipment safer to work on.

Multiple site visits were conducted by IDEA Inc., Eaton and Drycore Electric as part of the scope of work to investigate the existing electrical distribution system at building FF07 at Fort Frontenac. The equipment was opened and tested to document the equipment ratings, condition, wire sizes and types, perform voltage and current readings, take pictures and perform a thermographic scan while under load. This information was used to produce an updated single line diagram, and was entered into the Power System Software ETAP to perform the Short Circuit, Coordination, and Arc Flash Studies.

During the site visit, due to the condition and lack of maintenance reports on the 4160V equipment, it was deemed unsafe to open this equipment while energized to perform an inspection and analysis. With approval from DND and Kingston Utilities, the equipment was deenergized to perform the investigation.

The information for the electrical equipment used within the report by IDEA Inc. was provided by Drycore Electric and Kingston Utilities.

1.1. Study Introduction

The short circuit study is used to determine whether the SCCR (Short Circuit Current Rating) of the existing equipment is able to withstand the available fault current associated with the incoming service and down stream equipment.

The protective device coordination study analyzes the existing protective device settings and ratings under fault and normal operating conditions. This includes relay/breaker ratings and trip settings, and fuse ratings. The coordination study is used to ensure that during a fault or overload condition, the immediate upstream protective device associated with the equipment clears the anomaly opposed to a device further upstream. This limits the fault clearing time (FCT) and thus the associated incident energy.

The Arc Flash Incident Energy Report is produced based on CSA Z462:24 standard to study the incident energy available at the equipment and determine the Arc Flash Boundary. Per section 4.3.5.1 of CSA Z462:24, 'an arc flash risk assessment shall be performed to identify arc flash hazards, estimate the likelihood of occurrence of injury or damage to health and the potential of severity of injury or damage to health, and determine if additional protective measures are required, including the use of PPE'.

Once the arc flash assessment is performed, this information is used to determine the arc flash boundary and recommended PPE. The incident energy analysis method used in this report is the IEEE 1584 calculation method. With the incident energy and arc flash boundary determined, Table 2 of CSA Z462:24 provides the PPE requirements at that level of incident energy. The PPE, incident energy and boundary information is applied to an Arc Flash label specifically designed for each unique piece of equipment.

The Infrared Thermographic Scanning is performed to observe any temperature anomalies that occur within existing electrical equipment. These anomalies can occur due to many various reasons, including but not limited to:

- Loose connections or lugs
- Overloaded circuits
- Broken or malfunctioning equipment

An infrared thermal scan is a useful and less-invasive test to help keep electrical equipment in good working condition and should be performed at least once every 12 months for adequate maintenance of the equipment.

Phase balance and voltage drop readings are performed to make sure the electrical system is properly balanced, and the system isn't operating above or below nominal operating voltages regulated in Canada. Current readings are taken at the main service, and the down stream equipment while under load to observe the amperage readings on each phase. Voltage readings are taken at the incoming service transformer and then at each down stream piece of equipment such as panel or MCC to determine the voltage drop of the system.

Visual inspection to the interior and exterior of the existing equipment is performed to ensure that the equipment is free from any deterioration, damage, or corrosion. The installation is inspected to ensure the equipment meets or exceeds the current Canadian Electrical Code.

1.2. Recommendations

Recommendations obtained from the **Short Circuit Study**:

No recommendations from this section.

Further detail of the above recommendations can be found in section 2.6.

Recommendations obtained from the **Protective Device Coordination Study**:

Revise fuse size of fuse F_TRN-2 from 250A to 50A.

Revise fuse size of fuse F_DS-Main from 150A to 200A.

Revise the instantaneous trip setting of breaker CB_FF07 in DP-PRN-2 from Lo to Hi.

Further detail of the above recommendations can be found in section 3.6.

Recommendations obtained from the **Arc Flash Incident Energy Report**:

Revise size of fuse F_TRN-2 from 250A to 50A to reduce the incident energy at DP-PRN-2 from Level B (15.894 cal/cm2) to Level A (0.8 cal/cm2).

Further detail of the above recommendations can be found in section 4.6.

Recommendations obtained from the **Infrared Thermographic Scan**:

No recommendations from this section.

Further detail of the above recommendations can be found in Appendix B.

Recommendations obtained from the **Phase Balance and Voltage Drop Readings**:

No recommendations from this section.

Further detail of the above recommendations can be found in section 6.

Recommendations obtained from the **Visual and Mechanical Inspection**:

Panel P-A:

1. Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections.
2. Provide strapping to properly secure EMT above panel.
3. Replace breaker.
4. Replace panel.

Panel P-1:

1. Provide new label for panel via lamacoid.
2. Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections.
3. Remove owners' equipment in front of panel.
4. Replace breakers.
5. Provide panel inserts to cover exposed parts.
6. Replace Panel.

Panel P-2:

1. Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections. Consider replacing panel due to moisture.
2. Install insulated bushing on main feeder conduit.
3. Provide locking mechanism for panel.
4. Install new ground lugs. Installing a new panel due to multiple issues is the best recommendation.
5. Replace panel

Panel P-3:

1. Replace panel with NEMA 3R panel due to location in basement.
2. Install insulated bushing on main feeder conduit.
3. Replace wooden backing for secure mounting.

208V Splitter in Basement

1. Replace splitter.
2. Provide new metal lid for sump pit for proper footing in front of electrical equipment.

General Building:

1. Lamacoid/label all equipment as per single line diagram
2. Print and Frame Single Line Diagram as required by CEC.

2. Short Circuit Study

The importance of the short circuit study is to determine whether the existing equipment can withstand the available fault current of the distribution system. If the equipment is underrated, significant damage to the equipment and personnel working near the equipment can occur due to mechanical and electrical forces created during the fault. The Short Circuit Study was performed using the ETAP Power System Software.

2.1. Methodology

Utilizing ETAP, the short circuit coordination study is performed using the ANSI C37 calculation method. From the data obtained within the field from the existing equipment, and fault levels provided by the Local Utilities Company, the single line diagram for the building is created within the software, and the software simulates three phase bolted faults and line to ground bolted faults at every bus included within the system. Critical information needed for the study includes cable impedance and lengths, and transformer X/R ratios to determine how the fault propagates through the system. The equipment analyzes both symmetrical and asymmetrical fault current contributions at each bus. The results are compared to the rating of the equipment to determine if any marginal or critical failures can occur from a fault.

2.2. Information Provided

The field information for the existing equipment was obtained by the electrical contracting company Drycore Electric.

The Hydro Fault information was provided by Kingston Utilities.

2.3. Assumptions

Where device information was not obtainable due to damaged name plates or lack there of, design values and standard values are used and listed within.

2.4. Input Information

The following reports are exported from ETAP to list the input information used within the study:

Cables:

ID	kV	Cond./ Phase	Cond./ Cable	Size AWG/ mm²	Z				Length m	Conductor
					Z Ohms / Unit Length	R Ohms / Unit Length	X Ohms / Unit Length	L H / Unit Length		
CBL_DS-MAIN	0.6	1	3/C	4/0	0.23925	0.2198	0.0945	0.0002507	100	CU
CBL_DS-TX-1	0.6	1	1/C	2	0.20796	0.2	0.057	0.0001512	5	CU
CBL_DS-TX-2	0.6	1	1/C	2	0.20796	0.2	0.057	0.0001512	5	CU
CBL_P-1	0.6	1	1/C	4/0	0.08106	0.063	0.051	0.0001353	225	CU
CBL_P-2	0.6	1	1/C	1	0.16985	0.16	0.057	0.0001512	150	CU
CBL_P-3	0.6	1	1/C	1	0.16985	0.16	0.057	0.0001512	150	CU
CBL_P-A	0.6	1	1/C	250	0.07497	0.054	0.052	0.0001379	3	CU
CBL_P1-TRN1	0.6	1	1/C	1/0	0.12781	0.12	0.044	0.0001167	40	CU
CBL_SPLITTER-2	0.6	1	1/C	3/0	0.09458	0.079	0.052	0.0001379	1	CU
CBL_TX-1 PRI	0.6	1	1/C	1	0.16985	0.16	0.057	0.0001512	15	CU
CBL_TX-1 SEC	0.6	1	1/C	3/0	0.09458	0.079	0.052	0.0001379	15	CU
CBL_TX-2 PRI	0.6	1	1/C	2	0.20796	0.2	0.057	0.0001512	15	CU
CBL_TX-2 SEC	0.6	1	1/C	250	0.07497	0.054	0.052	0.0001379	5	CU
TRN1-TRN2	0.6	1	1/C	1/0	0.12781	0.12	0.044	0.0001167	375	CU

Buses/ Panels/ Switch Gear:

ID	Nominal kV	Type	Bracing Symm. kA	Bracing Asymm. kA	Bracing Peak kA
BUS_HV-SG	4.16	Switchgear		22	37.13
BUS_TRN-1	4.16	Cable Bus		22	37.13
BUS_TRN-2	4.16	Cable Bus		22	37.13
DP-PRN-2	0.6	Panelboard	22	22	
P-A	0.208	Panelboard	10	10	
SPLITTER-1	0.6	Cable Bus	22	22	
P-1	0.24	Panelboard	10	10	
P-2	0.24	Panelboard	10	10	
P-3	0.24	Panelboard	10	10	
SPLITTER-1	0.6	Cable Bus	22	22	
SPLITTER-2	0.24	Cable Bus	22	22	

Circuit Breakers

ID	kV	Type	Bus	Rated Int. Adj. kA	Rated Int. kA
CB_FF07	0.6	Molded Case	DP-PRN-2	22	22
MCB_P-1	0.24	Molded Case	P-1	10	10
MCB_P-2	0.24	Molded Case	P-2	10	10
MCB_P-3	0.24	Molded Case	P-3	10	10

Fuses:

ID	kV	Type	Bus	Rated Int. Adj. kA	Rated Int. kA
F_DS-MAIN	0.6	Fuse	SPLITTER-1	200	200
F_HV-SG	4.16	Fuse	BUS_HV-SG	26	26
F_P1	4.16	Fuse	BUS_HV-SG	26	26
F_TRN-2	0.6	Fuse	BUS_TRN-2	200	200
F_DS-P-1	0.24	Fuse	SPLITTER-2	10	10
F_DS-P-2	0.24	Fuse	SPLITTER-2	10	10
F_DS-P-3	0.24	Fuse	SPLITTER-2	10	10
F_DS-SPLITTER-2	0.24	Fuse	Bus15	10	10
F_DS-TX-1	0.6	Fuse	Bus2	200	200

Switches:

ID	kV	Type	Bus	Rated Mom. Asymm. kA
DS-MAIN	0.6	SPST Switch	SPLITTER-1	200
SW1_TRN-1	4.16	SPST Switch	BUS_TRN-1	22
SW1_TRN-2	4.16	SPST Switch	BUS_TRN-2	22
SW2_TRN-1	4.16	SPST Switch	BUS_TRN-1	22
SW_HV-SG	4.16	SPST Switch	BUS_HV-SG	26
SW_P1	4.16	SPST Switch	BUS_HV-SG	26
SW_TRN-2	4.16	SPST Switch	BUS_TRN-2	63
DS-P-1	0.24	SPST Switch	SPLITTER-2	10
DS-P-2	0.24	SPST Switch	SPLITTER-2	10
DS-P-3	0.24	SPST Switch	SPLITTER-2	10
DS-SPLITTER-2	0.24	SPST Switch	Bus15	10
DS-TX-1	0.6	SPST Switch	Bus2	200

2.5. Results

The following summary tables are exported from ETAP to evaluate the Fault Current Calculations against the Equipment ratings inputted into the software.

Project:	Arc Flash Study Fort Frontenac	ETAP		Page:	1
Location:	Fort Frontenac, Kingston	24.0.0C		Date:	01-10-2025
Contract:	KN229976			SN:	IDEAINC-01
Engineer:	Nicholas Frayn	Study Case:	SC	Revision:	Rev 1
Filename:	24549 - DCC Arc Flash - FF07			Config.:	Normal

Momentary Duty Summary Report

3-Phase Fault Currents: (Prefault Voltage = 100 % of the Bus Nominal Voltage)

Bus		Device		Momentary Duty					Device Capability		
ID	kV	ID	Type	Symm. kA rms	X/R Ratio	M.F.	Asymm. kA rms	Asymm. kA Peak	Symm. kA rms	Asymm. kA rms	Asymm. kA Peak
BUS_HV-SG	4.160	BUS_HV-SG	Switchgear	13.242	5.6	1.284	17.003	29.392		22.000	37.130
	4.160	SW_HV-SG	SPST Switch	13.242	5.6	1.284	17.003	29.392		26.000	
	4.160	SW_P1	SPST Switch	13.242	5.6	1.284	17.003	29.392		26.000	
BUS_TRN-1	4.160	BUS_TRN-1	Cable Bus	13.053	4.9	1.247	16.275	28.181		22.000	37.130
	4.160	SW1_TRN-1	SPST Switch	13.053	4.9	1.247	16.275	28.181		22.000	
	4.160	SW2_TRN-1	SPST Switch	13.053	4.9	1.247	16.275	28.181		22.000	
BUS_TRN-2	4.160	BUS_TRN-2	Cable Bus	11.270	2.4	1.071	12.069	20.257		22.000	37.130
	4.160	SW1_TRN-2	SPST Switch	11.270	2.4	1.071	12.069	20.257		22.000	
	4.160	SW_TRN-2	SPST Switch	11.270	2.4	1.071	12.069	20.257		63.000	
DP-PRN-2	0.600	DP-PRN-2	Panelboard	6.911	4.4	1.213	8.385	14.522	22.000	22.000	
P-A	0.208	P-A	Panelboard	5.360	2.0	1.043	5.592	9.175	10.000	10.000	
SPLITTER-1	0.600	SPLITTER-1	Cable Bus	6.339	2.9	1.112	7.046	12.040	22.000	22.000	
	0.600	DS-MAIN	SPST Switch	6.339	2.9	1.112	7.046	12.040		200.000	

- Method: IEEE - X/R is calculated from separate R & X networks.
- Generator protective device duty is calculated based on maximum through fault current. Other protective device duty is calculated based on total fault current.

- The multiplication factors for high voltage circuit-breaker and high voltage bus momentary duty (asymmetrical and crest values) are calculated based on system X/R.

* Indicates a device with momentary duty exceeding the device capability.

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Location:	Fort Frontenac, Kingston	24.0.0C		Date:	01-10-2025
Contract:	KN229976			SN:	IDEAINC-01
Engineer:	Nicholas Frayn	Study Case:	SC	Revision:	Rev 1
Filename:	24549 - DCC Arc Flash - FF07			Config.:	Normal

Interrupting Duty Summary Report

3-Phase Fault Currents: (Prefault Voltage = 100 % of the Bus Nominal Voltage)

Bus		Device			Interrupting Duty				Device Capability			
ID	kV	ID	Type	CPT (Cy)	Symm. kA rms	X/R Ratio	M.F.	Adj. Sym. kA rms	kV	Test PF	Rated Int.	Adjusted Int.
BUS_HV-SG	4.160	F_HV-SG	Fuse		13.242	5.6	1.000	13.242	4.760	6.65	26.000	26.000
		F_P1	Fuse		13.242	5.6	1.000	13.242	4.760	6.65	26.000	26.000
DP-PRN-2	0.600	F_TRN-2	Fuse		6.911	4.4	1.000	6.911	0.600	15.00	200.000	200.000
		CB_FF07	Molded Case		6.911	4.4	1.000	6.911	0.600	20.00	22.000	22.000
P-A	0.208				5.360	2.0						
SPLITTER-1	0.600	F_DS-MAIN	Fuse		6.339	2.9	1.000	6.339	0.600	20.00	200.000	200.000

- Method: IEEE - X/R is calculated from separate R & X networks.
- HV CB interrupting capability is adjusted based on bus nominal voltage.
- Short-circuit multiplying factor for LV Molded Case and Insulated Case Circuit Breakers is calculated based on asymmetrical current.
- Generator protective device duty is calculated based on maximum through fault current. Other protective device duty is calculated based on total fault current.

* Indicates a device with interrupting duty exceeding the device capability

** Indicates that the circuit breaker has been flagged as a generator circuit breaker. However, ETAP could not detect a single path, without a transformer, to the specified generator. Therefore, this circuit breaker is treated as a regular circuit breaker in short-circuit calculations.

\+ The prefault voltage exceeds the rated maximum kV limit of the circuit breaker - The rated interrupting kA must be derated.

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Engineer:	Nicholas Frayn	Study Case: SC		Revision:	Rev 1
Filename:	24549 - DCC Arc Flash - FF07			Config.:	Normal

Momentary Duty Summary Report

3-Phase & 1-Phase Fault Currents: (Prefault Voltage = 100 % of the Bus Nominal Voltage)

Bus		Device			Momentary Duty					Device Capability		
ID	kV	ID	Ckt #	Type	Symm. kA rms	X/R Ratio	M.F.	Asymm. kA rms	Asymm. kA Peak	Symm. kA rms	Asymm. kA rms	Asymm. kA Peak
SPLITTER-1	0.600	SPLITTER-1		Cable Bus	6.339	2.9	1.112	7.046	12.040	22.000	22.000	
Bus2	0.600	Bus2		Bus	5.430	2.8	1.101	5.976	10.174			
	0.600	DS-TX-1		SPST Switch	5.430	2.8	1.101	5.976	10.174		200.000	
Bus3	0.600	Bus3		Bus	5.273	2.5	1.079	5.690	9.596			
Bus13	0.240	Bus13		Bus	3.882	2.5	1.077	4.179	7.039			
Bus15	0.240	Bus15		Bus	3.739	2.3	1.064	3.979	6.648			
	0.240	DS-SPLITTER-2		SPST Switch	3.739	2.3	1.064	3.979	6.648		10.000	
SPLITTER-2	0.240	SPLITTER-2		Cable Bus	3.730	2.3	1.063	3.967	6.624	22.000	22.000	
	0.240	DS-P-3		SPST Switch	3.730	2.3	1.063	3.967	6.624		10.000	
	0.240	DS-P-2		SPST Switch	3.730	2.3	1.063	3.967	6.624		10.000	
	0.240	DS-P-1		SPST Switch	3.730	2.3	1.063	3.967	6.624		10.000	
Bus19	0.240	Bus19		Bus	3.730	2.3	1.063	3.967	6.624			
	0.240	DS-P-3		SPST Switch	3.730	2.3	1.063	3.967	6.624		10.000	
P-3	0.240	P-3		Panelboard	2.266	1.0	1.002	2.272	3.359	10.000	10.000	
Bus20	0.240	Bus20		Bus	3.730	2.3	1.063	3.967	6.624			
	0.240	DS-P-2		SPST Switch	3.730	2.3	1.063	3.967	6.624		10.000	
P-2	0.240	P-2		Panelboard	2.266	1.0	1.002	2.272	3.359	10.000	10.000	
Bus21	0.240	Bus21		Bus	3.730	2.3	1.063	3.967	6.624			
	0.240	DS-P-1		SPST Switch	3.730	2.3	1.063	3.967	6.624		10.000	
P-1	0.240	P-1		Panelboard	2.445	1.5	1.016	2.484	3.895	10.000	10.000	

Method: IEEE - X/R is calculated from separate R & X networks.

Protective device duty is calculated based on total fault current

For 1-Phase 3-Wire systems (fed from center-tap transformers), the calculated momentary duty for panel's main and feeder protective devices are based on max. of 1-pole and 2-pole faults.

* Indicates a device with momentary duty exceeding the device capability

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Engineer:	Nicholas Frayn	Study Case:	SC	Revision:	Rev 1
Filename:	24549 - DCC Arc Flash - FF07			Config.:	Normal

Interrupting Duty Summary Report

3-Phase & 1-Phase Fault Currents: (Prefault Voltage = 100 % of the Bus Nominal Voltage)

Bus		Device				Interrupting Duty				Device Capability			
ID	kV	ID	Ckt #	Type	CPT (Cy)	Symm. kA rms	X/R Ratio	M.F.	Adj. Sym. kA rms	kV	Test PF	Rated Int.	Adjusted Int.
Bus2	0.600	F_DS-TX-1		Fuse		5.430	2.8	1.000	5.430	0.600	20.00	200.000	200.000
Bus15	0.240	F_DS-SPLITTER-2		Fuse		3.739	2.3	1.000	3.739	0.250	20.00	10.000	10.000
SPLITTER-2	0.240	F_DS-P-3		Fuse		3.730	2.3	1.000	3.730	0.250	20.00	10.000	10.000
		F_DS-P-2		Fuse		3.730	2.3	1.000	3.730	0.250	20.00	10.000	10.000
		F_DS-P-1		Fuse		3.730	2.3	1.000	3.730	0.250	20.00	10.000	10.000
Bus19	0.240	F_DS-P-3		Fuse		3.730	2.3	1.000	3.730	0.250	20.00	10.000	10.000
P-3	0.240	MCB_P-3		Molded Case		2.266	1.0	1.000	2.266	0.240	50.00	10.000	10.000
Bus20	0.240	F_DS-P-2		Fuse		3.730	2.3	1.000	3.730	0.250	20.00	10.000	10.000
P-2	0.240	MCB_P-2		Molded Case		2.266	1.0	1.000	2.266	0.240	50.00	10.000	10.000
Bus21	0.240	F_DS-P-1		Fuse		3.730	2.3	1.000	3.730	0.250	20.00	10.000	10.000
P-1	0.240	MCB_P-1		Molded Case		2.445	1.5	1.000	2.445	0.240	50.00	10.000	10.000

Method: IEEE - X/R is calculated from separate R & X networks.

HV CB interrupting capability is adjusted based on bus nominal voltage

Short-Circuit multiplying factor for LV Molded Case and Insulated Case Circuit Breakers is calculated based on asymmetrical current.

Generator protective device duty is calculated based on maximum through fault current. Other protective device duty is calculated based on total fault current.

For 1-Phase 3-Wire systems (fed from center-tap transformers), the calculated interrupting duty for panel's main and feeder protective devices are based on max. of 1-pole and 2-pole faults.

* Indicates a device with interrupting duty exceeding the device capability

+ The prefault voltage exceeds the rated maximum kV limit of the circuit breaker - The rated interrupting kA must be derated.

Project:	Arc Flash Study Fort Frontenac	**ETAP**		Page:	3
Location:	Fort Frontenac, Kingston	24.0.0C		Date:	01-10-2025
Contract:	KN229976			SN:	IDEAINC-01
Engineer:	Nicholas Frayn	Study Case:	SC	Revision:	Rev 1
Filename:	24549 - DCC Arc Flash - FF07			Config.:	Normal

Three-Phase System Equivalent Model

Bus		Positive Sequence Imp. (ohm)			Negative Sequence Imp. (ohm)			Zero Sequence Imp. (ohm)		
ID	kV	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance	Resistance	Reactance	Impedance
SPLITTER-1	0.600	0.01761	0.05173	0.05465	0.01761	0.05173	0.05465	0.01968	0.05207	0.05567

2.6. Observations and Recommendations

Based on the short circuit results listed above, the existing equipment is adequately sized to suit the available fault current at this location and no modifications are required with regards to the short circuit study.

Fuses for transformer TRN-2 were not accessible other than the AJT 250A fuses that we're placed in series with the current limiting fuses. The style of fuses that weren't accessible are Bay-O-Net fuses and current limiting fuses installed within the transformer, and due to the lack of maintenance records on these transformers, Drycore Electric and Kingston Utilities recommended to not remove these fuses due to the high chance of failure upon reinstallation. The recommendation is to replace these fuses. Standard values from manufacturers loaded within the ETAP software were used. The recommendation is to replace these fuses with the size indicated in the report, at the short circuit and continuous amperage ratings. Short circuit to be 12kA or greater for current limiting fuses. Continuous rating to be 50A for TRN-2.

3. Protective Device Coordination Study

The protective device coordination study is performed to ensure appropriate protective device ratings and settings are selected to protect the electrical system. The Canadian Electrical Code gives design standards for overcurrent protection ratings such that the equipment won't trip during operation at rated load and will trip at values greater than the continuous amperage rating. Protective device coordination studies are required when considering protecting the system under fault conditions. Coordination studies help with two main concepts:

1. To stop the entire distribution system from shutting down during a down stream fault depending on the location, and
2. To reduce incident energy at the location of the fault by lowering the fault clearing time (FCT)

The above situations are designed by using time-current characteristics plots to ensure that the nearest upstream overcurrent device clears the fault at the specific location it occurs, rather being cleared from a further upstream device that may serve more loads. This can be illustrated by considering a system with a distribution panel (Panel X) that also feeds three downstream panels (Panel A, Panel B and Panel C) . If fault occurred at Panel B, you would want the breaker for Panel B to clear the fault and only energized Panel B. Poor coordination of the system would have the main breaker for Panel X clearing the fault, which would deenergize all three panels. This further away breaker would also give more time for incident energy build, creating a larger arc flash boundary and a dangerous distribution system.

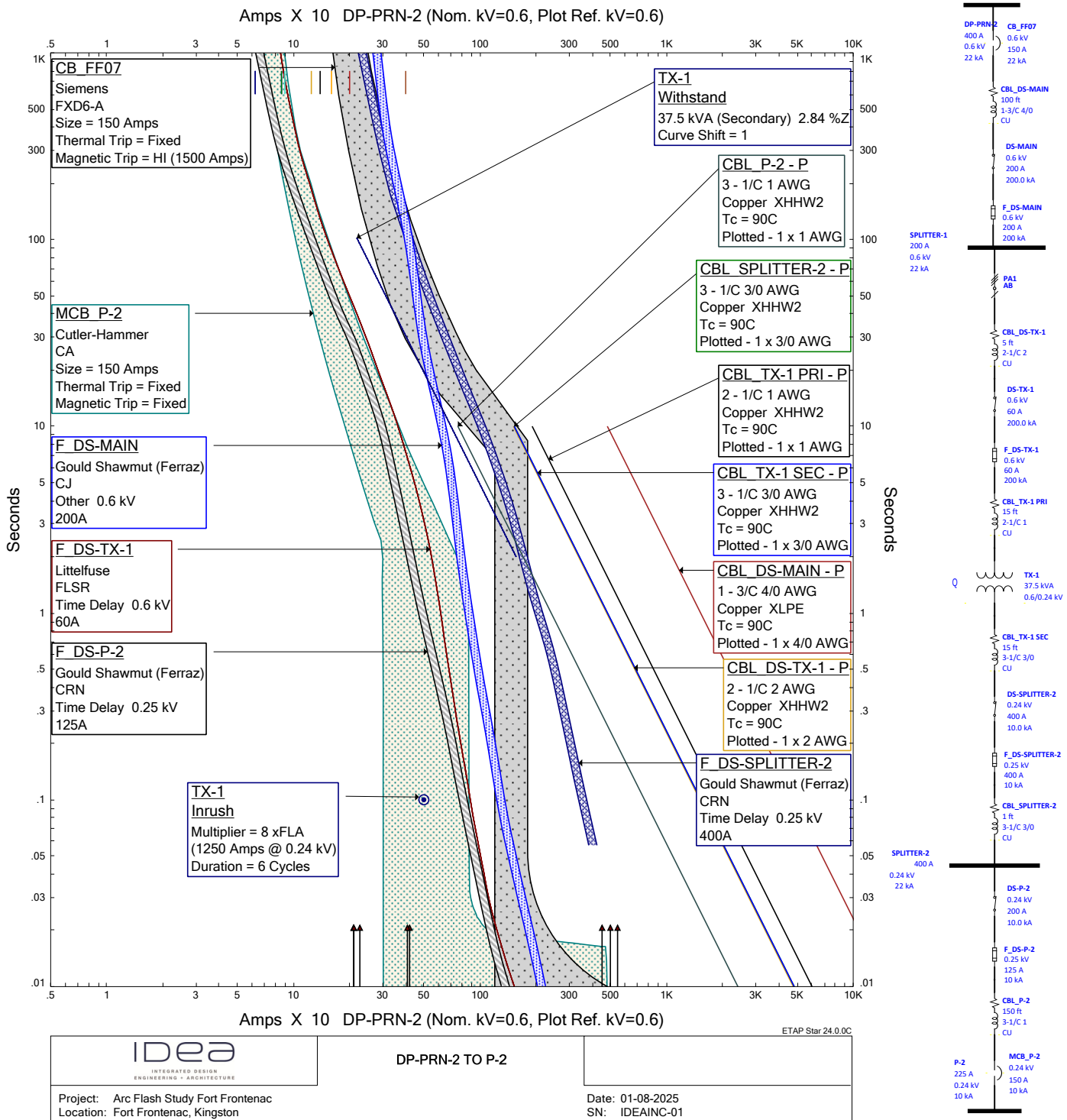
3.1. Methodology

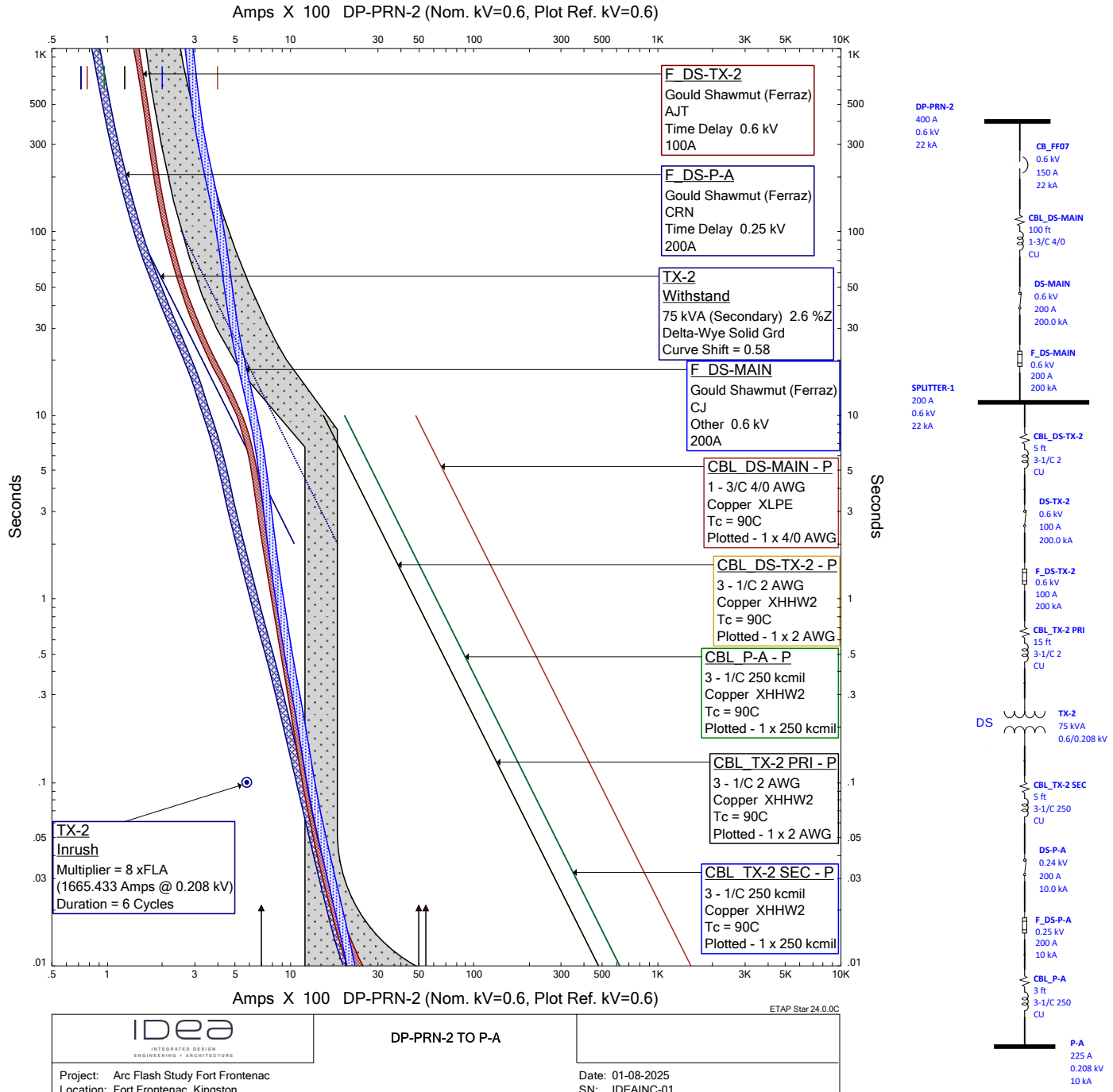
The Protective Device Coordination Study is performed utilizing the ETAP Power System Software. From the modeled distribution system, time-current characteristics curves for protective devices, cables, motors and transformers are plotted on logarithmic time plots (log-log axis). This view is used to visualize the order in which the protective devices will trip in an increasing order of magnitude of time versus current.

ETAP models the exact device make/models and breaker trip settings to show exactly how the device will operate in the field. In addition to protective device time-current plots, transformer damage curves and inrush current are plotted to ensure the transformer is adequately protected but will also not cause nuisance trips due to their magnetizing current. Cable curves are also displayed to show that the feeder and equipment cables are adequately protected.

With the time curves plotted, adequate separation between the downstream protective devices and upstream protective devices must be maintained with minimal overlap to ensure only one device, the nearest device, will trip during a fault.

3.2. Time Current Plots


Amps X 10 DP-PRN-2 (Nom. kV=0.6, Plot Ref. kV=0.6)
Seconds
CB_FF07
Siemens
FXD6-A
Size = 150 Amps
Thermal Trip = Fixed
Magnetic Trip = HI (1500 Amps)
MCB_P-2
Cutler-Hammer
CA
Size = 150 Amps
Thermal Trip = Fixed
Magnetic Trip = Fixed
F_DS-MAIN
Gould Shawmut (Ferraz)
CJ
Other 0.6 kV
200A
F_DS-TX-1
Littelfuse
FLSR
Time Delay 0.6 kV
60A
F_DS-P-2
Gould Shawmut (Ferraz)
CRN
Time Delay 0.25 kV
125A
TX-1
Inrush
Multiplier = 8 xFLA
(1250 Amps @ 0.24 kV)
Duration = 6 Cycles
TX-1
Withstand
37.5 kVA (Secondary) 2.84 %Z
Curve Shift = 1
CBL_P-2 - P
3 - 1/C 1 AWG
Copper XHHW2
Tc = 90C
Plotted - 1 x 1 AWG
CBL_SPLITTER-2 - P
3 - 1/C 3/0 AWG
Copper XHHW2
Tc = 90C
Plotted - 1 x 3/0 AWG
CBL_TX-1 PRI - P
2 - 1/C 1 AWG
Copper XHHW2
Tc = 90C
Plotted - 1 x 1 AWG
CBL_TX-1 SEC - P
3 - 1/C 3/0 AWG
Copper XHHW2
Tc = 90C
Plotted - 1 x 3/0 AWG
CBL_DS-MAIN - P
1 - 3/C 4/0 AWG
Copper XLPE
Tc = 90C
Plotted - 1 x 4/0 AWG
CBL_DS-TX-1 - P
2 - 1/C 2 AWG
Copper XHHW2
Tc = 90C
Plotted - 1 x 2 AWG
F_DS-SPLITTER-2
Gould Shawmut (Ferraz)
CRN
Time Delay 0.25 kV
400A
DP-PRN-2
400 A
0.6 kV
22 kA
CB_FF07
0.6 kV
150 A
22 kA
CBL_DS-MAIN
100 ft
1-3/C 4/0
CU
DS-MAIN
0.6 kV
200 A
200.0 kA
F_DS-MAIN
0.6 kV
200 A
200 kA
SPLITTER-1
200 A
0.6 kV
22 kA
PA1
AB
CBL_DS-TX-1
5 ft
2-1/C 2
CU
DS-TX-1
0.6 kV
60 A
200.0 kA
F_DS-TX-1
0.6 kV
60 A
200 kA
CBL_TX-1 PRI
15 ft
2-1/C 1
CU
TX-1
37.5 kVA
0.6/0.24 kV
CBL_TX-1 SEC
15 ft
3-1/C 3/0
CU
DS-SPLITTER-2
0.24 kV
400 A
10.0 kA
F_DS-SPLITTER-2
0.25 kV
400 A
10 kA
CBL_SPLITTER-2
1 ft
3-1/C 3/0
CU
SPLITTER-2
400 A
0.24 kV
22 kA
DS-P-2
0.24 kV
200 A
10.0 kA
F_DS-P-2
0.25 kV
125 A
10 kA
CBL_P-2
150 ft
3-1/C 1
CU
P-2
225 A
0.24 kV
10 kA
MCB_P-2
0.24 kV
150 A
10 kA
Amps X 10 DP-PRN-2 (Nom. kV=0.6, Plot Ref. kV=0.6)
ETAP Star 24.0.0C
IDEA
INTEGRATED DESIGN ENGINEERING + ARCHITECTURE
DP-PRN-2 TO P-2
Project: Arc Flash Study Fort Frontenac
Location: Fort Frontenac, Kingston
Contract: KN229976
Engineer: Nicholas Frayn
Date: 01-08-2025
SN: IDEAINC-01
Rev: Rev 1
Fault: Phase


Amps X 100 DP-PRN-2 (Nom. kV=0.6, Plot Ref. kV=0.6)
Seconds
F_DS-TX-2
Gould Shawmut (Ferraz)
AJT
Time Delay 0.6 kV
100A
F_DS-P-A
Gould Shawmut (Ferraz)
CRN
Time Delay 0.25 kV
200A
TX-2
Withstand
75 kVA (Secondary) 2.6 %Z
Delta-Wye Solid Grd
Curve Shift = 0.58
F_DS-MAIN
Gould Shawmut (Ferraz)
CJ
Other 0.6 kV
200A
CBL_DS-MAIN - P
1 - 3/C 4/0 AWG
Copper XLPE
Tc = 90C
Plotted - 1 x 4/0 AWG
CBL_DS-TX-2 - P
3 - 1/C 2 AWG
Copper XHHW2
Tc = 90C
Plotted - 1 x 2 AWG
CBL_P-A - P
3 - 1/C 250 kcmil
Copper XHHW2
Tc = 90C
Plotted - 1 x 250 kcmil
CBL_TX-2 PRI - P
3 - 1/C 2 AWG
Copper XHHW2
Tc = 90C
Plotted - 1 x 2 AWG
CBL_TX-2 SEC - P
3 - 1/C 250 kcmil
Copper XHHW2
Tc = 90C
Plotted - 1 x 250 kcmil
TX-2
Inrush
Multiplier = 8 xFLA
(1665.433 Amps @ 0.208 kV)
Duration = 6 Cycles
DP-PRN-2
400 A
0.6 kV
22 kA
CB_FF07
0.6 kV
150 A
22 kA
CBL_DS-MAIN
100 ft
1-3/C 4/0
CU
DS-MAIN
0.6 kV
200 A
200.0 kA
F_DS-MAIN
0.6 kV
200 A
200 kA
SPLITTER-1
200 A
0.6 kV
22 kA
CBL_DS-TX-2
5 ft
3-1/C 2
CU
DS-TX-2
0.6 kV
100 A
200.0 kA
F_DS-TX-2
0.6 kV
100 A
200 kA
CBL_TX-2 PRI
15 ft
3-1/C 2
CU
DS
TX-2
75 kVA
0.6/0.208 kV
CBL_TX-2 SEC
5 ft
3-1/C 250
CU
DS-P-A
0.24 kV
200 A
10.0 kA
F_DS-P-A
0.25 kV
200 A
10 kA
CBL_P-A
3 ft
3-1/C 250
CU
P-A
225 A
0.208 kV
10 kA
Amps X 100 DP-PRN-2 (Nom. kV=0.6, Plot Ref. kV=0.6)
ETAP Star 24.0.0C
IDEA
INTEGRATED DESIGN ENGINEERING + ARCHITECTURE
DP-PRN-2 TO P-A
Project: Arc Flash Study Fort Frontenac
Location: Fort Frontenac, Kingston
Contract: KN229976
Engineer: Nicholas Frayn
Date: 01-08-2025
SN: IDEAINC-01
Rev: Rev 1
Fault: Phase

3.3. Recommended Device Ratings and Settings

Protective Device Settings Report

Project:	Arc Flash Study Fort Frontenac	**Date:**	01-10-2025
Location:	Fort Frontenac, Kingston	**Revision:**	Rev 1 vs Base
Contract:	KN229976	When Revision vs Base/Revision is Reported:	
Filename:	H:\2024 Projects\24549 DCC Arc Flash\03 ELEC\ETAP Files\24549 - DCC Arc Flash -	= Revision color	

Protective Device Settings - Fuse									
Notes	**Designated Bus**	**Fuse ID**	**Base / Revision ID**	**Manufacturer**	**Model**	**Max kV**	**Speed**	**Size**	**Cont. Amp**
	Kingston Utility	F_HV-SG	Base	S&C	SM-5	4.76	Standard	200E	225
	BUS_HV-SG	F_P1	Base	S&C	SM-5	4.76	Standard	150E	187
	DP-PRN-2	F_TRN-2	Base	Gould Shawmut (Ferraz)	AJT	0.6	Time Delay	250A	250
1	DP-PRN-2	F_TRN-2	Rev 1	Gould Shawmut (Ferraz)	AJT	0.6	Time Delay	50A	50
	SPLITTER-2	F_DS-P-2	Base	Gould Shawmut (Ferraz)	CRN	0.25	Time Delay	125A	125
	SPLITTER-2	F_DS-P-1	Base	Gould Shawmut (Ferraz)	CRN	0.25	Time Delay	125A	125
	SPLITTER-1	F_DS-MAIN	Base	Gould Shawmut (Ferraz)	CJ	0.6	Other	150A	150
1	SPLITTER-1	F_DS-MAIN	Rev 1	Gould Shawmut (Ferraz)	CJ	0.6	Other	200A	200
	Bus2	F_DS-TX-1	Base	Littelfuse	FLSR	0.6	Time Delay	60A	60
	Bus6	F_DS-TX-2	Base	Gould Shawmut (Ferraz)	AJT	0.6	Time Delay	100A	100
	Bus15	F_DS-SPLITTER-2	Base	Gould Shawmut (Ferraz)	CRN	0.25	Time Delay	400A	400
	SPLITTER-2	F_DS-P-3	Base	Gould Shawmut (Ferraz)	CRN	0.25	Time Delay	60A	60
	Bus9	F_DS-P-A	Base	Gould Shawmut (Ferraz)	CRN	0.25	Time Delay	200A	200

Notes:

1 Rev 1 settings is different from Base

* Device Rating is different from Library

Protective Device Settings - Low Voltage Circuit Breaker with Thermal-Magnetic Trip Device										
Notes	Designated Bus	LVCB ID	Base / Revision ID	Manufacturer	Breaker		Thermal		Magnetic (Inst.)	
					Model	Size	Setting	Trip (Amps)	Setting	Trip (Amps)
	DP-PRN-2	CB_FF07	Base	Siemens	FXD6-A	150	Fixed	150.000	LO	799.950
1	DP-PRN-2	CB_FF07	Rev 1	Siemens	FXD6-A	150	Fixed	150.000	HI	1500.000
	P-1	MCB_P-1	Base	Westinghouse	CA	200	Fixed	200.000	Fixed	
	P-2	MCB_P-2	Base	Westinghouse	CA	150	Fixed	150.000	Fixed	
	P-3	MCB_P-3	Base	Square-D	QOB	70	Fixed	70.000	Fixed	

Notes:

1 Rev 1 settings is different from Base

* Device Rating is different from Library

4. Arc Flash Incident Energy Report

Arc Flash Risk Assessment has become far more recognized in the electrical industry over the past couple years and more specifically in Ontario as the Occupational Health and Safety Act (OHSA) has become more stringent on workplaces putting together protective measure and safety procedures for working with Electrical Equipment. The OHSA references CSA Z462:24 for good practice in electrical safety requirements and procedures.

Arc Flash Risk Assessment is covered via section 4.3.5 of CSA Z462:24. With respect to the frequency of when this analysis should be performed, the standard indicates that 'the incident energy analysis shall be updated when changes occur in the electrical distribution system that could affect the results of the analysis. The incident energy analysis shall also be review for accuracy at intervals not to exceed 5 years.

Performing the incident energy analysis determines the magnitude of energy available at the equipment and the distance of the arc flash boundary. The incident energy is defined as the amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arcing event. As the incident energy magnitude increases, so does that danger to the personnel working around the equipment. The most common injury to personnel is burns through arcs when the incident energy is released. There are four types of energies released during an arcing event. They are thermal energy, blast pressure energy, acoustic energy, and light energy.

Thermal energy causes the most damage to humans, by causing burns to both the skin and respiratory system. Blast pressure energy can cause damage to humans via physical trauma, such as door ejections or shattered equipment striking the person, causing falls and concussions. Acoustic and light energy cause the least harm to people, however the sound and bright intensity can be of the intensity to cause temporary discomfort.

The arc flash boundary is the distance at which the incident energy equals 1.2 cal/cm^2. People are exposed to multiple hazards within the arc flash boundary as listed above, and therefor need to take the appropriate precautions when entering within the boundary. Only qualified personnel should be allowed to work within the boundary, and they are to protect themselves with the appropriate PPE.

4.1. Personal Protective Equipment

Table 2 of CSA Z462:24 lists the selection of arc flash clothing and other PPE for when within the arc flash boundary. The rating of the clothing must also match or exceed the available arc flash energy at the equipment.

Table 2
Selection of arc-rated clothing and other PPE when the incident energy analysis method or an arc flash PPE selection table method is used
(See Clauses 4.3.5.6.2, H.1, H.2, Q.4, and V.4, and Tables H.1, V.1, V.2, and V.3.)

Incident energy exposures equal to 1.2 cal/cm² (5 J/cm²) up to and including 12 cal/cm² (50 J/cm²)
Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy* • Arc-rated long-sleeve shirt and pants or arc-rated coverall or arc flash suit (SR) • Arc-rated faceshield and arc-rated balaclava or arc flash suit hood (SR)† • Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner, high-visibility apparel) (AN)‡ Heavy-duty leather gloves, arc-rated gloves or rubber insulating gloves with protectors (SR)§ Hard hat Safety glasses or safety goggles (SR) Hearing protection Leather footwear**
Incident energy exposures greater than 12 cal/cm² (50 J/cm²)
Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy* • Arc-rated long-sleeve shirt and pants or arc-rated coverall or arc flash suit (SR) • Arc-rated arc flash suit hood • Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner, high-visibility apparel) (AN)‡ Arc-rated gloves or rubber insulating gloves with protectors (SR)§ Hard hat Safety glasses or safety goggles (SR) Hearing protection Leather footwear**

Legend:
SR = selection of one in group is required
AN = as needed

** Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit or a multi-layer system if tested as a combination consisting of an arc-rated shirt and pants, coverall, and arc flash suit.*
† Faceshields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by Clause 4.3.7.3.10 c). Where the back of the head is inside the arc flash boundary, a balaclava or an arc flash hood shall be required for full head and neck protection.
‡ The arc rating of outerwear worn over arc-rated clothing that are not used as part of a layered system shall not be required to be equal to or greater than the estimated incident energy exposure.
§ Rubber insulating gloves with protectors provide arc flash protection in addition to shock protection. Higher class rubber insulating gloves with protectors, due to their increased material thickness, provide increased arc flash protection.
*** Footwear other than leather or dielectric may be used, provided it has been tested for and demonstrates no ignition, melting, or dripping at or greater than the estimated incident energy exposure.*

The equipment selected for use within an Arc Flash Boundary from Table 2 also have to meet the standards of Table 4 from CSA Z462:24.

4.2. Job Safety Planning

The Arc Flash risk assessment is only one portion of the standardized best practice for electrical job safety in accordance with CSA Z462:24. Employers are required to put in place an Electrical Safety Program to ensure for each and every electrical job all hazards are identified. With this program a Job

Safety Plan is to be in place in order to identify the risk for each and every job. Section 4.1.7.9.2 identifies that the Job Safety Plan for each job shall have the following requirements:

1. Be completed by a qualified person,
2. Be documented,
3. Include the following information:
    a. A description of the job and task;
    b. Identification of the electrical hazards associated with each task;
    c. A shock risk assessment in accordance with Clause 4.3.4 for task involving shock hazards
    d. An arc flash risk assessment in accordance with Clause 4.3.5 for tasks involving an arc flash hazard;
    e. Work procedures involved, special precautions, and energy source controls; and
    f. An emergency response plan.

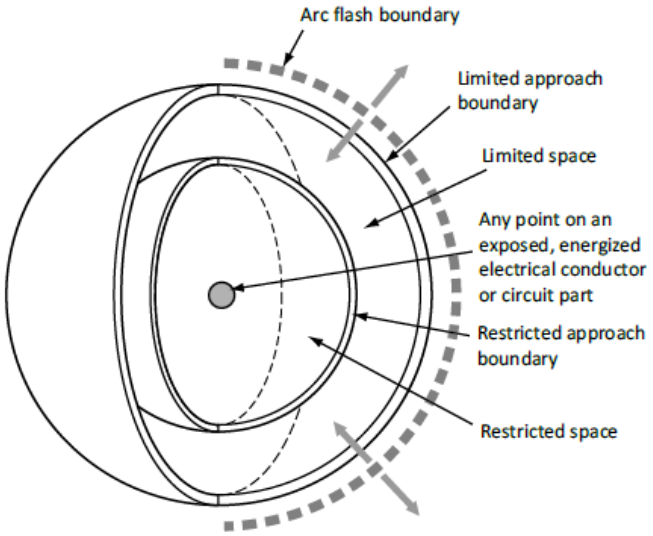
CSA Z462:24 should be reviewed in depth by each employer to create the Job Safety Plan to properly identify the information noted above.

4.3. Shock Risk Assessment

In most cases projects that have an arc flash risk will also have a shock risk component to them in dealing with electrical sources. The shock risk assessment is performed to identify shock hazards, estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health, and determine if additional protective measures are required.

By performing a shock risk hazard assessment, the shock protection boundaries will be identified. These are known as the limited and restricted approach boundaries, with each having their own degree of requirements to ensure worker safety. The arc flash boundary, limited approach boundary, and restricted approach boundary are depicted in the image below pulled from CSA Z462.

Limits of approach
(See Clause C.1.3.)



The Arc Flash boundary indicates the proximity to the electrical equipment in which workers are to be wearing arc flash rated clothing.

The limited approach boundary is the area in which no unqualified personnel shall be permitted to approach near energized conductors and circuit parts. Where there is a need for an unqualified person to enter the limited approach boundary, a qualified person shall warn workers of the possible hazards and continuously escort the unqualified person(s) while inside the limited approach boundary.

The restricted approach boundary has the most strict rules for approaching the equipment. Under absolutely no circumstance shall unqualified person(s) be permitted to cross the restricted approach boundary. Qualified persons shall not approach or bring conductive objects closer to the exposed energized electrical conductors or circuit parts operating greater than 30Vac or 60Vdc than the restricted approach boundary specified in Tables 1A and 1B unless at least one of the following applies:

a) The qualified person is insulated or guarded from the energized electrical conductors or circuit parts operating at voltages greater than 30 V ac or 60 V dc. Rubber insulating gloves and sleeves shall be considered insulation only with regard to the energized parts on which work is being performed.

b) The energized electrical conductors or circuit parts are insulated or guarded by a barrier in accordance with Clause 4.3.7.4.8 from the qualified person and from any other conductive object at a different potential.

4.4. Rated Personnel Protective Equipment

In addition to the Arc Flash rating, there are additional standards to the personal protective equipment the qualified personnel are to use within arc flash and shock boundaries. The standards that are to be followed are listed in Table 4 from CSA Z462 below:

Table 4
Standards for personal protective equipment
(See Clause 4.3.7.3.14 and Table A.1.)

Subject	Standard(s)
Apparel — Arc-rated	ASTM F1506
	ASTM F1449
	ASTM F2757
Aprons — Insulating	ASTM F2677
Eye and face protection — General	CSA Z94.3
Face protective products — Arc-rated	ASTM F2178/F2178M
Fall protection	CSA Z259 series of Standards on fall protection
	ASTM F887

Table 4 (Continued)

Subject	Standard(s)
Footwear — Dielectric specification	ASTM F1117
Footwear — Dielectric test method	ASTM F1116
Footwear — Standard performance specification and test method	CSA Z195
Gloves — Arc-rated	ASTM F2675/F2675M
Gloves — Leather protectors	ASTM F696
Gloves and sleeves — Rubber insulating — In-service care	ASTM F496
Gloves – Non-Leather Protectors	ASTM F3258
Gloves — Rubber insulating	ASTM D120
Head protection — Hard hats	CSA Z94.1
Raingear — Arc-rated	ASTM F1891
Rubber protective products — Visual inspection	ASTM F1236
Sleeves — Rubber insulating	ASTM D1051

The shock risk assessment also lists the glove class the qualified worker is to wear when approaching the live equipment. The gloves classifications with respect to equipment voltage are as follows:

Table 3A
Maximum use voltage for rubber insulating gloves
(See Clause 4.3.7.3.7.)

Class designation of glove or sleeve	Maximum AC use Voltage rms, V	Maximum DC use Voltage avg., V	Distances between protector glove cuff and rubber insulating glove cuff, min
00	500	750	13 mm (0.5 in)
0	1000	1500	13 mm (0.5 in)
1	7500	11 250	25 mm (1 in)
2	17 000	25 500	51 mm (2 in)
3	26 500	39 750	76 mm (3 in)
4	36 000	54 000	102 mm (4 in)

Both the protective equipment and gloves listed above are to be maintained on a regular basis, in which CSAZ462 gives guidelines for the appropriate intervals for maintenance of your equipment.

Table 3B
Rubber insulating equipment test intervals
(See Clauses 4.3.7.2.4 and 4.3.7.3.7.)

Type of rubber insulating equipment	When to test	Governing Standard for test voltage
Blankets	Before first issue and every 12 months thereafter	ASTM F479
Covers	Upon indication that insulating value is suspect	ASTM F478
Gloves	Before first issue and every 6 months thereafter	ASTM F496
Line hose	Upon indication that insulating value is suspect	ASTM F478
Sleeves	Before first issue and every 12 months thereafter	ASTM F496

4.5. Methodology

The incident energy analysis method is used in this report to determine the appropriate protective equipment and procedures on is to use during an arc flash, and also produce the arc flash labels stating the ratings of the equipment. The incident energy exposure level is based on the working distance of the worker's face and chest area from a perspective of arc source for the task to be performed. In addition to this the incident energy analysis takes into consideration the characteristics of the overcurrent protective device and its fault clearing time, including its condition of maintenance.

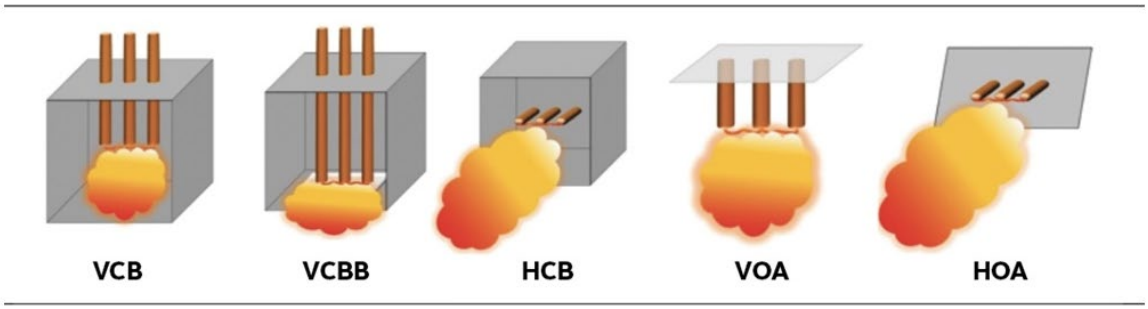
ETAP Power System Software is used to calculate the available arc flash incident energy. The software uses the IEEE 1584 calculation method to determine the available energy and Arc Flash boundary.

The IEEE 1584 method uses updated mathematical models for the calculations. The models take into consideration the system nominal voltage, gap spacing between conductors, electrode configuration, box size, open/enclosed equipment, working distance and coordination information (Time Characteristics Curves). This is why it's important to perform the coordination study and obtain this information for the arc flash analysis.

The electrode configuration is important to take into consideration as it drastically effects how much energy can be released from the equipment. The different types of configurations are:

1. VCB – Vertical conductors/electrodes in a metal box/enclosure
2. VCBB – Vertical conductors/electrodes terminated in a metal box/enclosure's insulating barrier
3. HCB –Horizontal conductors/electrodes in a metal box/enclosure
4. VOA – Vertical conductors/electrodes in open air
5. HOA – Horizontal conductors/electrodes in open air

The five types are illustrated below:



arc flash direction in the various electrode/bus configurations

VCBB, HCB, and HOA were the most recently added configurations to the standard as they were found to greatly increase the incident energy released from the enclosure.

4.6. Arc Incident Energy Summary

Bus Arc Flash Hazard Analysis Summary

Faulted Bus				Fault Current			Trip Device							
ID	Nom. kV	Equipment Type	Gap (mm)	Bolted Fault (kA) Bus	Bolted Fault (kA) PD	PD Arc Fault (kA)	Source Trip Device ID	Trip (cycle)	Open (cycle)	FCT (cycle)	Arc Flash Boundary (ft)	Incident Energy (cal/cm²)	Working Distance (in)	Energy Level
P-1	0.240	Panelboard	25	2.445	2.445	1.109	F_DS-P-1	120.00	0.00	120.00	3.5	4.7	18	Level A
P-2	0.240	Panelboard	25	2.266	2.266	1.021	F_DS-P-2	120.00	0.00	120.00	3.3	4.3	18	Level A
P-3	0.240	Panelboard	25	1.555	1.555	0.367	F_DS-P-3	120.00	0.00	120.00	1.8	1.6	18	Level A
SPLITTER-2	0.240	Cable Bus	13	3.516	0.703	0.210	F_DS-TX-1	120.00	0.00	120.00	3.1	3.7	18	Level A

Bus Arc Flash Hazard Analysis Summary

Faulted Bus				Fault Current			Trip Device							
ID	Nom. kV	Equipment Type	Gap (mm)	Bolted Fault (kA) Bus	Bolted Fault (kA) PD	PD Arc Fault (kA)	Source Trip Device ID	Trip (cycle)	Open (cycle)	FCT (cycle)	Arc Flash Boundary (ft)	Incident Energy (cal/cm²)	Working Distance (in)	Energy Level
BUS_HV-SG	4.160	Switchgear	104	13.242	13.242	11.487	F_HV-SG	1.53	0.00	1.53	1.4	0.3	36	Level A
BUS_TRN-1	4.160	Cable Bus	104	13.053	13.053	11.326	F_P1	1.42	0.00	1.42	1.5	0.4	36	Level A
BUS_TRN-2	4.160	Cable Bus	104	11.270	11.270	9.807	F_P1	1.58	0.00	1.58	1.4	0.4	36	Level A
DP-PRN-2	0.600	Panelboard	25	6.911	0.997	0.721	F_P1	85.85	0.00	85.85	7.5	15.7	18	Level B
P-A	0.208	Panelboard	25	5.360	1.858	0.693	F_TRN-2	2.75	0.00	2.75	0.5	0.2	18	Level A
SPLITTER-1	0.600	Cable Bus	13	6.339	6.339	5.463	CB_FF07	0.56	0.00	0.56	0.3	0.1	18	Level A

Arc Flash Analysis Results:

The results of the Arc Flash Incident Energy summary indicate all electrical equipment within the study have an Arc Flash Energy Level Classification of Level A except for DP-PRN-2 at Level B.

Please note that the size of fuse TRN-2 has been revised to 40A in an Arc Flash Study for Building FF01, and this reduced the Arc Flash Incident Energy at DP-PRN-2 from Level B (15.894 cal/cm2) to Level A (0.8 cal/cm2).

4.7. Arc Flash Labels

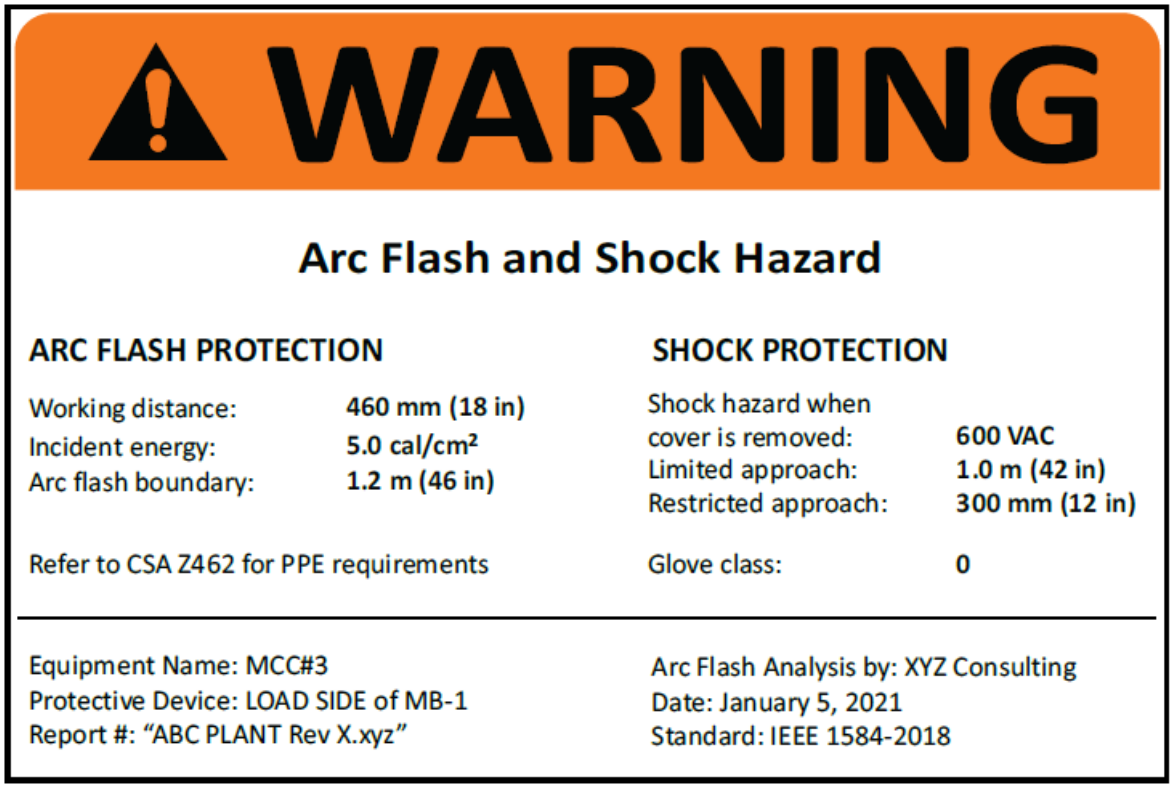
With the incident energy, arc flash boundary, and PPE requirements determined, the information is to be affixed to the equipment in the form of an Arc Flash Label. The Arc Flash labels contain the following information:

1. Nominal System Voltage
2. Arc Flash Boundary
3. At least one of the following:
    a. Available incident energy and the corresponding working distance;
    b. The arc flash PPE minimum arc rating in Table V.1 or V.2 for ac equipment, or V.3 for dc equipment;
    c. Minimum arc-rating of PPE; or
    d. site-specific level of PPE; and
4. date the information required by this Clause was determined.

The label must also:

1. be sufficiently durable to withstand the environment involved.
2. The method of calculation and data to support the information must be documented
3. And the data shall be reviewed for accuracy at intervals not to exceed 5 years

An example of an arc flash label is below:



5. Infrared Thermographic Scanning Report

An infrared thermographic scan should be performed as part of an electrical distribution systems yearly maintenance. Temperature variations can show defects in electrical distribution systems due to the direct correlation of heat loss from current flowing through equipment. Temperature variations can occur because of improper installation (loose connections or lugs), unbalanced loading, undersized equipment due to design error, faulty equipment, and overloaded circuits.

The scan is performed with the equipment covers removed, while under normal operating load to be able to observe any anomalies in temperature variations throughout the internal components and terminations. DCC was notified that the main switchgear was not able to be inspected live, so the two 4160V main switch gear equipment on base were not thermally scanned. The scanning was performed by Eaton personnel with both Arc Flash and Infrared certified training using state of the art equipment exceeding NFPA standards.

The thermographic scan performed by Eaton indicated that no anomalies were present at this building. The thermal images for the equipment can be found in the following:

1. Remaining Equipment with no Anomalies (Remaining Thermal Images - in Appendix B)

6. Phase Balancing Analysis and Equipment Testing

Current and voltage readings were taken at every piece of equipment to determine loading of the distribution system and the voltage drop witnessed from the incoming service to the furthest panel

installed. The results complete with notable observations and solutions are listed below. The complete list of equipment within FF07 including all current and voltage readings can be found in Appendix E.

Observations:

1. All three phase and single phase panels are appropriately balanced from the readings obtained on-site.
2. The voltage drop readings from the incoming electrical service to the furthest downstream electrical equipment are within the appropriate tolerances to meet the requirements of the Canadian Electrical Code.

7. Visual and Mechanical Inspections

A visual and mechanical inspection was performed while the equipment was scanned and analysed during the site visit. Observations were made to note any corrosion, rust, leaks, safety hazards, violations of the Canadian Electrical Code, grounding issues, physical damage, evidence of moisture, electrical arcing, and the overall general condition of the equipment to ensure it is operating as intended. The internal components were checked for discolouration and proper anchorage. Labelling and panel schedules were also observed on-site and noted for compliance. Lastly the age of the equipment was obtained or estimated from the equipment and included within the report. The results complete with notable observations and solutions are listed below. The complete list of equipment within FF07 including all physical observations can be found in Appendix D&E.

Observations:

Panel P-A:

1. Moisture and corrosion present.
2. EMT strapping missing above panel.
3. Two Pole 20A breaker in circuit position 2/4 is missing set screw for connection to the bus bar.

Recommendation:

1. **Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections.**
2. **Provide strapping to properly secure EMT above panel.**
3. **Replace breaker.**
4. **Replace panel.**

Panel P-1:

1. Panel label not legible.
2. Corrosion present within panel.
3. 1 meter of clearance not present in front of panel.
4. Circuit 18 and circuit 20 breakers are missing set screws.
5. Panel inserts are missing.

Recommendation:

1. **Provide new label for panel via lamacoid.**

2. **Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections.**
3. **Remove owners' equipment in front of panel.**
4. **Replace breakers.**
5. **Provide panel inserts to cover exposed parts.**
6. **Replace panel**

Panel P-2:

1. Corrosion and moisture present within panel.
2. No bushing installed on main feeder conduit.
3. Missing lock on panel cover.
4. No ground lugs within panel.

Recommendation:

1. **Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections.**
2. **Install insulated bushing on main feeder conduit.**
3. **Provide locking mechanism for panel.**
4. **Install new ground lugs. Installing a new panel due to multiple issues is the best recommendation.**
5. **Replace panel.**

Panel P-3:

1. Moderate oxidation and rust present within panel.
2. No bushing installed on main feeder conduit.
3. Mounted on wooden 2x4's that are weathered and aged.

Recommendation:

1. **Replace panel with NEMA 3R panel due to location in basement.**
2. **Install insulated bushing on main feeder conduit.**
3. **Replace wooden backing for secure mounting.**

208V Splitter in Basement

1. Excessive rust present on splitter.
2. Sump pit in front of splitter with excessively rusted lid and construction barricade infront of splitter.

Recommendation:

1. **Replace splitter.**
2. **Provide new metal lid for sump pit for proper footing in front of electrical equipment.**

General Building:

1. Electrical equipment lacks labelling throughout the building.
2. Single Line Diagram missing from Electrical Room

Recommendation:

1. **Lamacoid/label all equipment as per single line diagram**
2. **Print and Frame Single Line Diagram as required by CEC.**

Appendix A – Single Line Diagram



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LEVEL OF SECURITY | NIVEAU DE SÉCURITÉ
UNCLASS | NON CLASSIFIÉ

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INTEGRATED DESIGN
ENGINEERING + ARCHITECTURE

595 Byron Ave., Ottawa Ont. Ca.
Tele: (613) 728-0008 - Email: info@integrateddesign.ca

NO.	DATE	REVISION	APPR.
1	2025-03-14	ISSUED FOR FINAL REPORT	

SCALE | ÉCHELLE
1:150

LOCATION | EMPLACEMENT
388 ONTARIO STREET
KINGSTON
ONTARIO

PROJECT | PROJET
ARC FLASH STUDY
FORT FRONTENAC
KN299976

TRADE | MÉTIER	DATE
ELECTRICAL	2025-03-14

SUBJECT | SUJET
ELECTRICAL
SITE PLAN

PRODUCTION	REVIEWED | REVU	
DESIGNED | ÉTUDIÉ N.F.	ENG O | O ING	DES O | AGENT CONC
DRAWN | DESSINÉ B.R.	CUSTOMER | CLIENT	PROJ MGR | GEST PROJ
CHECKED | VÉRIFIÉ N.F.	SECT OC | CMDT CSG	DES MGR | GEST CONC
COORDINATION		FIRE | INCENDIE

WBS NO. | NO. OTP	PF NO. | NO. DP
N.700114.23.15	PF500659505

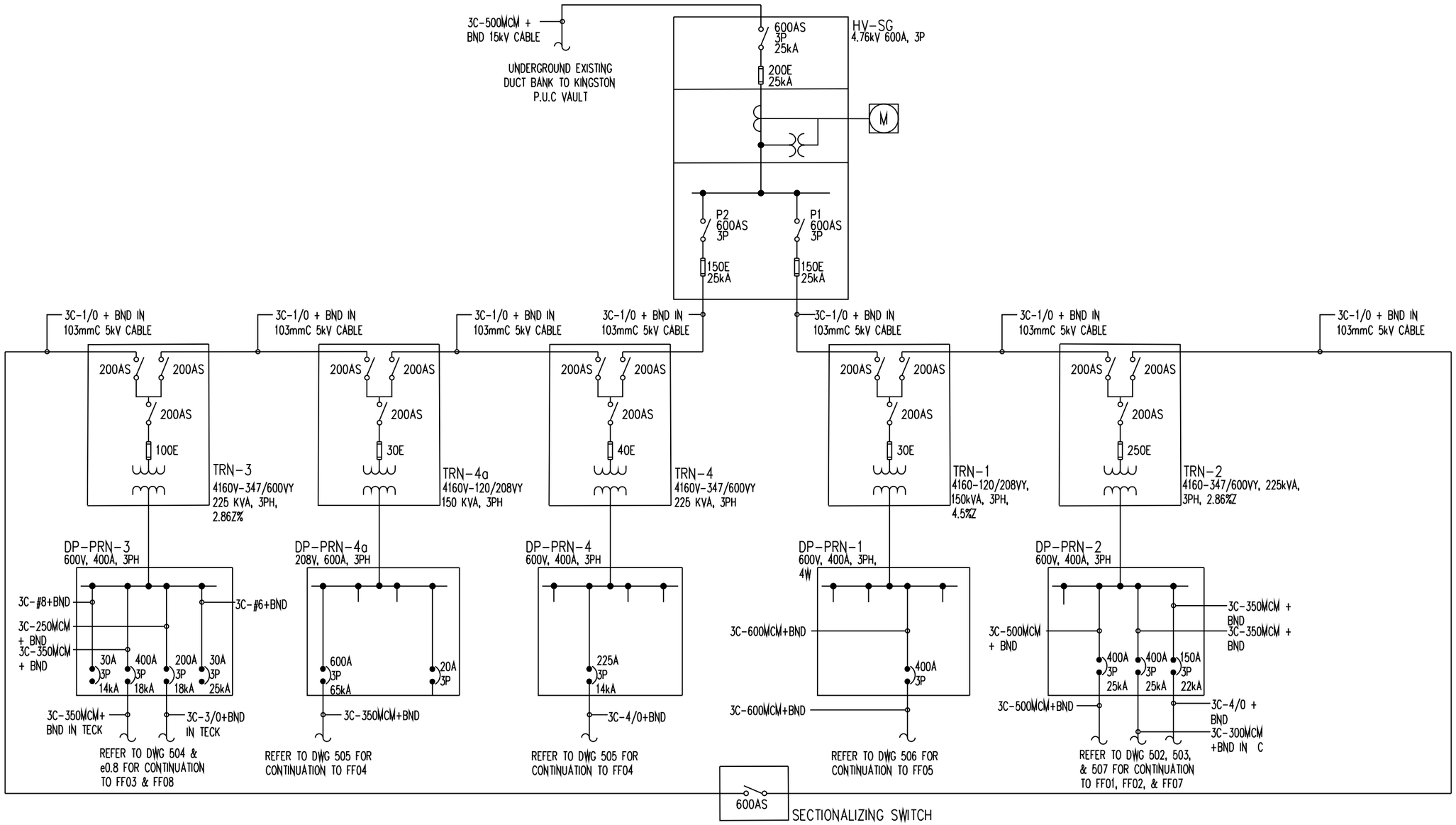
DWG. NO. | NO. DESSIN
K-B35-9306/91-500

Canada

BORDER LAST UPDATED 2012-04-01

2025/Mar/12, 4:50pm nfrayn H:\2024 Projects\24549 DCC Arc Flash\01 A DWGs\5 CADs\04 Electrical\01 Drawing Sheets Electrical\24549 Single Line Diagrams.dwg

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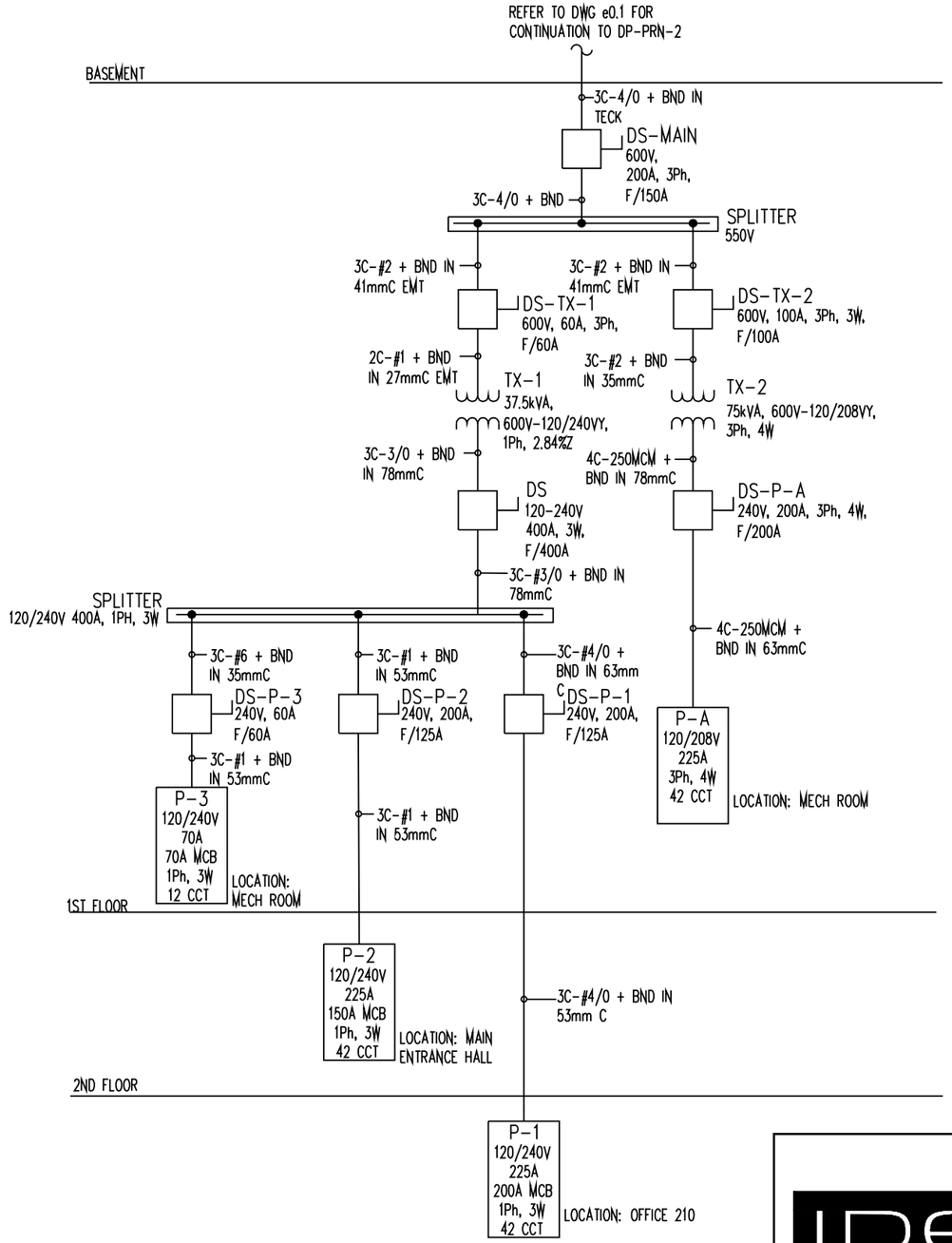
BORDER LAST UPDATED 2011-11-11

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595 Byron Ave., Ottawa Ont. Ca.
Tele: (613) 728-0008 - Email: info@integrateddesign.ca

PROJECT: ARC FLASH STUDY
PROJET: FORT FRONTENAC KN299976
SUBJECT: SINGLE LINE DIAGRAM
SUJET: TRANSFORMER LOOP
DATE: 2025-03-14

APPROVED: / APPROUVÉ PAR:	N.F.	
	N.F.	
SCALE: / ÉCHELLE:	N/A	
WBS NO.: / NO. OTP:	N.700114.23.15	
PF NO.: / NO. DP:	PF500659505	2/10
DWG NO.: / NO. DESSIN:	K-B35-9306/91-501	

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595 Byron Ave., Ottawa Ont. Ca.
Tele: (613) 728-0008 - Email: info@integrateddesign.ca

PROJECT: ARC FLASH STUDY
PROJET: FORT FRONTENAC KN299976
SUBJECT: SINGLE LINE DIAGRAM
SUJET: FF07

DATE: 2025-03-14

APPROVED: / APPROUVÉ PAR:	N.F.	
	N.F.	
SCALE: / ÉCHELLE:	N/A	
WBS NO.: / NO. OTP:	N.700114.23.15	
PF NO.: / NO. DP:	PF500659505	8/10
DWG NO.: / NO. DESSIN:	K-B35-9306/91-507	

BORDER LAST UPDATED 2011-11-11

Appendix B – Thermal Scan Images

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[redacted]

INFRARED SCAN AND EQUIPMENT PICTURES

[redacted]

FORT FRONTENAC

388 ONTARIO ST.

KINGSTON, ONTARIO

K7K 2X9

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DRYCORE
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Job Summary

Project Name: Fort Frontenac IR Scan October 2024

Drycore Job Number: 24-348

Service Location: Fort Frontenac 388 Ontario St. Kingston Ontario

Performed for:
Idea Integrated Design
595 Byron Ave.
Ottawa Ontario
K2A 4C4

Customer Contact: Nick Frayn

Performed By:
Drycore Electric,
1-5480 Canotek Rd.
Ottawa Ontario
K1B 5N2

Field Representative: Andrew Beuman

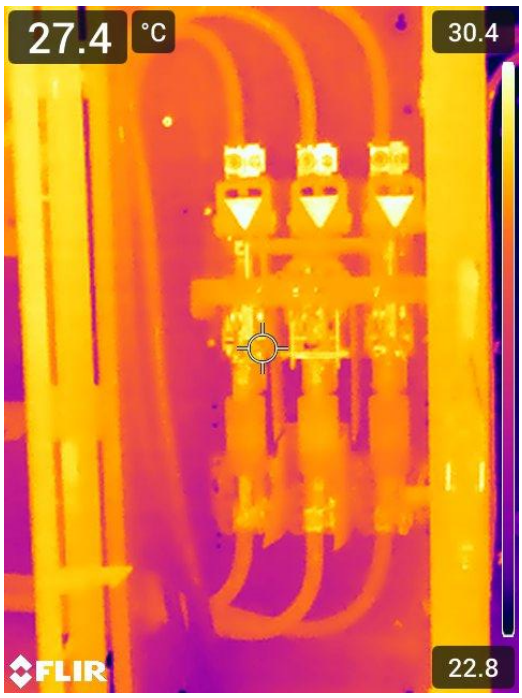
Date of Scan: October 28th to November 1st, 2024

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Floor/ Room Number	Equipment Type	Equipment Identification	IR File Number	Picture File Number
BUILDING FF07				
Basement	DISC	Main Disconnect	2144	2145
	SPLITTER	600v	2146	2147
	DISC	DS-TX2	2148	2149
	Transformer	TX2	2152	2153
	DISC	DS-P-A	2154	2155
	PANEL	P-A (Panel A)	2168	2169
	DISC	DS-TX1	2150	2151
	Transformer	TX1	2156	2157
	DISC	DS240V	2158	2159
	SPLITTER	240V Splitter	2160	2161
	DISC	DS-P1	2164	2165
	DISC	DS-P2	2162	2163
	DISC	DS-P3	2166	2167
	PANEL	P-3 Panel	2170	2171
2nd Floor	PANEL	P-2 Panel	2172	2173
3rd Floor	PANEL	P-1 Panel	2174	2175

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Location	Building FF07 BASEMENT
Component	MAIN DISCONNECT
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Picture File Name	FLIR2145
Date	TUESDAY October 29th
Image time	3:18 PM

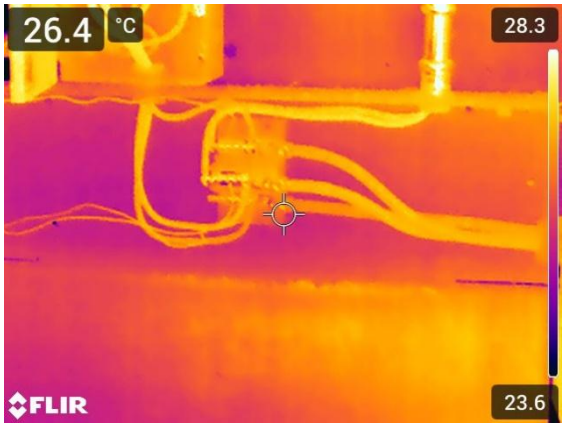




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Location	Building FF07 BASEMENT
Component	600V SPLITTER
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Picture File Name	FLIR2147
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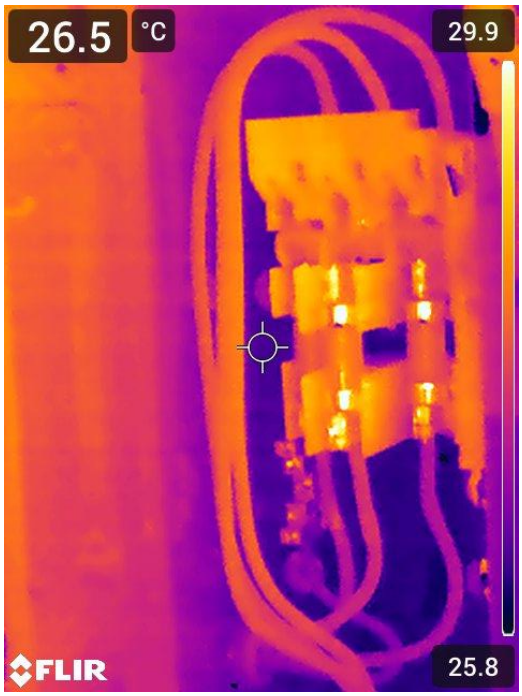




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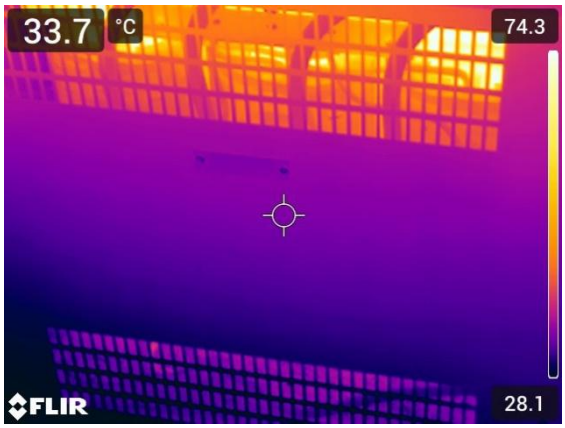
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Component	DS-TX2 DISCONNECT
IR File Name	FLIR2148
Picture File Name	FLIR2149
Date	TUESDAY October 29th
Image time	3:19 PM





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Location	Building FF07 BASEMENT
Component	TRANSFORMER TX2
IR File Name	FLIR2152
Picture File Name	FLIR2153
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Image time	3:19 PM

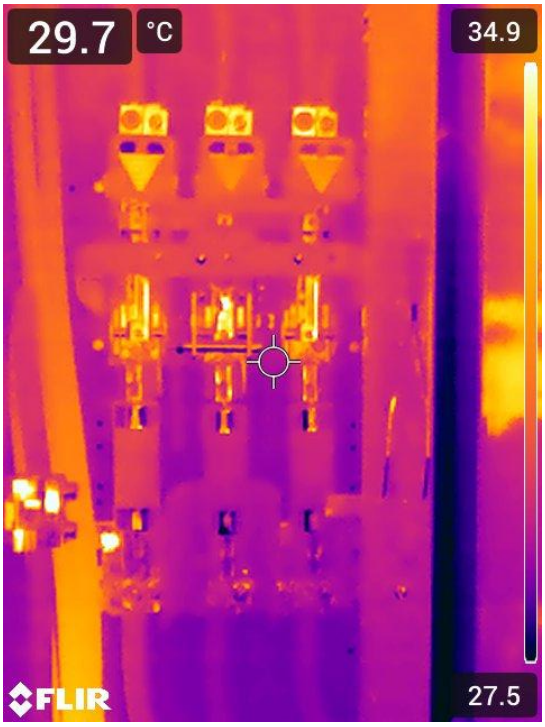


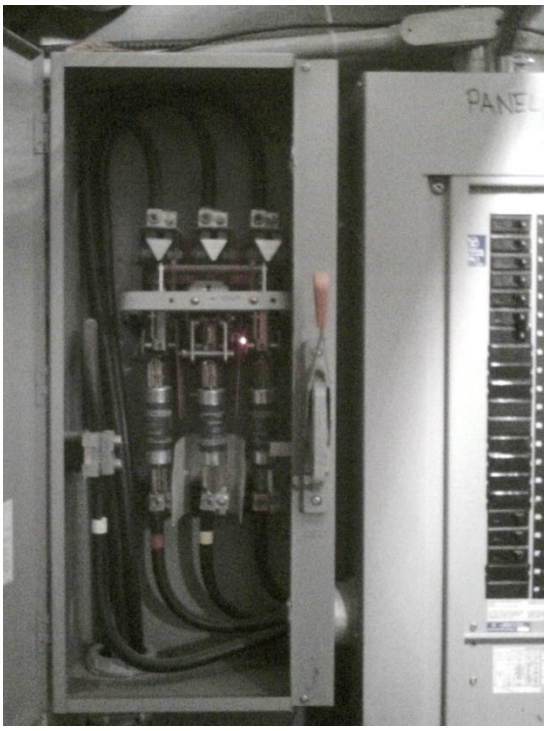


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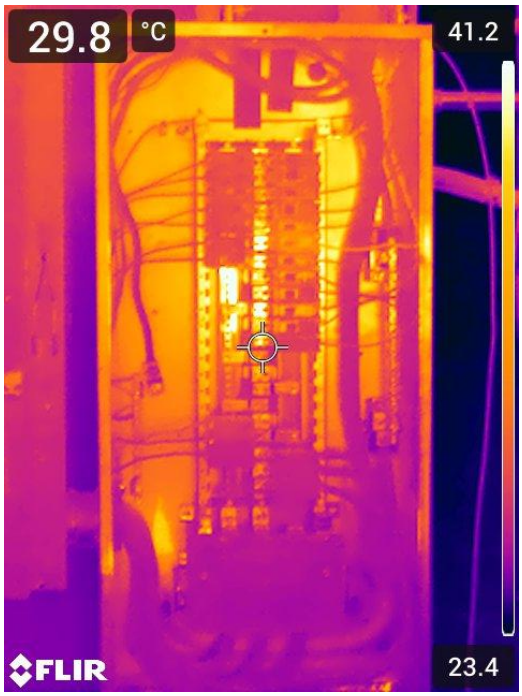
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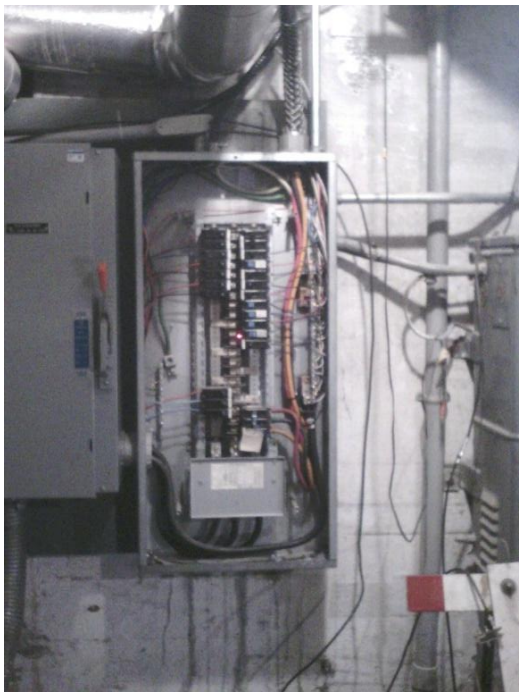




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Component	P-A PANEL
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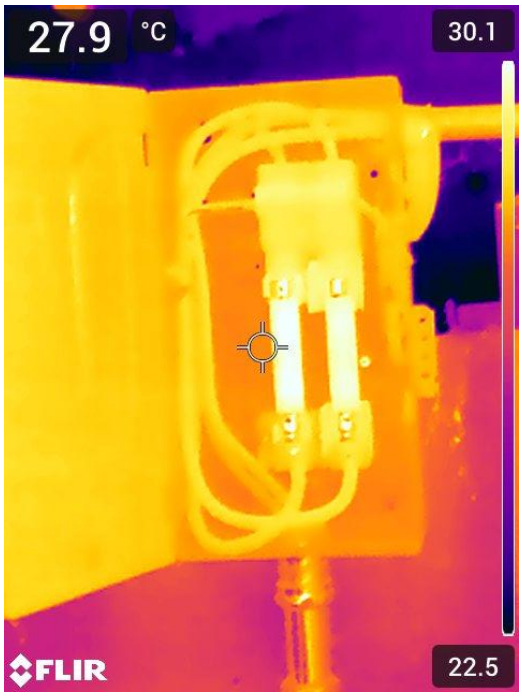


PHASE	LOAD IN AMPS	PHASE	VOLTS
A PHASE	2.1	**A-N**	120
B PHASE	5.3	**B-N**	120
C PHASE	4.7	**C-N**	120
NEUTRAL	4.5	**A-B**	212
		A-C	212
		B-C	213

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Location	Building FF07 BASEMENT
Component	DS-TX1 DISCONNECT
IR File Name	FLIR2150
Picture File Name	FLIR2151
Date	TUESDAY October 29th
Image time	3:19 PM





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Location	Building FF07 BASEMENT
Component	TRANSFORMER TX1
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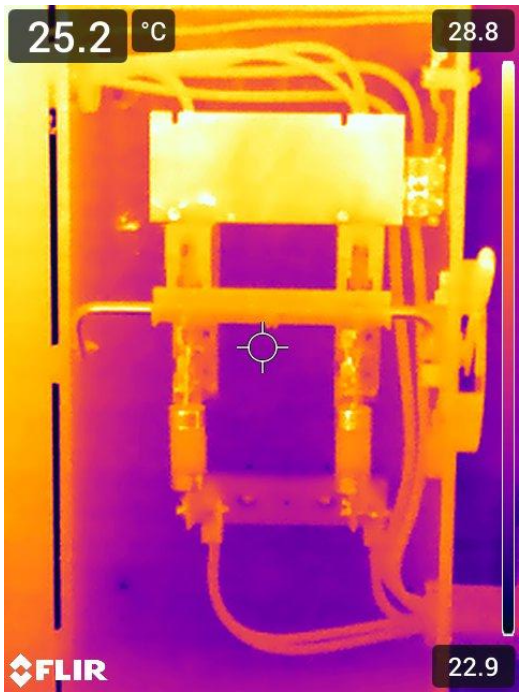




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Location	Building FF07 BASEMENT
Component	DS240V DISCONNECT
IR File Name	FLIR2158
Picture File Name	FLIR2159
Date	TUESDAY October 29th
Image time	3:21 PM





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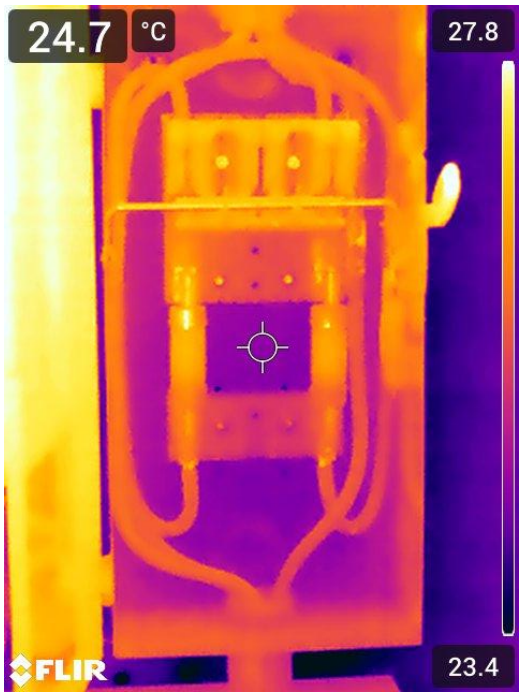
Location	Building FF07 BASEMENT
Component	240V SPLITTER
IR File Name	FLIR2160
Picture File Name	FLIR2161
Date	TUESDAY October 29th
Image time	3:29 PM





DRYCORE
ELECTRIC • ÉLECTRIQUE

Location	Building FF07 BASEMENT
Component	DS-P1 DISCONNECT
IR File Name	FLIR2164
Picture File Name	FLIR2165
Date	TUESDAY October 29th
Image time	3:30 PM

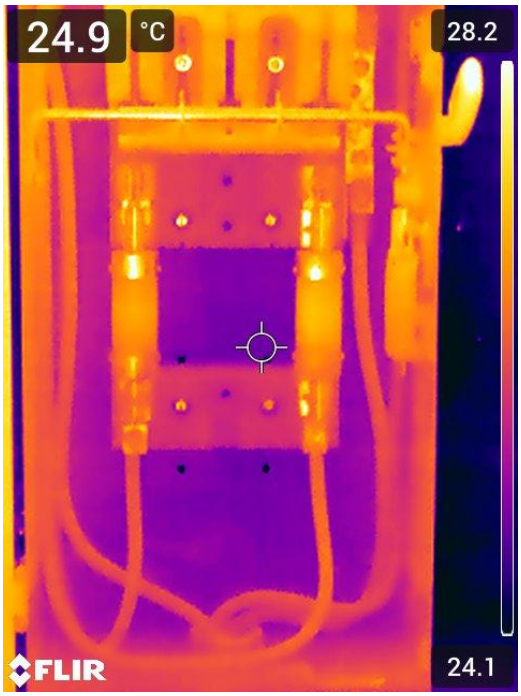




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DRYCORE
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Location	Building FF07 BASEMENT
Component	DS-P2
IR File Name	FLIR2162
Picture File Name	FLIR2163
Date	TUESDAY October 29th
Image time	3:30 PM

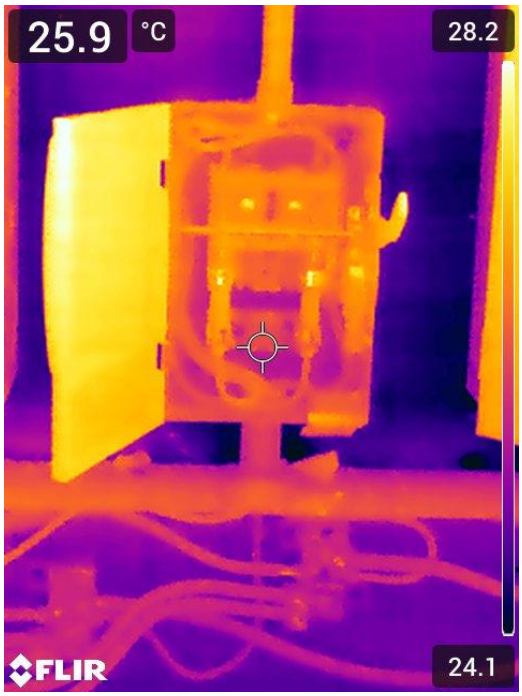




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DRYCORE
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Location	Building FF07 BASEMENT
Component	DS-P3 DISCONNECT
IR File Name	FLIR2166
Picture File Name	FLIR2167
Date	TUESDAY October 29th
Image time	3:31 PM

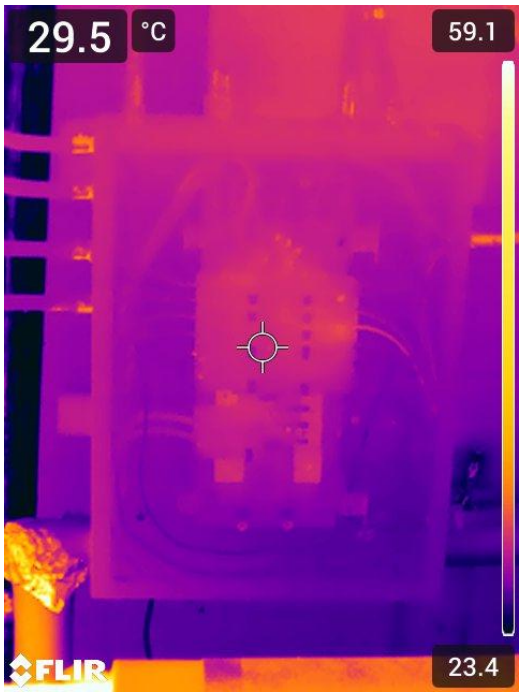


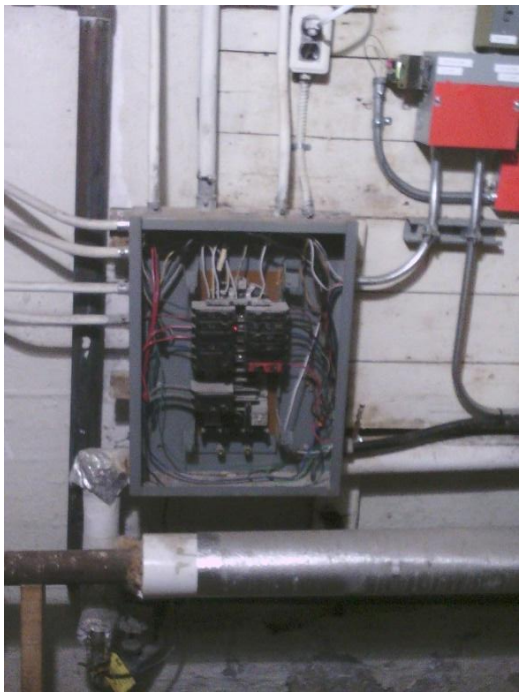


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Location	Building FF07 BASEMENT
Component	PANEL P-3
IR File Name	FLIR2170
Picture File Name	FLIR2171
Date	TUESDAY October 29th
Image time	3:40 PM



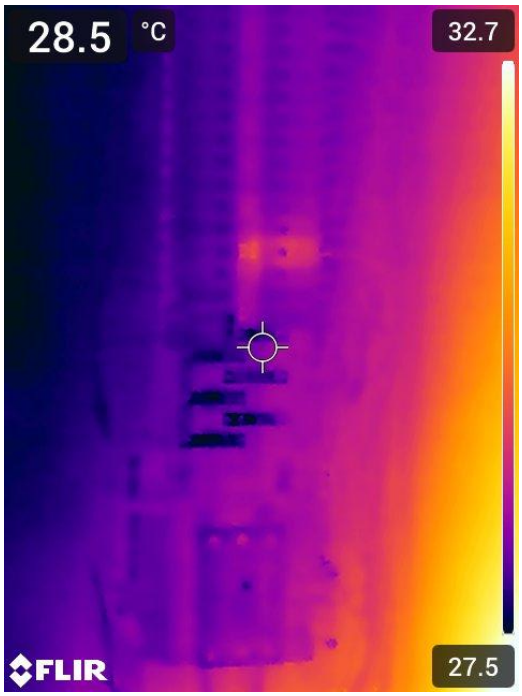


PHASE	LOAD IN AMPS	PHASE	VOLTS
A PHASE	5	**A-N**	122
B PHASE	.3	**B-N**	122
C PHASE	N/A	**C-N**	N/A
NEUTRAL	4	**A-B**	245
		A-C	N/A
		B-C	N/A

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DRYCORE
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Location	Building FF07 2ND FLOOR
Component	PANEL P-2
IR File Name	FLIR2172
Picture File Name	FLIR2173
Date	WEDNESDAY October 30th
Image time	9:03 AM





PHASE	LOAD IN AMPS	PHASE	VOLTS
A PHASE	1.8	**A-N**	121
B PHASE	3.8	**B-N**	121
C PHASE	N/A	**C-N**	N/A
NEUTRAL	1.9	**A-B**	243
		A-C	N/A
		B-C	N/A

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DRYCORE
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Location	Building FF07 3RD FLOOR
Component	PANEL P-1
IR File Name	FLIR2174
Picture File Name	FLIR2175
Date	WEDNESDAY October 30th
Image time	9:16 AM



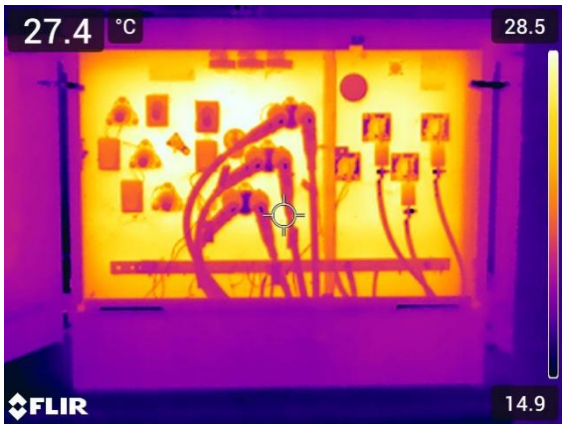


PHASE	**LOAD IN AMPS**	**PHASE**	**VOLTS**
A PHASE	7.2	**A-N**	121
B PHASE	9.3	**B-N**	121
C PHASE	N/A	**C-N**	N/A
NEUTRAL	3.4	**A-B**	243
		A-C	N/A
		B-C	N/A

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DRYCORE
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Location	EXTERIOR BEHIND FF07
Component	TRANSFORMER TRN-2
IR File Name	FLIR2204
Picture File Name	FLIR2205
Date	THURDSAY October 31th
Image time	10:30 AM

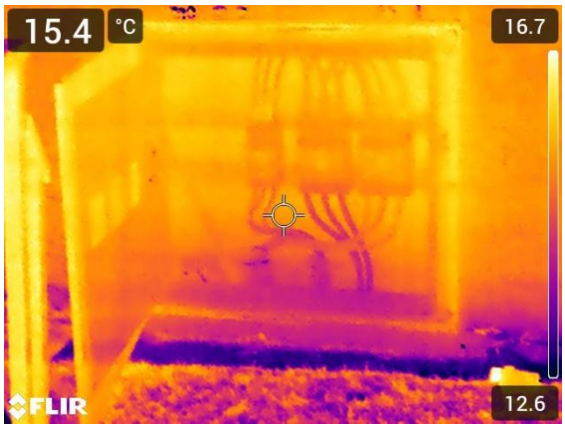




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DRYCORE
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Location	EXTERIOR BEHIND FF07
Component	TAP BOX DP-PRN2
IR File Name	FLIR2202
Picture File Name	FLIR2203
Date	THURDSAY October 31th
Image time	10:06 AM





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Appendix C – Site Checklist

FF07

Line #	Tasks	Confirmation of Completion	Results/Notes
1	DS-MAIN BASEMENT		
2	Confirm amperage rating	☐	200A
3	Confirm voltage rating	☐	600V 100HP
4	Remove cover plate	☐	
5	Perform thermal scanning, record photo's for report	☐	
6	Confirm if fused or unfused	☐	FUSED
7	Confirm fuse ratings (if applicable)	☐	150A
8	Confirm fuse type, series, & manufacturer	☐	GOULD AMPTRAP CJ150
9	Confirm SCCR rating	☐	200KA
10	Confirm wire size, number of cables per phase, & cable type (Cu/Al) from TRN-2 to DS-MAIN	☐	4/0 CU WIRE 1 WIRE PER PHASE, IN 3 WIRE TECK
11	Confirm wire size, number of cables per phase, & cable type (Cu/Al) from DS-MAIN to SPLITTER	☐	4/0 CU WIRE 1 WIRE PER PHASE
12	Confirm wire length, conduit type, & conduit size from TRN-2 to DS-MAIN	☐	3 WIRE TECK CABLE 100'
13	Confirm wire length, conduit type, & conduit size from DS-MAIN to SPLITTER	☐	3' OF WIRE THROUGH 2 1/2" NIPPLE
14			
15	SPLITTER		
16	Confirm amperage rating	☐	NO MARKING VISIBLE
17	Confirm voltage rating	☐	550V
18	Remove cover panel	☐	
19	Perform thermal scanning, record photo's for report	☐	
20			
21	*Confirm the following wire sizes, number of cables per phase, & cable type (Cu/Al):*		
22	SPLITTER to DS-TX-1	☐	#2 CU WIRES 1 WIRE PER PHASE. 2 WIRES TO TX-1
23	SPLITTER to DS-TX-2	☐	#2 CU WIRES 1 WIRE PER PHASE. 3 WIRES TO TX-2
24			
25	*Confirm the following lengths of wire, conduit type, & conduit size:*		
26	SPLITTER to DS-TX-1	☐	5' THROUGH 1 1/2" EMT
27	SPLITTER to DS-TX-2	☐	5' THROUGH 1 1/2" EMT
28			
29	DS-TX-1		
30	Confirm amperage rating	☐	NO MARKINGS
31	Confirm voltage rating	☐	600V
32	Remove cover plate	☐	
33	Perform thermal scanning, record photo's for report	☐	
34	Confirm if fused or unfused	☐	FUSED
35	Confirm fuse ratings (if applicable)	☐	60A TIME DELAY
36	Confirm fuse type, series, & manufacturer	☐	LITTLE FUSE CLASS RK-5 FLSR60
37	Confirm SCCR rating	☐	200KA
38			
39	TX-1		
40	Perform thermal scanning, record photo's for report	☐	
41	Confirm wire size, number of cables per phase, & cable type (Cu/Al) from DS-TX-1 to TX-1	☐	#1 CU WIRE 1 WIRE PER PHASE
42	Confirm wire size, number of cables per phase, & cable type (Cu/Al) from TX-1 to DS	☐	3/0 CU WIRE 1 WIRE PER PHASE
43	Confirm wire length, conduit type, & conduit size from DS-TX-1 to TX-1	☐	15' THROUGH 1" EMT
44	Confirm wire length, conduit type, & conduit size from TX-1 to DS	☐	15' THROUGH 3" RIGID
45	Confirm kVA rating	☐	37.5 KVA
46	Confirm winding configurations	☐	DELTA/ WYE 600/240
47	Confirm impedance rating & X/R ratio	☐	2.84%
48			
49	DS		

50	Confirm amperage rating	☐	400A
51	Confirm voltage rating	☐	240V
52	Remove cover plate	☐	
53	Perform thermal scanning, record photo's for report	☐	
54	Confirm if fused or unfused	☐	FUSED CEFCON TIME DELAY
55	Confirm fuse ratings (if applicable)	☐	CRN D 400A
56	Confirm fuse type, series, & manufacturer	☐	DUEL ELLEMENT
57	Confirm SCCR rating	☐	NONE
58			
59	SPLITTER		
60	Confirm amperage rating	☐	LABEL DAMAGED
61	Confirm voltage rating	☐	600V
62	Remove cover panel	☐	
63	Perform thermal scanning, record photo's for report	☐	
64			
65	*Confirm the following wire sizes, number of cables per phase, & cable type (Cu/Al):*		
66	DS to SPLITTER	☐	3/0 CU 4 WIRE 1 WIRE PER PHASE
67	SPLITTER to DS-P-1	☐	4/0 CU 4 WIRE 1 WIRE PER PHASE
68	SPLITTER to DS-P-2	☐	#1 CU 4 WIRE 1 WIRE PER PHASE
69	SPLITTER to DS-P-3	☐	#6 CU 4 WIRE 1 WIRE PER PHASE
70			
71	*Confirm the following lengths of wire, conduit type, & conduit size:*		
72	DS to SPLITTER	☐	3" NIPPLE
73	SPLITTER to DS-P-1	☐	2 1/2" NIPPLE 5' OF WIRE
74	SPLITTER to DS-P-2	☐	2" NIPPLE 5' OF WIRE
75	SPLITTER to DS-P-3	☐	1 1/4" NIPPLE 5' OF WIRE
76			
77	DS-P-1		
78	Confirm amperage rating	☐	200A
79	Confirm voltage rating	☐	240V
80	Remove cover plate	☐	
81	Perform thermal scanning, record photo's for report	☐	
82	Confirm if fused or unfused	☐	FUSED CEFECON TIME DELAY
83	Confirm fuse ratings (if applicable)	☐	CRN D 125A
84	Confirm fuse type, series, & manufacturer	☐	DUEL ELEMENT
85	Confirm SCCR rating	☐	NONE
86			
87	P-1		
88	Refer to panel information sheet & perform visual testing for P-1	☐	
89	Remove panel coverplate	☐	
90	Perform thermal scanning, record photo's for report	☐	
91	Refer to panel information sheet and perform panel testing	☐	
92	Confirm all breaker ratings	☐	
93	Confirm all breaker SCCR ratings	☐	
94	Confirm incoming wire size, number of cables per phase, & cable type (Cu/Al):	☐	4/0 CU WIRE 1 WIRE PER PHASE
95	Confirm wire length, conduit type, & conduit size from DS-P-1 to P-1	☐	225' THROUGH 2" RIGID
96			
97	DS-P-2		
98	Confirm amperage rating	☐	200A
99	Confirm voltage rating	☐	240V
100	Remove cover plate	☐	
101	Perform thermal scanning, record photo's for report	☐	
102	Confirm if fused or unfused	☐	FUSED CEFECON TIME DELAY
103	Confirm fuse ratings (if applicable)	☐	CRN D 125A
104	Confirm fuse type, series, & manufacturer	☐	DUEL ELEMENT
105	Confirm SCCR rating	☐	NONE
106			
107	P-2		

108	Refer to panel information sheet & perform visual testing for P-2	☐	
109	Remove panel coverplate	☐	
110	Perform thermal scanning, record photo's for report	☐	
111	Refer to panel information sheet and perform panel testing	☐	
112	Confirm all breaker ratings	☐	
113	Confirm all breaker SCCR ratings	☐	NONE VISIBLE
114	Confirm incoming wire size, number of cables per phase, & cable type (Cu/Al):	☐	3 PHASE PANEL FED AS SINGLE #1 CU WIRE 1 WIRE PER PHASE
115	Confirm wire length, conduit type, & conduit size from DS-P-2 to P-2	☐	150' THROUGH 2" EMT
116			
117	DS-P-3		
118	Confirm amperage rating	☐	60A
119	Confirm voltage rating	☐	240V
120	Remove cover plate	☐	
121	Perform thermal scanning, record photo's for report	☐	
122	Confirm if fused or unfused	☐	FUSED CEFCON TIME DELAY
123	Confirm fuse ratings (if applicable)	☐	DUEL ELEMENT 60A
124	Confirm fuse type, series, & manufacturer	☐	CER N D
125	Confirm SCCR rating	☐	NONE
126			
127	P-3		
128	Refer to panel information sheet & perform visual testing for P-3	☐	
129	Remove panel coverplate	☐	
130	Perform thermal scanning, record photo's for report	☐	
131	Refer to panel information sheet and perform panel testing	☐	
132	Confirm all breaker ratings	☐	
133	Confirm all breaker SCCR ratings	☐	
134	Confirm incoming wire size, number of cables per phase, & cable type (Cu/Al):	☐	#1 CU WIRE 1 WIRE PER PHASE
135	Confirm wire length, conduit type, & conduit size from DS-P-3 to P-3	☐	150' THROUGH 2" EMT
136			
137	DS-TX-2		
138	Confirm amperage rating	☐	100A
139	Confirm voltage rating	☐	600V
140	Remove cover plate	☐	
141	Perform thermal scanning, record photo's for report	☐	
142	Confirm if fused or unfused	☐	FUSED
143	Confirm fuse ratings (if applicable)	☐	MARS AJT100
144	Confirm fuse type, series, & manufacturer	☐	FERRAZ SHAWMUTT
145	Confirm SCCR rating	☐	NOT VISIBLE
146			
147	TX-2		
148	Perform thermal scanning, record photo's for report	☐	
149	Confirm wire size, number of cables per phase, & cable type (Cu/Al) from DS-TX-2 to TX-2	☐	#2 CU WIRE 1 WIRE PER PHASE
150	Confirm wire size, number of cables per phase, & cable type (Cu/Al) from TX-2 to DS-P-A	☐	250 MCM CU 1 WIRE PER PHASE
151	Confirm wire length, conduit type, & conduit size from DS-TX-2 to TX-2	☐	15' THROUGH 1 1/4" METALIC FLEX
152	Confirm wire length, conduit type, & conduit size from TX-2 to DS-P-A	☐	5' WIRE THROUGH 3" NIPPLE
153	Confirm kVA rating	☐	75KVA
154	Confirm winding configurations	☐	DELTA/WYE
155	Confirm impedance rating & X/R ratio	☐	600V:208 NO IMPEDANCE MARKING
156			
157	DS-P-A		
158	Confirm amperage rating	☐	200A
159	Confirm voltage rating	☐	240V
160	Remove cover plate	☐	
161	Perform thermal scanning, record photo's for report	☐	

162	Confirm if fused or unfused	☐	FUSED
163	Confirm fuse ratings (if applicable)	☐	200A
164	Confirm fuse type, series, & manufacturer	☐	GOULD TYPE D
165	Confirm SCCR rating	☐	NOT MARKED
166			
167	P-A		
168	Refer to panel information sheet & perform visual testing for P-A	☐	
169	Remove panel coverplate	☐	
170	Perform thermal scanning, record photo's for report	☐	
171	Refer to panel information sheet and perform panel testing	☐	
172	Confirm all breaker ratings	☐	
173	Confirm all breaker SCCR ratings	☐	10KA
174	Confirm incoming wire size, number of cables per phase, & cable type (Cu/Al):	☐	250 MCM CU 1 WIRE PER PHASE
175	Confirm wire length, conduit type, & conduit size from DS-P-Ato P-A	☐	3' WIRE THROUGH 2 1/2" NIPPLE
176			
177	General		
178	Ensure all relays are located and captured	☐	
179	Measure current on all phases of any piece of equipment found to be anomalous during thermal scans	☐	

TRANSFORMERS USE BAYONET FUSES THAT ARE UNREADABLE WITHOUT DE-ENERGIZATION AND REMOVAL
WE WERE ADVISED BY EATON AND UTILITIES KINGSTON NOT TO TOUCH

Exterior Inspection

Line #	Tasks	Confirmation of Completion	Results/Notes
1	HV Switchgear		
2	*Confirm the following wire sizes, number of cables per phase, & cable type (Cu/Al):*		
3	Incoming service 1 CABLE IN 3 DIFFERENT CONDUITS	☐	500 MCM 15KV CABLE 1 WIRE PER PHASE
4	Feeder P1 to TRN 1	☐	1/0, 5 KV CABLE 1 WIRE PER PHASE
5	Feeder TRN 1 to TRN 2	☐	1/0, 5KV CABLE 1 WIRE PER PHASE
6	Feeder P2 to TRN 3	☐	1/0, 5 KV CABLE 1 WIRE PER PHASE
7	Feeder TRN 3 to TRN 4	☐	1/0, 5 KV CABLE 1 WIRE PER PHASE
8	Feeder TRN 4 to TRN 4a	☐	1/0 5 KV CABLE 1 WIRE PER PHASE
9	Feeder TRN 4a to Sectionaliazing Switch	☐	1/0, 5KV CABLE 1 WIRE PER PHASE
10	Feeder TRN 2 to Sectionaliazing Switch	☐	1/0, 5KV CABLE 1 WIRE PER PHASE
11			
12	*Confirm the following lengths of wire, conduit type, & conduit size:*		
13	HV Switchgear to upstream equipment/location	☐	UNKNOWN
14	Feeder P1 to TRN 1	☐	40' THROUGH 4" DB2
15	Feeder TRN 1 to TRN 2	☐	375' THROUGH 4" DB2
16	Feeder P2 to ~~TRN 3~~ TRN4	☐	250' THROUGH 4" DB2
17	Feeder TRN 3 to TRN 4	☐	225' THROUGH 4" DB2
18	Feeder TRN 4 to TRN 4a	☐	20' THROUGH 4" DB2
19	Feeder TRN 4a to Sectionaliazing Switch	☐	300' THROUGH 4" DB2
20	Feeder TRN 2 to Sectionaliazing Switch	☐	500' THROUGH 4" DB2
21			
22	Refer to panel information sheet & perform visual testing for HV Switchgear	☐	
23	Refer to panel information sheet & perform primary conductor testing	☐	
24	Confirm all upstream equipment from switchgear	☐	KINGSTON UTILITIES EQUIPMENT UNKNOWN
25	Confirm voltage rating	☐	4.76 KV
26	Confirm amperage rating	☐	600A
27	Confirm fuse ratings	☐	200A
28	Confirm fuse type, series, & manufacturers	☐	S&C ELECTRIC CANADA LTD.
29	Confirm fuse SCCR rating	☐	25000 A
30	Confirm main switch amperage rating	☐	200A
31	Confirm main switch SCCR rating	☐	25000A
32	Confirm feeder P1 amperage rating	☐	150A
33	Confirm feeder P1 SCCR rating	☐	25000A
34	Confirm feeder P2 amperage rating	☐	150A
35	Confirm feeder P2 SCCR rating	☐	25000A
36	Open incoming main feeder enclosure and perfrom thermal scanning, record photo's for report	☐	
37	Open main switch enclosure and perfrom thermal scanning, record photo's for report	☐	
38	Open metering enclosure and perform thermal scanning, record photo's for report	☐	
39	Open feeder P1 enclosure and perform thermal scanning, record photo's for report	☐	
40	Open feeder P2 enclosure and perform thermal scanning, record photo's for report	☐	
41			
42	TRN 01		
43	Refer to panel information sheet & perform visual testing for TRN 01	☐	
44	Refer to panel information sheet and perform transformer primary and secondary testing	☐	

45	Confirm primary voltage rating	☐	4161/2400V
46	Confirm secondary voltage rating	☐	120/208V
47	Confirm kVA rating	☐	150KVA
48	Confirm winding configurations	☐	DELTA/WYE
49	Confirm impedance rating & X/R ratio	☐	4.5%
50	Open TRN 01 enclosure and perform thermal scanning, record photo's for report	☐	
51	Confirm over current protection device	☐	Fuses are bayonet fuses: UK advise not to touch
52	Confirm if FF05 is supplied by main tap at TRN 01 or if its fed from distribution panel PRN-1	☐	Fed through DP-PRN-1
53	Remove cover panel from PRN-1 and perform thermal scanning, record photo's for report	☐	
54	Confirm breaker ratings within PRN-1	☐	
55	Confirm breaker SCCR ratings within PRN-1	☐	
56			
57	DP-PRN-1		
58	Refer to panel information sheet & perform visual testing for DP-PRN-1	☐	
59	Remove panel coverplate	☐	
60	Perform thermal scanning, record photo's for report	☐	
61	Refer to panel information sheet and perform panel testing	☐	
62	Confirm all breaker ratings	☐	
63	Confirm all breaker SCCR ratings	☐	60KA @ 220VAC
64			
65	TRN 02		
66	Refer to panel information sheet & perform visual testing for TRN 01	☐	
67	Refer to panel information sheet and perform transformer primary and secondary testing	☐	
68	Confirm primary voltage rating	☐	4160/2400V
69	Confirm secondary voltage rating	☐	347/600V
70	Confirm kVA rating	☐	225KVA
71	Confirm winding configurations	☐	DELTA/ WYE
72	Confirm impedance rating & X/R ratio	☐	2.86%
73	Open TRN 02 enclosure and perfrom thermal scanning, record photo's for report	☐	
74	Confirm over current protection device	☐	250A Fuses AMPTRAMP Dual Element Time Delay
75	Confirm if FF01, 02, & 07 are supplied by main tap at TRN 02 or if they're fed from distribution panel	☐	FED THROUGH DP-PRN-2
76	If TRN 02 feeds a pad mount distribution panel (PRN-#) perfrom the following:	☐	
77	Remove cover panel from PRN and perform thermal scanning, record photo's for report	☐	
78	Confirm breaker ratings within PRN	☐	
79	Confirm breaker SCCR ratings within PRN	☐	
80			
81	DP-PRN-2		
82	Refer to panel information sheet & perform visual testing for DP-PRN-2	☐	
83	Remove panel coverplate	☐	
84	Perform thermal scanning, record photo's for report	☐	
85	Refer to panel information sheet and perform panel testing	☐	
86	Confirm all breaker ratings	☐	
87	Confirm all breaker SCCR ratings	☐	
88			
89	TRN 03		
90	Refer to panel information sheet & perform visual testing for TRN 01	☐	
91	Refer to panel information sheet and perform transformer primary and secondary testing	☐	

Appendix D – Site Panel Information

Arc Flash Study Fort Frontenac – KN299976
Visual Inspection Sheet
388 Ontario St, Kingston, Ontario, K7K 2X9
IDEA #24549

NOTE: These sequences of operation and the test parameters are written to convey the general sequence of events and the expected minimum test parameters measured and testes. This testing document does not convey or attempt to convey the requirements for the contractor's safety program, lockout/tagout or compliance with the CSA Standard Z462 for Arc Flash and Low Voltage Safety. Safety procedures and protocols are the responsibility of the constructor to develop and implement.

PANEL INSPECTION NOTES:

1. Electrician to ensure interior pictures have been recorded for all panels within this inspection document. All recorded pictures are to be sent to IDEA Inc. alongside this completed document.
2. CEC violations inspection is to include the presence of any stored equipment obstructing all electrical equipment listed below.

FF07

Branch Panel – P-A:

Visual Testing

1. Make/Model/Age of Equipment	WESTING HOUSE PRL1
2. Voltage Rating	120/208V
3. Amperage Rating	225A
4. Number of Circuits	42cct
5. Phase (1/3)	3
6. MLO or MCB	MLO
7. MCB Rating (If Applicable)	
8. Short Circuit Current Rating (kA)	
9. Corrosion/Rust/Leaks Present?	CORROSION PRESENT
10. Panel Location (Floor #, Room #)	Basement, Mech Room
11. Physical Damage Present?	NO
12. Evidence of Moisture or Intrusions?	MOISTURE
13. General Condition of Components	GOOD
14. Bus Bar Condition	GOOD, Light pitting on bus
15. Verify Panel Labeling	GOOD
16. Verify Panel Directories	PRESENT
17. Condition of Cable Connections	GOOD
18. CEC Violations Present?	EMT strapping above panel
19. Insulation Bushing at Entrance	YES
20. Appropriate Anchoring Present?	YES
21. Evidence of Arcing?	NONE
22. Notes	Cct 2,4 2 pole 20A breaker with no load wires, missing screw to the busbar

Panel Testing

1. Voltage Phase A to Neutral	120.2
2. Voltage Phase B to Neutral	120.3
3. Voltage Phase C to Neutral	120.7
4. Voltage Phase A to B	212
5. Voltage Phase A to C	212
6. Voltage Phase B to C	213
7. Current Phase A	2.1
8. Current Phase B	5.3
9. Current Phase C	4.7
10. Current on Neutral	4.5
11. Current on Ground	0
12. Notes	

Branch Panel – P-1:

Visual Testing

1. Make/Model/Age of Equipment	Label not legible
2. Voltage Rating	120/240V
3. Amperage Rating	225A
4. Number of Circuits	42cct
5. Phase (1/3)	1
6. MLO or MCB	MCB
7. MCB Rating (If Applicable)	200A
8. Short Circuit Current Rating (kA)	
9. Corrosion/Rust/Leaks Present?	NO
10. Panel Location (Floor #, Room #)	Top of stairs office 210
11. Physical Damage Present?	NO
12. Evidence of Moisture or Intrusions?	YES
13. General Condition of Components	CORROSION
14. Bus Bar Condition	CORROSION
15. Verify Panel Labeling	No panel label on outside of panel
16. Verify Panel Directories	PRESENT
17. Condition of Cable Connections	OK
18. CEC Violations Present?	1M of clearance, cct 18, 20 should be re terminated under set screw
19. Insulation Bushing at Entrance	YES
20. Appropriate Anchoring Present?	YES
21. Evidence of Arcing?	NONE
22. Notes	missing breaker fillers

Panel Testing

1. Voltage Phase A to Neutral	121
2. Voltage Phase B to Neutral	121
3. Voltage Phase C to Neutral	
4. Voltage Phase A to B	243
5. Voltage Phase A to C	
6. Voltage Phase B to C	
7. Current Phase A	7.2
8. Current Phase B	9.3
9. Current Phase C	
10. Current on Neutral	3.4
11. Current on Ground	
12. Notes	

Branch Panel – P-2:

Visual Testing

1.	Make/Model/Age of Equipment	Westinghouse/NQB/
2.	Voltage Rating	120/240V
3.	Amperage Rating	225A
4.	Number of Circuits	42cct
5.	Phase (1/3)	1
6.	MLO or MCB	MCB
7.	MCB Rating (If Applicable)	150A
8.	Short Circuit Current Rating (kA)	
9.	Corrosion/Rust/Leaks Present?	RUST
10.	Panel Location (Floor #, Room #)	1ST Floor hall @ main entrance
11.	Physical Damage Present?	NONE
12.	Evidence of Moisture or Intrusions?	MOISTURE
13.	General Condition of Components	Some oxidization
14.	Bus Bar Condition	Some oxidization
15.	Verify Panel Labeling	GOOD
16.	Verify Panel Directories	PRESENT
17.	Condition of Cable Connections	GOOD
18.	CEC Violations Present?	No bushing on main feeder conduit
19.	Insulation Bushing at Entrance	NO
20.	Appropriate Anchoring Present?	YES
21.	Evidence of Arcing?	NONE
22.	Notes	Neutral terminal is rusting, missing lock on cover need ground lugs for ground

Panel Testing

1.	Voltage Phase A to Neutral	121
2.	Voltage Phase B to Neutral	121
3.	Voltage Phase C to Neutral	
4.	Voltage Phase A to B	243
5.	Voltage Phase A to C	
6.	Voltage Phase B to C	
7.	Current Phase A	1.8
8.	Current Phase B	3.8
9.	Current Phase C	
10.	Current on Neutral	1.9
11.	Current on Ground	0
12.	Notes	

Branch Panel – P-3:

Visual Testing

1.	Make/Model/Age of Equipment	Square D/QBN-312/
2.	Voltage Rating	120/240V
3.	Amperage Rating	70A
4.	Number of Circuits	12cct
5.	Phase (1/3)	1
6.	MLO or MCB	MCB
7.	MCB Rating (If Applicable)	70A
8.	Short Circuit Current Rating (kA)	
9.	Corrosion/Rust/Leaks Present?	RUST
10.	Panel Location (Floor #, Room #)	Basement, Mech Room
11.	Physical Damage Present?	NO
12.	Evidence of Moisture or Intrusions?	Oxidization moderate
13.	General Condition of Components	Oxidization moderate
14.	Bus Bar Condition	Oxidization moderate
15.	Verify Panel Labeling	GOOD
16.	Verify Panel Directories	PRESENT
17.	Condition of Cable Connections	GOOD
18.	CEC Violations Present?	NO
19.	Insulation Bushing at Entrance	NO
20.	Appropriate Anchoring Present?	Mounted on wooden 2x4 that are old and weathered
21.	Evidence of Arcing?	NONE
22.	Notes	

Panel Testing

1.	Voltage Phase A to Neutral	122
2.	Voltage Phase B to Neutral	122
3.	Voltage Phase C to Neutral	
4.	Voltage Phase A to B	245
5.	Voltage Phase A to C	
6.	Voltage Phase B to C	
7.	Current Phase A	5
8.	Current Phase B	.3
9.	Current Phase C	
10.	Current on Neutral	4
11.	Current on Ground	.2
12.	Notes	

Transformer – TRN-2:

Visual Testing

1. Make/Model/Age of Equipment	CARTE INTERNATIONAL INC.
2. Voltage Rating	4160/2400V 600/347V
3. Amperage Rating	
4. Number of Circuits	
5. Phase (1/3)	3
6. MLO or MCB	
7. MCB Rating (If Applicable)	
8. Short Circuit Current Rating (kA)	
9. Corrosion/Rust/Leaks Present?	
10. Panel Location (Floor #, Room #)	BETWEEN FF01 AND FF02
11. Physical Damage Present?	NO
12. Evidence of Moisture or Intrusions?	NO
13. General Condition of Components	GOOD
14. Bus Bar Condition	GOOD
15. Verify Panel Labeling	NA
16. Verify Panel Directories	NA
17. Condition of Cable Connections	GOOD
18. CEC Violations Present?	NO
19. Insulation Bushing at Entrance	NA
20. Appropriate Anchoring Present?	YES
21. Evidence of Arcing?	NONE
22. Notes	NO penetrox at connections

Transformer Testing (Primary)

1. Voltage Phase A to B	NO VOLTAGE DUE TO HIGH VOLTAGE TERMINATIONS
2. Voltage Phase A to C	
3. Voltage Phase B to C	
4. Current Phase A	
5. Current Phase B	
6. Current Phase C	
7. Current on Ground	
8. Notes	

Transformer Testing (Secondary)

1. Voltage Phase A to Neutral — 353
2. Voltage Phase B to Neutral — 354
3. Voltage Phase C to Neutral — 351
4. Voltage Phase A to B — 614
5. Voltage Phase A to C — 611
6. Voltage Phase B to C — 611
7. Current Phase A — 24.6
8. Current Phase B — 33.4
9. Current Phase C — 28
10. Current on Neutral — NA
11. Current on Ground — .1
12. Notes

Sault Ste. Marie
705.949.5291
421 Bay St. Suite 507
Sault Ste. Marie, ON, P6A 1X3

info@integrateddesign.ca
www.integrateddesign.ca

Ottawa
613.728.0008
595 Byron Ave.
Ottawa, ON, K2A 4C4

Distribution Panel – DP-PRN-2:

Visual Testing

1.	Make/Model/Age of Equipment	UNKNOWN
2.	Voltage Rating	UNKNOWN
3.	Amperage Rating	UNKNOWN
4.	Number of Circuits	SPACE FOR 4 BREAKERS
5.	Phase (1/3)	3
6.	MLO or MCB	
7.	MCB Rating (If Applicable)	NA
8.	Short Circuit Current Rating (kA)	UNKNOWN
9.	Corrosion/Rust/Leaks Present?	MINOR SURFACE RUST
10.	Panel Location (Floor #, Room #)	OUTSIDE FF04
11.	Physical Damage Present?	NO
12.	Evidence of Moisture or Intrusions?	NO
13.	General Condition of Components	GROUND LUG OXIDIZED
14.	Bus Bar Condition	NA
15.	Verify Panel Labeling	NO
16.	Verify Panel Directories	YES
17.	Condition of Cable Connections	GOOD
18.	CEC Violations Present?	REQUIRES FEILD EVALUATION OF ESAFE
19.	Insulation Bushing at Entrance	NA
20.	Appropriate Anchoring Present?	YES
21.	Evidence of Arcing?	NONE
22.	Notes	Needs field evaluation Esafe

Panel Testing

1.	Voltage Phase A to Neutral	353
2.	Voltage Phase B to Neutral	354
3.	Voltage Phase C to Neutral	351
4.	Voltage Phase A to B	614
5.	Voltage Phase A to C	611
6.	Voltage Phase B to C	611
7.	Current Phase A	24.6
8.	Current Phase B	33.4
9.	Current Phase C	28
10.	Current on Neutral	
11.	Current on Ground	.1
12.	Notes	

CB1 EMPTY POSITION
CB2
SIEMENS
CENTRO SERIES 150A
FXD6A
FXD63B150
600V
22KA
SETTINGS LOW
LINE 350MCM CU
LOAD 3/0 CU
FEEDING FF07

CB3
SIEMENS
400A
SERIEN SERIES
JD63F400
JD6A
25KA
SETTING MIN
LINE 500 MCM CU
LOAD 350MCM CU
FEEDING FF01

CB4
SIEMENS
400A
SERIEN SERIES
JD63F400
J06-A
25KA
SETTINGS MIN
LINE 350 MCM CU
LOAD 300 MCM TECK 90
FEEDING FF02

Main High Voltage Switch Gear at TRN1 Location:

Visual Testing

1. Make/Model/Age of Equipment	S&C ELECTRIC CANADA LTD.
2. Voltage Rating	4.76 KV
3. Amperage Rating	600
4. Number of Circuits	
5. Phase (1/3)	3
6. MLO or MCB	FUSED
7. MCB Rating (If Applicable)	FUSED AT 200A FUSES ARE SMU-40 S&C ELECTRIC FUSES
8. Short Circuit Current Rating (kA)	25KA STANDARD SPEED FUSES
9. Corrosion/Rust/Leaks Present?	RUST ON INTERIOR OF DOOR MAIN SWITCH, SW1 AND SW2
10. Panel Location (Floor #, Room #)	OUTSIDE BEHIND FF05
11. Physical Damage Present?	NO
12. Evidence of Moisture or Intrusions?	MINOR RUST AT REAR VENT
13. General Condition of Components	GOOD
14. Bus Bar Condition	GOOD
15. Verify Panel Labeling	GOOD
16. Verify Panel Directories	YES
17. Condition of Cable Connections	GOOD
18. CEC Violations Present?	NO
19. Insulation Bushing at Entrance	NO
20. Appropriate Anchoring Present?	YES
21. Evidence of Arcing?	NO
22. Notes	

SW1
FUSED AT 150 E
SW2
FUSED AT 150 E

FUSES ARE THE SAME
S&C ELECTRIC CANADA
KV NOMINAL 4.8
KV NOMINAL 5.5
AMPS INT 25,000
STANDARD SPEED
TCC 153-2

Primary Conductor Testing

1. Voltage Phase A to Neutral	NO VOLTAGE DUE TO KINGSTON UTILITIES SHUTDOWN
2. Voltage Phase B to Neutral	
3. Voltage Phase C to Neutral	
4. Voltage Phase A to B	
5. Voltage Phase A to C	
6. Voltage Phase B to C	
7. Current Phase A	
8. Current Phase B	
9. Current Phase C	
10. Current on Neutral	
11. Current on Ground	
12. Notes	

Appendix E – Kingston Utilities Information

Short Circuit Study Report

Service Address: 317 St, Kingston, Ontario

Study Location: Primary side of the transformer for 317 Ontario St.

Date: September 12, 2024

Max. Short-circuit Info.

LLL,Amp	LLG,Amp	LL,Amp	LG,Amp
13242	11920	11499	7720
R1, ohm	X1,ohm	R0,ohm	X0,ohm
0.0336	0.1875	0.0773	0.5954

Min. Short-circuit Info.

LLL,Amp	LLG,Amp	LL,Amp	LG,Amp
2256	2242	1954	1786
R1, ohm	X1,ohm	R0,ohm	X0,ohm
0.5000	0.9517	0.3532	1.9399

This report was prepared by Utilities Kingston on behalf of Kingston Hydro for IDEA. The material in it reflects Utilities Kingston's best judgement in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on decisions to be mad based on it, are the responsibility of such third parties, Utilities Kingston accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Appendix F – Arc Flash Labels

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**36**	**in**	Shock Hazard when covers removed	**4160**	**VAC**
Incident Energy in cal/cm²	**0.3**				
Arc Flash Boundary	**1.4**	**ft**	Limited approach	**5.0**	**ft**
			Restricted approach	**2.2**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**1**	

Equipment: **BUS_HV-SG** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**36**	**in**	Shock Hazard when covers removed	**4160**	**VAC**
Incident Energy in cal/cm²	**0.4**				
Arc Flash Boundary	**1.5**	**ft**	Limited approach	**5.0**	**ft**
			Restricted approach	**2.2**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**1**	

Equipment: **BUS_TRN-1** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**36**	**in**	Shock Hazard when covers removed	**4160**	**VAC**
Incident Energy in cal/cm²	**0.4**				
Arc Flash Boundary	**1.4**	**ft**	Limited approach	**5.0**	**ft**
			Restricted approach	**2.2**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**1**	

Equipment: **BUS_TRN-2** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**600**	**VAC**
Incident Energy in cal/cm²	**15.7**				
Arc Flash Boundary	**7.5**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**0**	

Equipment: **DP-PRN-2** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**208**	**VAC**
Incident Energy in cal/cm²	**3.8**				
Arc Flash Boundary	**3.1**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **P-A** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**600**	**VAC**
Incident Energy in cal/cm²	**0.1**				
Arc Flash Boundary	**0.3**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**0**	

Equipment: **SPLITTER-1** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**240**	**VAC**
Incident Energy in cal/cm²	**4.1**				
Arc Flash Boundary	**3.2**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **Bus13** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**240**	**VAC**
Incident Energy in cal/cm²	**3.8**				
Arc Flash Boundary	**3.1**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **Bus15** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when		
Incident Energy in cal/cm²	**0.4**		covers removed	**240**	**VAC**
Arc Flash Boundary	**0.7**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **Bus19**

03-09-2025

Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc.

File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**240**	**VAC**
Incident Energy in cal/cm²	**3.7**				
Arc Flash Boundary	**3.1**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **Bus20** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**240**	**VAC**
Incident Energy in cal/cm²	**3.7**				
Arc Flash Boundary	**3.1**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **Bus21** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**600**	**VAC**
Incident Energy in cal/cm²	**0.1**				
Arc Flash Boundary	**0.3**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**0**	

Equipment: **Bus3** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**240**	**VAC**
Incident Energy in cal/cm²	**4.7**				
Arc Flash Boundary	**3.5**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **P-1** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**240**	**VAC**
Incident Energy in cal/cm²	**4.3**				
Arc Flash Boundary	**3.3**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **P-2** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when covers removed	**240**	**VAC**
Incident Energy in cal/cm²	**1.6**				
Arc Flash Boundary	**1.8**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **P-3** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Arc Flash and Shock Hazard Present

ARC FLASH PROTECTION			SHOCK PROTECTION		
Working Distance	**18**	**in**	Shock Hazard when		
Incident Energy in cal/cm²	**3.7**		covers removed	**240**	**VAC**
Arc Flash Boundary	**3.1**	**ft**	Limited approach	**3.5**	**ft**
			Restricted approach	**1.0**	**ft**
Refer to CSA Z462 for PPE requirements			Gloves class	**00**	

Equipment: **SPLITTER-2** 03-09-2025 Std. IEEE 1584

Arc Flash Analysis by: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**36**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**0.3**		couvercles enlevés	**4160**	**VAC**
Périmètre d’éclats d’arcs	**1.4**	**ft**	Périmètre d’accès limite	**5.0**	**ft**
			Périmètre d’accès restreint	**2.2**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**1**	

Équipement: **BUS_HV-SG** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**36**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**0.4**		couvercles enlevés	**4160**	**VAC**
Périmètre d’éclats d’arcs	**1.5**	**ft**	Périmètre d’accès limite	**5.0**	**ft**
			Périmètre d’accès restreint	**2.2**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**1**	

Équipement: **BUS_TRN-1** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**36**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**0.4**		couvercles enlevés	**4160**	**VAC**
Périmètre d’éclats d’arcs	**1.4**	**ft**	Périmètre d’accès limite	**5.0**	**ft**
			Périmètre d’accès restreint	**2.2**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**1**	

Équipement: **BUS_TRN-2** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**15.7**		couvercles enlevés	**600**	**VAC**
Périmètre d’éclats d’arcs	**7.5**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**0**	

Équipement: **DP-PRN-2** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**3.8**		couvercles enlevés	**208**	**VAC**
Périmètre d’éclats d’arcs	**3.1**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **P-A** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**0.1**		couvercles enlevés	**600**	**VAC**
Périmètre d’éclats d’arcs	**0.3**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**0**	

Équipement: **SPLITTER-1** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**4.1**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**3.2**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **Bus13** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**3.8**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**3.1**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **Bus15** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**0.4**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**0.7**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **Bus19** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**3.7**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**3.1**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **Bus20** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**3.7**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**3.1**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **Bus21** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**0.1**		couvercles enlevés	**600**	**VAC**
Périmètre d’éclats d’arcs	**0.3**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**0**	

Équipement: **Bus3** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**4.7**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**3.5**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **P-1** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**4.3**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**3.3**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **P-2** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**1.6**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**1.8**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **P-3** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Risque d’éclats d’arcs et de choc électrique ÉPI approprié requis

PROTECTION D’ÉCLATS D’ARCS			PROTECTION DE CHOC ÉLECTRIQUE		
Distance de travail	**18**	**in**	Choc électrique quand		
Énergie incidente cal/cm²	**3.7**		couvercles enlevés	**240**	**VAC**
Périmètre d’éclats d’arcs	**3.1**	**ft**	Périmètre d’accès limite	**3.5**	**ft**
			Périmètre d’accès restreint	**1.0**	**ft**
Se référer à Z462 pour ÉPI approprié requis			Classe de gants	**00**	

Équipement: **SPLITTER-2** 03-09-2025 Std. IEEE 1584

Étude d’éclats d’arcs par: IDEA Inc. File: 24549 - DCC Arc Flash - FF07

Appendix G – Cost Estimate

Project: **Arc Flash Study Fort Frontenac - KN229976** Date: 14-Mar-25

Phase **Class D Budget Cost Estimate - Building FF07** File Ref: 24549

SECTIONAL COST SUMMARY

Group Item	Element	Element Subtotal	Subtotal	-20.00%	20.00%
1	**TRN-2**		**$ 3,000**	**$ 2,400.0**	**$ 3,600.0**
1.1	Revise size of fuses in TRN-2 (Bay-o-net and CLF) from 250A to 50A	$ 3,000		$ 2,400.0	$ 3,600.0
2	**DP-PRN-2**		**$ 260**	**$ 208.0**	**$ 312.0**
2.1	Revise instantaneuos trip setting of breaker CB-FF07 from Lo to Hi	$ 260		$ 208.0	$ 312.0
3	**DS-MAIN**		**$ 500**	**$ 400.0**	**$ 600.0**
3.1	Revise size of fuse from 150A to 200A	$ 500		$ 400.0	$ 600.0
4	**Panel P-A**		**$ 6,500**	**$ 5,200.0**	**$ 7,800.0**
4.1	Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections.	$ -		$ -	$ -
4.2	Provide strapping to properly support conduits above panel	$ 300		$ 240.0	$ 360.0
4.3	A two pole 20A breaker is missing the set screw for connection to the bus bar. Replace breaker.	$ 200		$ 160.0	$ 240.0
4.4	Replace Panel	$ 6,000		$ 4,800.0	$ 7,200.0
5	**Panel P-1**		**$ 6,350**	**$ 5,080.0**	**$ 7,620.0**
5.1	Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections.	$ -		$ -	$ -
5.2	Remove owner's equipment infront of panel to provide 1m clearance.	$ -		$ -	$ -
5.3	Circuit 18 and 20 are missing set screws in the breakers. Replace the breakers,	$ 200		$ 160.0	$ 240.0
5.4	Provide panel inserts to cover exposed parts.	$ 150		$ 120.0	$ 180.0
5.5	Replace panel	$ 6,000		$ 4,800.0	$ 7,200.0
6	**Panel P-2**		**$ 7,230**	**$ 5,784.0**	**$ 8,676.0**
6.1	Tag panel to be monitored and perform thermal scan every one to two years. Increased corrosion can cause faulty connections. Replace panel.	$ 6,000		$ 4,800.0	$ 7,200.0
6.2	Install insulated bushing on main feeder conduit	$ 300		$ 240.0	$ 360.0
6.3	Provide new locking mechanism for panel	$ 360		$ 288.0	$ 432.0
6.4	Install new ground lugs	$ 570		$ 456.0	$ 684.0
7	**Panel P-3**		**$ 5,800**	**$ 4,640.0**	**$ 6,960.0**
7.1	Replace panel with NEMA 3R panel due to location in basement.	$ 5,000		$ 4,000.0	$ 6,000.0
7.2	Install insulated bushing on main feeder conduit	$ 300		$ 240.0	$ 360.0
7.3	Replace wooden backing for secure mounting	$ 500		$ 400.0	$ 600.0
8	**208V Splitter in Basement**		**$ 1,520**	**$ 1,216.0**	**$ 1,824.0**
8.1	Replace splitter	$ 1,020		$ 816.0	$ 1,224.0
8.2	Provide new metal lid for sump pit infront of splitter for proper footing in front of electrical equipment.	$ 500		$ 400.0	$ 600.0
9	**General Building**		**$ 650**	**$ 520.0**	**$ 780.0**
9.1	Print and frame Single Line Diagram as required by CEC.	$ 150		$ 120.0	$ 180.0
9.2	Provide new nomenclature and labelling for the entire distribution system.	$ 500		$ 400.0	$ 600.0
	TOTAL BUDGET ESTIMATE		**$ 31,810** (+/- 20%)	$25,448	$38,172

Note: The above estimates are exclusive of the following:
Professional Design Fees
Hydro utility company charges and levies
US / Canada Tarrifs