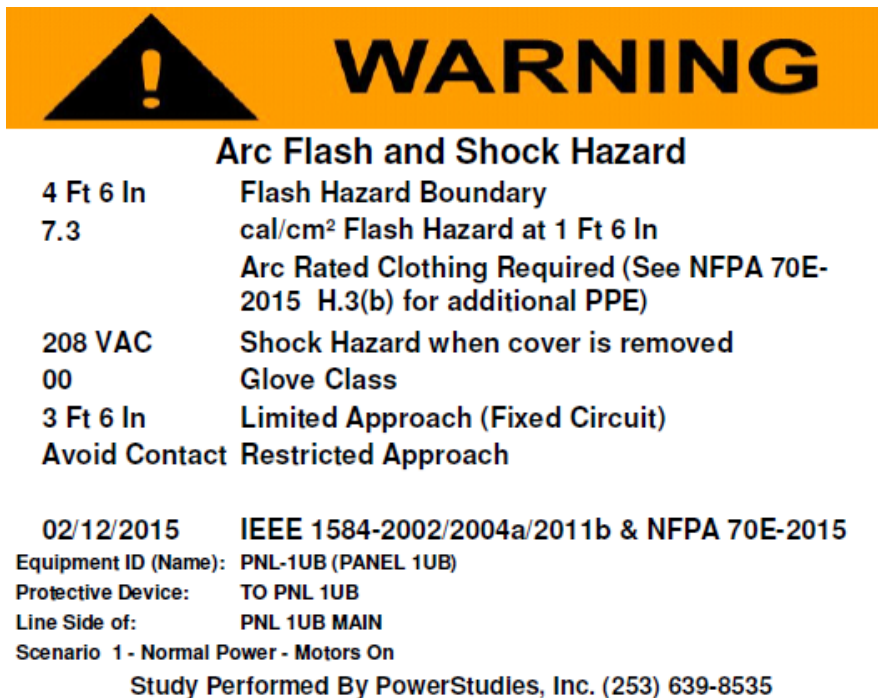


**Instructions: Modify the specifications below. Items shown in red are options.**

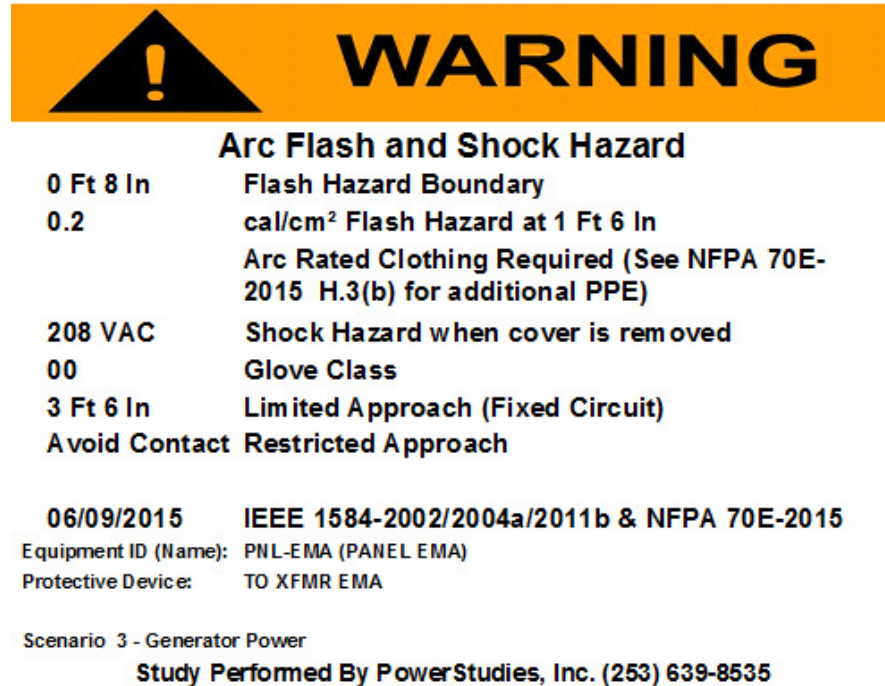
**PART 1 - GENERAL**

1.1 DESCRIPTION

- A. Provide an Arc Flash Hazard Study for the electrical distribution system shown on the one line drawings **or equipment included in the Site Electrical Equipment Inventory Spreadsheet**. The intent of the Arc Flash Hazard Study is to determine hazards that exist at each major piece of electrical equipment shown on the one line drawing **or equipment included in the Site Electrical Equipment Inventory Spreadsheet**. This includes switchgear, switchboards, panelboards, motor control centers, PDUs, UPS, ATSSs, and transformers. Arc flash study shall not exclude equipment exempted by NFPA 70(E) and IEEE 1585, which allow exclusion of equipment that operates at 240 volts maximum and is fed from a transformer smaller than 125 kVA. The proposal shall state the total number of arc flash labels (locations with calculations) that will be supplied. The study will include creation of Arc Flash Hazard Warning Labels listing all items as shown on the sample label below. These labels serve as a guide to assist technicians and others in the selection of proper Personal Protective Equipment when working around exposed and energized conductors. The electrical contractor will install the labels.



**Figure 1 – Example Arc Flash Label**



**Figure 2 – Example Arc Flash Label for 240 & 208 Volt Areas served by less than 125 kVA Transformers**

- B. The arc flash hazard study shall include the electrical distribution system equipment shown on the one line drawing down to and including all equipment fed by transformers rated 125 kVA and below. Equipment fed by transformers rated 125 kVA or less with a secondary voltage of 240 V or less, is considered to be a low Hazard Risk (see Figure 2) by NFPA 70E.
- C. If an existing up-to-date current short-circuit and protective device coordination study is not available, perform a short circuit and protective device coordination study for the electrical distribution system before performing the Arc Flash Hazard Study. Use of NFPA 70E Task tables to determine AF Hazard Category is not allowed.
- D. The arc flash hazard study shall consider all operating scenarios during normal conditions alternate operations, emergency power conditions, and any other operations, which could result in maximum arc flash hazard. The label shall list the maximum incidental energy calculated and the Scenario number and description on the label. The following is a list of the known operating scenarios: (Modify for your site or facility)
1. Normal Utility Power
  2. Emergency Generator Power
  3. Bus Tie Breakers open
  4. Bus Tie Breakers closed
  5. UPS Power
- E. Existing Equipment Data will be provided by the owner Or Existing Equipment Data will be provided by the owner's contractor (\_\_\_\_\_) who will be invoicing the owner but under the direction of Power Studies, Inc. Or Existing Equipment Data will be

provided by the owner’s contractor ( \_\_\_\_\_ ) who will be invoicing Power Studies.com and will be working under the direction of Power Studies.com. Or Existing Equipment Data will be provided by the PowerStudies, Inc’s electrical contractor ( \_\_\_\_\_ )and will be working under the direction of Power Studies.com. Power Studies.com will provide Equipment data sheets for the electrical contractor to complete and /or the PSDB electrical equipment database to the electrical contractor to enter data.

F. Power System Equipment Database (PSDB) shall be provided to the owner at the completion of the study. The database shall contain and list all electrical equipment used in the study and the results of the short circuit, protective device study, and arc flash study. This equipment database shall be a Microsoft ACCESS Database. The data base shall have the minimum features and functions:

1. Equipment Nameplate Data and Protective Device Settings for the following equipment shown in the table below. The database shall also have equipment database report listing the data below for each piece of equipment.

ATs	Control Panels	Disconnect Switches
Circuit Breakers	Fuses	Generators
Motor Control Centers	Motor Starters	Motors > 50 HP
Bus Duct Runs	Panelboards	PDUs
Relays	Switchboards	Switchgear
Transformers	UPS	VSD
Conductor	Other Equipment	Utility Data

The equipment nameplate data shall include a minimum of the following information:

Manufacturer	Type	Voltage
Amperage	kVA	HP
Size (conductor)	Length (conductor)	# per Phase (conductor)
RLA (motor)	LRA (motor)	NEMA Code (motor)
Frame Size	Trip	Sensor
Breaker & Relay Settings	Impedance (generators & transformers)	Winding Connections (Transformers)
Temperature Ratings	Short Circuit Rating	Withstand Rating
Date of Manufacture	Weight (transformers)	Catalog Number
Serial Number		

2. Library with conductor, transformer, fuse, relay, and circuit breaker data.

3. Short Circuit Study results importation from SKM program for all operating scenarios.

4. Arc Flash Study results importation from SKM program for all operating scenarios.

5. The database shall produce the following reports:

Low Voltage Equipment Short Circuit Summary	Medium Voltage Equipment Short Circuit	Arc Flash Energy Report (All Scenarios)
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Sheet	Summary Sheet	
Arc Flash Energy Report (Maximum Energy) Equipment Nameplate Data and settings Report	Arc Flash Labels (All Scenarios) Discussion of TCCs Report	Arc Flash Labels (Maximum Energy) Missing Transformer Data Report
Missing Motor Data Report	Missing Conductor Data Report	Missing Connections Report

6. Ability to print Arc Flash labels from the database.
  7. Protective Device sizes and settings
  8. Time Current Curve report and with comments on each curve.
- G. The owner OR owner's electrical contractor will install the arc flash labels. OR PowerStudies, Inc's electrical contractor will install the arc flash labels.
- H. The proposal for this study must state the following items
1. Number of arc flash labels (locations) that will vendor will be produce.
  2. Number of operating scenarios to be included in the study.
  3. Who will collect the existing equipment data
  4. Who will be installing the labels.
  5. Any exceptions to the specifications and requirements shall be clearly stated in the proposal.
  6. Terms and Conditions
  7. Estimated data collection time
  8. Estimated completion date.

## 1.2 QUALIFICATIONS

- A. The Contractor shall have the study prepared by qualified engineers of an independent consultant. The consultant shall be a Registered Professional Electrical Engineer (licensed in the state where the project is completed) who has at least ten (10) years of experience and specializes in performing power system studies.
- B. The arc flash hazard study shall be performed using SKM PowerTools for Windows computer software package. No substitutions. Or The arc flash hazard study shall be performed using SKM PowerTools for Windows (or equivalent) computer software package. Using NFPA 70E Task Tables to determine Hazard Classification is not acceptable.
- C. Pre-approved: PowerStudies, Inc. – Maple Valley, WA. Phone 253-639-8535. Web site [www.powerstudies.com](http://www.powerstudies.com)

## 1.3 SUBMITTALS

- A. The contractor or consulting firm shall submit a draft report for review by the owner before printing the arc flash hazard labels. The draft report shall contain paper copies of the proposed labels.
- B. The contractor or consulting firm shall submit the final arc flash hazard study and arc flash warning labels at least 30 days prior to energizing the electrical equipment.

- C. Submit three (3) copies of the study and (1) set of warning labels.

## PART 2 - EXECUTION

### 2.1 SHORT CIRCUIT STUDY

- A. Before performing the Arc Flash Hazard Study perform a short circuit study for the equipment shown on the one line diagram. Compare the calculated short circuit current to the equipment short circuit ratings. Verify that the equipment is properly rated for the available short circuit current. See Section 16XXX(Short Circuit and Protective Device Coordination Study Specifications). **Or The owner / design engineer will provide (or has) a current up-to-date short circuit study that compares the calculated fault current to the equipment short circuit ratings.**

### 2.2 PROTECTIVE DEVICE COORDINATION STUDY

- A. Before performing the Arc Flash Hazard Study perform a protective device coordination study for the equipment shown on the one line diagram. Determine the proper settings for the protective devices. For complex protective devices, create time current curves to determine the appropriate protective device sizes and settings. See Section 16XXX (Short Circuit and Protective Device Coordination Study Specifications). **Or The owner / design engineer will provide a current up-to-date protective device coordination study. Use these settings for the Arc Flash Hazard Study. OR Collect the settings from the existing equipment and use these settings for the Arc Flash Hazard Study.**

### 2.3 ARC FLASH HAZARD STUDY

- A. Perform the arc flash hazard study after the short circuit and protective device coordination study has been completed.
- B. The study shall be calculated by means of the SKM PowerTools for Windows computer software package. Pertinent data, rationale employed, and assumptions in developing the calculations shall be incorporated in the introductory remarks of the study.
- C. The study shall be in accordance with latest applicable NFPA 70E, OSHA 29-CFR, Part 1910 Sub part S, IEEE 1584, and NESC Standards. The study must be performed using IEEE 1584 for equipment rated 50 to 15 kV and NESC for equipment rated above 15 kV.
- D. Determine the items shown on the example labels (figure 1 & 2) at each location shown on the one line drawing **or equipment included in the Site Electrical Equipment Inventory Spreadsheet.**
- E. Produce an Arc Flash Warning label as shown above in Figures 1 & 2.. Also include the bus name and voltage. Labels shall be printed in color and shall be moisture proof, adhesive backed. Labels for outdoor equipment shall be vinyl and UV resistant to avoid fading.
- F. Produce three Arc Flash Evaluation Summary Sheet reports. The first shall list the items below for the maximum calculated energy levels. The second report shall list all incident energy values at each location for each scenario. The third report shall list all "Dangerous" locations (using maximum calculated energy levels) where the incident energy level is 40 Cals/cm<sup>2</sup>. The reports shall list the following items:

1. Bus Name
2. Scenario
3. Upstream Protective Device Name, Type, and Settings
4. Bus Line to Line Voltage
5. Bus Bolted Fault
6. Protective Device Bolted Fault Current
7. Arcing Fault Current
8. Protective Device Trip / Delay Time
9. Breaker Opening Time
10. Solidly Grounded Column
11. Equipment Type
12. Gap
13. Arc Flash Boundary
14. Working Distance
15. Incident Energy

G. Create an impedance one-line diagram. All electrical equipment wiring to be protected by the overcurrent devices installed under this project and each location where the fault current will be calculated shall be shown. Clearly show, on the one-line, the schematic wiring of the electrical distribution system.

1. Show reference nodes on the one-line diagram referring to a formal report, to include the following specific information:
2. X/R ratios, utility contribution, and short circuit values (asymmetrical and symmetrical) at the bus of the main service, and all downstream equipment containing overcurrent devices.
3. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
4. Voltage at each bus.
5. Identifications of each bus.
6. Feeder sizes, quantity per phase, and length.

### **PART 3 - ANALYSIS**

Analyze the short circuit, protective device coordination, and arc flash calculations and highlight any equipment that is determined to be underrated or causes an abnormally high incident energy calculation. Propose general methods and approaches to reduce the energy levels. Proposed major corrective modifications will be taken under advisement by the Engineer, and the Contractor will be given further instructions.

### **PART 4 - REPORT**

The results of the power system study shall be summarized in a final report. The report shall include the following sections:

- A. Introduction, executive summary and recommendations, assumptions, reduced copy of the one line **and impedance** drawings.
- B. Arc Flash Evaluations Summary Spreadsheet (Maximum Energy Calculation)
- C. Arc Flash Evaluations Summary Spreadsheet (All Scenarios for each location Energy Calculation)
- D. Arc Flash Evaluations Summary Spreadsheet (Dangerous Locations)
- E. Arc Flash Hazard Warning Labels printed in color on paper. Instruction on how to install the labels on the equipment.
- F. One set of labels printed in color on moisture proof adhesive backed labels. Labels for outdoor equipment shall be vinyl and UV resistant to avoid fading.
- G. Protective Device List
- H. **SKM project data base files.**
- I. **Existing Equipment (PSDB) Database files**