



Arc Flash Hazard Analysis & Protective Device Coordination Study

Sample facility: 480Y/277 V industrial / commercial service

Short circuit · Device evaluation · Coordination · Arc flash · Labels

REDACTED SAMPLE — ILLUSTRATIVE EXCERPT

This document follows the structure and assumption language of PowerSafe Engineering's sealed study reports. Table values are actual model outputs from completed studies with every client, site and equipment identifier replaced. It is not sealed and must not be used for PPE selection or labeling. A real report is sealed by a PE licensed in the facility's state.

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A full PowerSafe report runs roughly 22–80 pages depending on scope. Sections omitted from this excerpt include complete SKM input/output reports (fault contributions, comprehensive bus and device evaluations), every time-current curve, photographs, utility correspondence, and the full one-line drawing. Load flow / voltage drop and motor starting sections are added when in scope.

1 Executive Summary

This study evaluates the 480Y/277 V and 208Y/120 V distribution system served by a 2,000 kVA utility pad-mount transformer. Field data was collected by PowerSafe engineers. The study includes a short circuit analysis and equipment duty evaluation, a protective device coordination study with proposed settings, and an arc flash hazard analysis per IEEE 1584-2018 and NFPA 70E-2024.

Short circuit. Maximum available bolted fault current is 51.8 kA at MCC-1. Two locations have interrupting ratings below the available fault current (HP-1 branch breakers and the PNL-2 main) and require action — see Section 3.

Coordination. Electronic-trip breakers at SWBD-1 were found at factory default settings. Proposed settings in Section 4 restore selectivity between the main and feeders and reduce downstream incident energy.

Arc flash. Incident energy ranges from 0.09 to 91.00 cal/cm². Two locations exceed 40 cal/cm² and receive DANGER labels: the line side of the main switchboard and the fire pump controller, both fed directly from the utility transformer and cleared only by the utility primary fuse. Energized work is not permitted at these locations; de-energize through the utility. All other evaluated equipment receives WARNING labels. Labels are valid only once the proposed settings are implemented.

2 Introduction

2.1 Distribution system overview

The facility is served at 480Y/277 V from a utility-owned pad-mount transformer feeding main switchboard SWBD-1. SWBD-1 feeds two motor control centers, power panel HP-1, a fire pump controller, and step-down transformers serving 208Y/120 V lighting and receptacle panels. A standby generator serves selected loads through an automatic transfer switch.

2.2 Calculation methods

The system was modeled in SKM Power*Tools: DAPPER for fault analysis and equipment evaluation, CAPTOR for protective device coordination, and Arc Flash Evaluation for incident-energy analysis per IEEE 1584-2018.

2.3 Study assumptions

- Utility three-phase and single-line-to-ground fault current and X/R are taken from the utility's letter and increased 10% for conservatism.
- Transformer impedance is taken from nameplate; X/R from typical values. Where impedance is a range, the value producing the worst case is used.
- Conductor size, type and sets per phase were recorded in the field. Lengths were estimated by orthogonal routing and rounded short, which maximizes fault current.
- Devices that could not be accessed safely are listed individually with the make, model and settings assumed.
- Enclosure dimensions not measured in the field use typical sizes by equipment class (IEEE 1584-2018 enclosure correction).
- This study is not a code-compliance review. Results are void if the system is modified after the survey; notify PowerSafe of changes.

2.4 Naming conventions

Bus created only for modeling purposes are named BUS-XXX and are excluded from equipment and arc flash evaluations.

3 Short Circuit Analysis & Equipment Evaluation

Fault current was calculated at every bus for the normal utility source and for generator operation. Each protective device's interrupting rating (and each assembly's short-circuit current rating) is compared with the available fault current per NEC 110.9 and 110.10.

Bus	Device / assembly	Rating (kA)	Available (kA)	Duty	Status
SWBD-1	SWBD-1 main CB	65	51.6	79%	OK
MCC-1	MCC-1 bus / SCCR	65	51.8	80%	OK
HP-1	HP-1 branch CBs	35	40.6	116%	UNDER-RATED — verify tested series rating (NEC 240.86) or replace
PNL-2	PNL-2 main CB	14	22.4	160%	UNDER-RATED — replace or add current-limiting protection
LP-1	LP-1 branch CBs	10	6.8	68%	OK

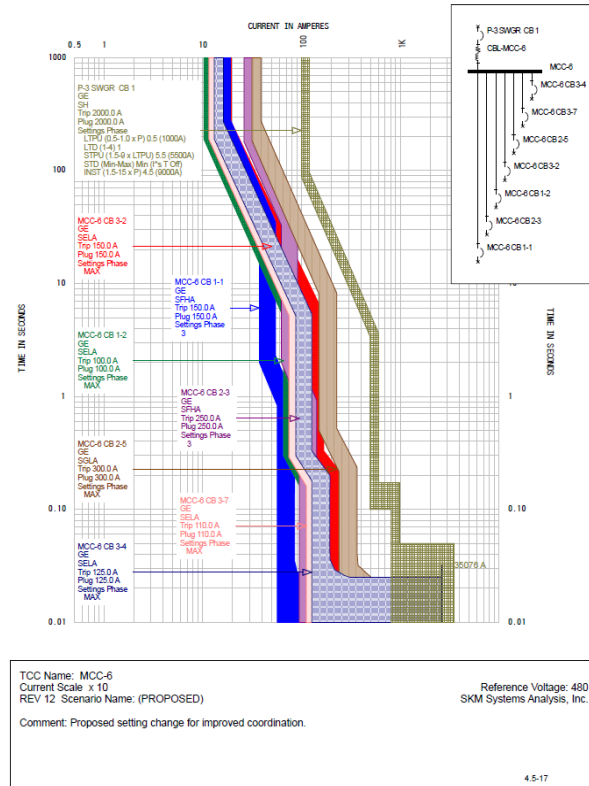
Where a breaker is under-rated, PowerSafe first checks for a manufacturer-tested series rating (NEC 240.86) before recommending replacement or current-limiting protection upstream.

4 Protective Device Coordination Study

Time-current curves (TCCs) were plotted from the utility primary fuse down to the largest branch device on each bus, including transformer inrush and damage curves and cable damage curves. Existing and proposed settings are tabulated so maintenance staff can implement them directly; changed values are highlighted.

Device	Setting	Existing (as found)	Proposed
SWBD-1 main (LSIG)	Long-time pickup / delay	1.0 × / band 4	0.9 × / band 4
	Short-time pickup / delay	3 × / 0.10 s	4 × / 0.30 s (I ² t out)
	Instantaneous	10 ×	OFF (ST provides selectivity)
	Ground fault pickup / delay	0.2 × / 0.10 s	0.4 × / 0.30 s
SWBD-1 feeder to MCC-1	Short-time pickup / delay	3 × / 0.10 s	5 × / 0.10 s
	Instantaneous	10 ×	8 ×

Illustrative settings. Real proposed settings are calculated for the specific trip units and are checked against arc flash results before issue.



Example TCC (proposed settings) — MCC main and branch breakers plotted against the upstream switchgear breaker.

5 Arc Flash Hazard Analysis

Calculations follow IEEE 1584-2018 with an 80% clear-fault threshold, a maximum arcing duration of 2.0 seconds, and induction-motor contribution included for 5 cycles. The risk assessment was performed per NFPA 70E-2024, reporting the worst case across all scenarios (utility and generator). Labels use the incident-energy method: incident energy at the working distance, arc flash boundary, and minimum arc rating — never mixed with PPE categories.

Bus	Protective device	kV	Bolted kA	Arcing kA	Cfg.	Box W×H×D (in)	AF bdry (in)	WD (in)	IE (cal/cm ²)	Label
MSB (main line side)	Utility primary fuse	0.480	34.80	24.78	VCB	30×66×17	270	18	91.00	DANGER
Fire pump controller	Utility primary fuse	0.480	17.24	13.28	VCB	72×66×18	173	18	44.65	DANGER
FD-2 (line side)	Utility primary fuse	0.480	18.01	12.14	VCB	28×70×15	151	18	35.75	WARNING
P-1 disconnect	P-1 fuse	0.480	10.96	8.40	VCB	28×50×10	86	18	14.61	WARNING
SWBD-1 (main line side)	Utility primary fuse	0.480	51.64	27.96	VCB	36×30×36	82	18	13.57	WARNING
MCC-2 (line side)	FD-1 fuse	0.480	19.41	13.06	VCB	18×40×15	66	18	9.66	WARNING
MCC-1	MCC-1 feeder CB	0.480	51.75	31.93	VCB	20×20×20	38	18	4.04	WARNING
RP-1	RP-1 main CB	0.208	1.62	0.63	VCB	20×44×6.5	26	18	2.12	WARNING
HP-1	HP-1 feeder CB	0.480	40.60	27.66	VCB	20×36×6	16	18	1.00	WARNING
LP-1	T-LP1 secondary CB	0.208	6.79	3.01	VCB	20×36×6	8	18	0.34	WARNING
P-1 VFD	P-1 VFD fuse	0.480	18.09	13.92	VCB	12×14×10	8	18	0.32	WARNING
DP-1	MCC-1 feeder CB	0.480	5.08	3.76	VCB	32×91×12	4	18	0.09	WARNING

Excerpt of the Arc Flash Evaluation Report (12 representative locations). Gap = 25 mm for all 480 V and 208 V equipment shown. Locations at the 2-second limit are cleared only by the utility primary fuse.

5.1 Results summary

- Incident energy ranges from 0.09 to 91.00 cal/cm².
- 2 locations exceed 40 cal/cm² (DANGER) — both upstream of the first customer-owned protective device.
- About a quarter of locations fall between 12 and 40 cal/cm²; the remainder are 12 cal/cm² or less.
- On generator power, several feeders clear more slowly than on utility; the higher value is reported. Section 6 lists mitigation.

5.2 Sample labels

WARNING
Arc Flash and Shock Hazard — Appropriate PPE Required
Incident energy: 9.66 cal/cm² at 18 in
Arc flash boundary: 66 in
Min. arc rating: 9.66 cal/cm²
Shock hazard: 480 V AC
Limited approach: 42 in
Restricted approach: 12 in
Equipment: MCC-2 · Study date 04/2026 PowerSafe Engineering

DANGER
Arc Flash and Shock Hazard — Appropriate PPE Required
Incident energy: 91.00 cal/cm² at 18 in
Arc flash boundary: 270 in
Energized work: Not permitted — de-energize
Shock hazard: 480 V AC
Limited approach: 42 in
Restricted approach: 12 in
Equipment: MSB line side · Study date 04/2026 PowerSafe Engineering

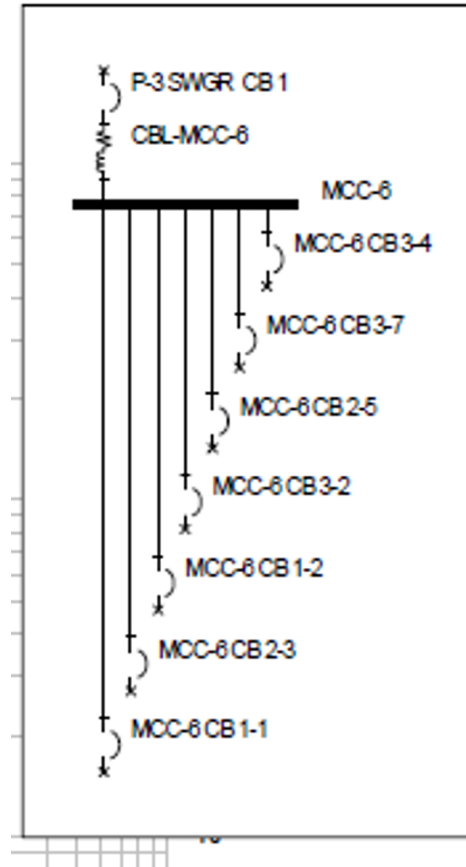
5.3 Arc-rated PPE

NFPA 70E Table 130.5(G) assigns arc-rated clothing and PPE in two bands when the incident-energy method is used: exposures of 1.2 up to 12 cal/cm², and exposures greater than 12 cal/cm². The full report reproduces the employer's applicable table; arc rating must be equal to or greater than the incident energy on the label.

6 Recommendations

- **Implement the proposed settings** in Section 4 before installing labels; label values assume them.
- **MSB line side and fire pump controller:** establish a de-energized work rule; coordinate any work with the utility.
- **HP-1 branch breakers:** confirm a tested series rating with the main; otherwise replace with breakers rated ≥ 42 kA.
- **PNL-2 main:** replace, or add upstream current-limiting fuses sized to a listed series combination.
- **Generator operation:** add an ATS-position-switched alternate settings group (or an energy-reducing maintenance switch) on SWBD-1.
- **Update interval:** review this assessment at least every five years, and after any change that affects fault current or clearing time (NFPA 70E 130.5).

Appendix A One-line Diagram (excerpt)



The full drawing shows every bus with its available fault current, conductor schedule, and device ratings — drawn to the facility's equipment tags.

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