



**DEPARTMENT OF VETERANS AFFAIRS
VA MEDICAL CENTER – ERIE, PA**

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Fault Current Study and Arc Flash Analysis

SECTION 3

DEVICE COORDINATION ANALYSIS

3.0 DEVICE COORDINATION ANALYSIS

3.1 Introduction

TEAMWORKnet, Inc. has carefully reviewed the design of the overcurrent and short circuit protection schemes. We have reviewed the power distribution one-line diagrams, the short circuit one-line diagram and researched the devices used to protect the facility. Appendix III – Device Coordination Model Analysis Results, show the coordination schemes utilized. These curves were developed in conjunction with the Short Circuit Study. All curves were developed using Modeling Software.

3.2 General Protective Device Coordination Procedure

The following is a tested, generally accepted philosophy for selecting and setting protective devices:

- 3.2.1 A feeder "first line" or "primary" protective device will remove a faulty circuit as quickly as possible.
- 3.2.2 If the feeder primary protection fails a "back-up" protective device will remove the fault. The back-up function is usually provided by an upstream device, which acts as the primary device in its zone. Therefore, time-current coordination is required between the feeder primary and back-up protective devices.
- 3.2.3 The protective-device settings are individually chosen to accommodate circuit parameters.
- 3.2.4 The criteria commonly used in determining the recommended feeder protective-device settings are:
 - a. Full-load current.
 - b. Allowance for selectivity with downstream protective devices set to the highest pickup and time delay.
 - c. Compliance with American National Standards Institute (ANSI) and National Electrical Code (NEC) requirements.
 - d. Avoidance of nuisance tripping due to transformer magnetizing inrush currents, motor starting currents, or load current peaks.
 - e. Short-circuit current for faults occurring in the protected zone of the system.

3.3 Specific Device Coordination Procedures (See Appendix VIII)

3.4 Analysis of Results and Recommendations

3.4.1 As-Found Time-Current Coordination Descriptions and Comments

Below is a summary of the modeled TCC Curves and comments/observations made as part of the analysis:

VA MEDICAL CENTER – ERIE, PA
POWER SYSTEM STUDY - As-Found Time-Current Coordination Descriptions and Comments

TCC CURVE	Adjustments Recommended (YES / NO)	Reference Voltage (V)	FAULT	COMMENTS
TCC-01 Main MV Swgr 1B	NO	12,470	InitSym 3P	003B-1 Main would operate after the Utility fuse. Lower 003B-1 Main pickup or have utility change fuse.
TCC-02 Main MV Swgr 1A	NO	12,470	InitSym 3P	003A-1A Main would operate after the Utility fuse. Lower 003A-1A Main pickup or have utility change fuse.
TCC-03 Quarters Fdr	YES - (2 Options)	12,470	InitSym 3P	003A-1A Main would operate after the Utility fuse. Lower 003A-1A Main pickup or have utility change fuse.
TCC-04 Laundry Fdr	YES - (2 Options)	12,470	InitSym 3P	003A-1A Main would operate after the Utility fuse. Lower 003A-1A Main pickup or have utility change fuse.
TCC-05 Xray Fdr	NO	12,470	InitSym 3P	003A-1A Main would operate after the Utility fuse. Lower 003A-1A Main pickup or have utility change fuse. Fuse XF Xray-208V also is miscoordinated with the Utility fuse.
TCC-06 SWBD 1B	NO	12,470	InitSym 3P	Reviewed: No Changes Recommended
TCC-06 SWBD 1B GND	NO	480	InitSym 3P	Reviewed: No Changes Recommended
TCC-07 SWBD 1A	NO	12470	InitSym 3P	Reviewed: No Changes Recommended
TCC-07 SWBD 1A GND	NO	480	InitSym 3P	Reviewed: No Changes Recommended
TCC-08 SWBD 2A	NO	480	InitSym 3P	Reviewed: No Changes Recommended
TCC-09 SWBD 2B	NO	480	InitSym 3P	Reviewed: No Changes Recommended
TCC-10 DPG2	YES	480	InitSym 3P	Fuse 010-2 T4, Some Miscoordination with 010-1 Main, Lower MAG Trip to 75%
TCC-11 MDP-2 (2.1 and 2.2)	NO	480	InitSym 3P	Reviewed: No Changes Recommended
TCC-12 MDP-1 (1.1 and 1.2)	NO	480	InitSym 3P	Reviewed: No Changes Recommended
TCC-13 MDP-1 to Fire Pump Mtr	NO	480	InitSym 3P	Reviewed: No Changes Recommended
TCC-032-01A Main to AHU-2 Cond	NO	208	InitSym 3P	Reviewed: No Changes Recommended
TCC 032-01A Main to MTR B1 Chiller 2	YES	208	InitSym 3P	Miscoordination
TCC 032-01A Main to MTR B1 Chiller Rm	YES	208	InitSym 3P	Miscoordination, Tie Breaker and Main Breaker were set near identical. This provided no discrimination in priority.
TCC 032-01A Main to PNL B1 LE-1D	NO	208	InitSym 3P	Reviewed: No Changes Recommended
TCC 032B-07 ATS-LS to PNL B1 DP-LS-E	NO	208	InitSym 3P	Reviewed: No Changes Recommended
TCC CB B1 Pnl A MB to Pnl B1 A1	NO	260	InitSym 3P	Reviewed: No Changes Recommended
TCC Laundry - FU B1 PNL AA to PNL B1 BB	NO	480	InitSym 3P	
TCC Laundry - Xfmr to PNL B1 AA	NO	12,470	InitSym 3P	Reviewed: No Changes Recommended
TCC Quarters - B10A Dist Pnl to PNL B3 Dist	YES	208	InitSym 3P	Miscoordination, Limited selectivity of protective device
TCC Quarters - Fdr to PNL B10A Dist Pnl	NO	12,470	InitSym 3P	Miscoordination, Limited selectivity of protective device
TCC Xray 208 to Pnl B1 1BWA	NO	12,470	InitSym 3P	Reviewed: No Changes Recommended
TCC Xray - 208 xfmr to Mtr B1 ER AC Comp	YES	12,470	InitSym 3P	Miscoordination, Limited selectivity of protective device
TCC Xray - Fdr to PNL B1 Xray 208	YES	12,470	InitSym 3P	Miscoordination, recommend increasing the instantaneous to accommodate downstream feeder breakers to operate first.
TCC Xray - Fdr to PNL B1 Xray 480	NO	12,470	InitSym 3P	Reviewed: No Changes Recommended

3.4.2 Settings Table: As-Found and Recommended (Options)

Based on the above table and Section 3.4.3 where adjustments are recommended, the following is a summary of recommended settings for consideration:

Settings Table: As-Found and Recommended							
TCC CURVE NAME: TCC-03 Quarters Fdr AND TCC-04 Laundry Fdr (Below Reflects Option #1 and Option #2)							
Type Device	Fuses Name/Type	Description		As Found Settings		Recommended Settings (Option #1)	
FUSE	FU: UTIL WEST High Voltage	S&C Positrol, 14.4kV 6T-200T T-Speed	Positrol, 100T	Cartridge/Trip 100.0A 100.0A	100 Amps	Positrol, 140T 140.0A 140.0A	140 Amps
Type Device		Device Description		As Found Settings		Recommended Settings (Option #2)	
	003A-1A Main 50/51 Electronic	SQUARE D Sepam Series 40, S40-42 50/51 (DT)	Sepam S42	Is, DT 0.55 (330A) EIT, Sec. 0.1 Is, DT 3 (1800A) Definite Time 0.3		Is, DT 0.1 (60A) EIT, Sec. 1.45 Is, DT 2.15 (1290A) Definite Time 0.11	
TCC CURVE NAME: TCC-10 DPG2							
Type Device		Device Description		Frame/ Model	As Found Settings	Recommended Settings	
LV	010-2 T4 Thermal Magnetic	SQUARE D LA 125-400A	LA	400.0A 300.0A	Thermal Curve INST HI (3000A)	Thermal Curve INST LO (1500A)	
TCC CURVE NAME: TCC 032-01A Main to MTR B1 Chllr 2							
Type Device		Device Description		Frame/ Model	As Found Settings	Recommended Settings	
LV	032-01A MAIN Static Trip	SQUARE D Masterpact NW, 5.0 & 6.0 A/P/H LSI, 400-5000A, ANSI	NW40H2	4000.0A 4000.0A	LTPU/LTD (A 0.4-1.0 x S) 1 (4000A); 1 STPU (1.5-10 x LTPU) 2.5 (10000A) STD (INST-0.4) 0.1 (I²t Out) INST (NW**N1,H1,H2) 15 (60000A)	LTPU/LTD (A 0.4-1.0 x S) 1 (4000A); 1 STPU (1.5-10 x LTPU) 2.5 (10000A) STD (INST-0.4) 0.2 (I²t Out) INST (NW**N1,H1,H2) 15 (60000A)	
TCC CURVE NAME: TCC 032-01A Main to MTR B1 Chiller Rm							
Type Device		Device Description		Frame/ Model	As Found Settings	Recommended Settings	
LV	032-02 TIE Static Trip	SQUARE D Masterpact NW, 5.0 & 6.0 A/P/H LSI, 400-5000A, ANSI	NW40H2	4000.0A 4000.0A	LTPU/LTD (A 0.4-1.0 x S) 1 (4000A); 1 STPU (1.5-10 x LTPU) 2.5 (10000A) STD (INST-0.4) 0.1 (I²t Out) INST (NW**N1,H1,H2) 15 (60000A)	LTPU/LTD (A 0.4-1.0 x S) 0.7 (2800A); 1 STPU (1.5-10 x LTPU) 2 (5600A) STD (INST-0.4) 0.1 (I²t Out) INST (NW**N1,H1,H2) 15 (60000A)	
TCC CURVE NAME: TCC Quarters - B10A Dist Pnl to PNL B3 Dist							
Type Device		Device Description		Frame/ Model	As Found Settings	Recommended Settings	
LV	CB: B10A DIST PNL MAIN Thermal Magnetic	FEDERAL PIONEER NJL, HJL, 2-3 Pole 70-400A	NJL 2-3P	400.0A 400.0A	Thermal Curve INST 4 (1600A)	Thermal Curve INST 10 (4000A)	
TCC CURVE NAME: TCC Xray 208 xfmr to Mtr B1 ER AC Comp							
Type Device		Device Description		Frame/ Model	As Found Settings	Recommended Settings	
LV	CB: B1 AIR COND ER Thermal Magnetic	SQUARE D LA 125-400A	LA	400.0A 300.0A	Thermal Curve INST 3 (2316A)	Thermal Curve INST LO (1500A)	
TCC CURVE NAME: TCC Xray 208 xfmr to Mtr B1 ER AC Comp							
Type Device		Device Description		Frame/ Model	As Found Settings	Recommended Settings	
LV	CB: B1 XRAY 208 DIST MAIN Static Trip	SQUARE D Powerpact P-Frame, 1.0I LJ, 250-1200A, UL	PG	1200.0A 1200.0A	LTPU;LTD 1,Fixed; INST (PG) 1.5 (1800A)	LTPU (A);LTD 0.4 (480A); 24 INST (PG 250-1200) 12 (14400A)	

3.4.3 Time-Current Coordination Graphs - Recommended Settings

Based on the above As-Found and Recommended (Options) settings outlined in Section 3.4.2, the following are the As-Found TCC Curves and Recommended Settings TCC Curves (OPTIONS 1 and 2):

AS FOUND (See Rev 0):

TCC-01 Main MV Swgr 1B	NO Changes
TCC-02 Main MV Swgr 1A	NO Changes
TCC-03 Quarters Fdr	YES - (2 Options)
TCC-04 Laundry Fdr	YES - (2 Options)
TCC-05 Xray Fdr	NO Changes
TCC-06 SWBD 1B	NO Changes
TCC-06 SWBD 1B GND	NO Changes
TCC-07 SWBD 1A	NO Changes
TCC-07 SWBD 1A GND	NO Changes
TCC-08 SWBD 2A	NO Changes
TCC-09 SWBD 2B	NO Changes
TCC-10 DPG2	YES
TCC-11 MDP-2 (2.1 and 2.2)	NO Changes
TCC-12 MDP-1 (1.1 and 1.2)	NO Changes
TCC-13 MDP-1 to Fire Pump Mtr	NO Changes
TCC-032-01A Main to AHU-2 Cond	NO Changes
TCC 032-01A Main to MTR B1 Chiller 2	YES
TCC 032-01A Main to MTR B1 Chiller Rm	YES
TCC 032-01A Main to PNL B1 LE-1D	NO Changes
TCC 032B-07 ATS-LS to PNL B1 DP-LS-E	NO Changes
TCC CB B1 Pnl A MB to Pnl B1 A1	NO Changes
TCC Laundry - FU B1 PNL AA to PNL B1 BB	NO Changes
TCC Laundry - Xfmr to PNL B1 AA	NO Changes
TCC Quarters - B10A Dist Pnl to PNL B3 Dist	YES
TCC Quarters - Fdr to PNL B10A Dist Pnl	NO Changes
TCC Xray 208 to Pnl B1 1BWA	NO Changes
TCC Xray - 208 xfmr to Mtr B1 ER AC Comp	YES
TCC Xray - Fdr to PNL B1 Xray 208	YES
TCC Xray - Fdr to PNL B1 Xray 480	NO Changes

OPTION 1 (See Rev 1):

TCC-03 Quarters Fdr	YES - (2 Options)
TCC-04 Laundry Fdr	YES - (2 Options)
TCC-10 DPG2	YES
TCC 032-01A Main to MTR B1 Chiller 2	YES
TCC 032-01A Main to MTR B1 Chiller Rm	YES
TCC Quarters - B10A Dist Pnl to PNL B3 Dist	YES
TCC Xray - 208 xfmr to Mtr B1 ER AC Comp	YES
TCC Xray - Fdr to PNL B1 Xray 208	YES

OPTION 2 (See Rev 2):

TCC-03 Quarters Fdr	YES - (2 Options)
TCC-04 Laundry Fdr	YES - (2 Options)

TCC CURVES

CD File: TCC Curves AS FOUND (Summary)

CD File: TCC Curves – Option 1 (Summary)

CD File: TCC Curves – Option 2 (Summary)

3.5 As Found and Recommended Device Settings
(See: Appendix III)

3.6 Device Coordination Model Analysis Results
(See: Appendix III)