



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

Fault Current Study and Arc Flash Analysis

Contract No. V244-P-1779
TWN Project No. 2113994

August 2011

SECTION 1

EXECUTIVE SUMMARY

1. Introduction

The Department of Veterans Affairs (VA), VA Medical Center (VAMC) Erie, PA Fault Current Study and Arc Flash Analysis was prepared by TEAMWORKnet, Inc. (TWN) under Project No. 562-11-106, Contract No. V244-P-1779 awarded on 15-June-2011.

This Fault Current Study with Arc Flash Analysis encompasses the Erie VAMC Campus inclusive of Buildings 1-7, 9, 10, 10a, and 12. The Power System Study prepared by Wiley/Wilson dated March 23, 2009 and Short-Circuit, Overcurrent Device Coordination & Arc Flash Hazard Analyses prepared by Square D Engineering Services dated December 9, 2009 was utilized in the development and completion of the system model. The results of the Short Circuit and System (Relay) Coordination Analysis form the basis for the Arc Flash Hazard Survey which provides existing arc flash energy at all locations encompassed by this study.

The Five (5) Year Plan identifies remedial action required to ensure proper personnel and equipment protection from faults. This Five (5) Year Plan also includes a budgetary cost estimate of the work outlined.

TEAMWORKnet used SKM's Power Tools for Windows® (the "MODEL" - Version 6.5.2.8) Software to model the Erie VAMC electrical distribution system for Short Circuit, System (Relay) Coordination, and Arc Flash Hazard Survey. The model of the electrical system will be turned over to Erie VAMC so that it may be maintained and updated. The proper use of the model can facilitate more efficient and safer electrical designs and/or changes.

TEAMWORKnet, Inc. appreciates the opportunity to provide our professional engineering services to Erie VAMC, and looks forward to working with you again. Please feel free to contact us if you have any questions or comments regarding this study.

2. Scope of Work

The scope of this project was to complete a fault current study and associated flash hazard analysis in accordance with NFPA 70E and IEEE 1584 to determine the level of arc flash hazards for qualified personnel working on live electrical circuits in the following buildings: 1, 2, 3, 4, 5, 6, 7, 9, 10, 10a and 12.

3. Study Objectives

The goals of this project are to provide flash hazard data (including fault current, flash protection boundary, incident energy and recommended PPE), outline safe work practices for qualified employees, install appropriate flash hazard/PPE signs for VA Erie Healthcare high and low voltage facilities, and conduct electrical safety training (for qualified persons) to comply with OSHA standards for live work on high and low voltage systems.

4. Station Information / Electrical Overview

TWN used the Power System Study prepared by Wiley/Wilson dated March 23, 2009, which was provided in electronic form, to create the model and verify the components based on a field survey performed in June 2011. The model was then updated based on the Short-Circuit, Overcurrent Device Coordination & Arc Flash Hazard Analyses prepared by Square D Engineering Services dated December 9, 2009, pdf's provided on disk. The Square D study was for changes made in the switchgear building and main switchboards in room EE-200 after the Wiley/Wilson report was completed.

This study is broken into three (3) major sections: Short Circuit, System (Relay) Coordination, and Arc Flash analysis. Our field review, plus any drawings or information received from Erie VAMC, form the basis upon which this report was developed.

The Short Circuit Study is used to calculate system fault current duties, which can be compared with the short circuit current ratings of circuit-interrupting devices, such as circuit breakers and fuses. This study can also guide in the selection and rating or setting of short circuit protective devices such as direct-acting, trip devices, fuses, and relays. The scope of the Short Circuit Study includes the utility feed (PENELEC "FRENCH" East feeder and "GLENWOOD" West feeder) at 12.47 kV to the medium voltage switchgear and the low voltage electrical distribution system down to building panels. Included under Appendix VII are the Specific Short Circuit Analysis Procedures utilized in the development of this report.

The Device Coordination analysis was performed to determine optimum fuse sizes and relay coordination settings for the facility. The scope of the Device Coordination analysis includes the entire Erie VAMC distribution system. Included under Appendix VIII are the Specific Device Coordination Study procedures utilized for the development of this report. The Time Current Characteristics (TCC) Curves developed for this study are located under Appendix III.

Included in Appendix IV are the Arc Flash Hazard Analysis Table (As Found) and the Arc Flash Threshold Report. This data is provided by SKM's Power Tools for Windows® SKM-PTW and the available fault currents and protective device clearing times as determined in the SKM-PTW system model. Accurately interpreting this data requires the use of the Arc Flash Analysis Focus within the SKM-PTW Software. The reports establish the Arc Flash energy and arc flash boundaries for all electrical equipment modeled in SKM's Power Tools for Windows® based on personnel working on exposed live parts at a working distance of 18".

With the data provided, Erie VAMC can accurately establish and identify for operation and maintenance personnel the Personal Protective Equipment (PPE) required to perform their duties in a safer manner.

Familiarity with NFPA-70E/IEEE 1584 is required to accurately interpret the data provided herein, in the SKM-PTW Arc Flash Evaluation and to apply the information to establish proper PPE levels and equipment approach boundaries. We've included in

Appendix IX a summary (introduction) to provide a basic understanding of NFPA-70E/IEEE 1584.

The Arc Flash Hazard Study results can only be as accurate as the system model. Therefore, any changes to the base electrical system should be reviewed with regard to Arc Flash Hazard and NFPA-70E/IEEE 1584 prior to implementing. Additionally, all changes should be represented on the facilities one-line diagram(s).

Please note NFPA-70E/IEEE 1584 is still being refined and future revisions may impact the results provided. SKM is planning a revision to PTW to ensure compliance with the planned revision to NFPA-70E and other applicable standards including IEEE-1584. We would recommend that Erie VAMC stay current with regards to the latest revision of NFPA-70E and have a new system study every five (5) years or before any major changes in the facility in order to ensure compliance.

Under the Appendix there is a CD containing all computer files developed for this Power System Study. These computer files have been turned over to Erie VAMC and should be updated to accurately reflect all future changes to the electrical system. Please note that items listed as “available on disc only” in this report are located on this CD.

The assembly of impedance data (for the SKM-PTW Model) and utility data for this study was accomplished in a number of ways. TEAMWORKnet performed a field survey of the electrical system in order to verify the Wiley/Wilson data for the distribution systems in the buildings. Plus, any drawings provided by Erie VAMC or the aforementioned reports were utilized as a reference when verifying data on the distribution system.

5. Study Assumptions

Some assumptions for input data were required and may affect the results of this study. In general, assumptions are needed because of limited access, safety concerns in obtaining equipment nameplate data, or lack of documentation. Significant differences between the assumptions listed here and actual values will require that this power system analysis be revised.

It is noted that appropriate assumptions and exceptions (inclusive of and not limited to) were utilized and are listed below.

1. The model used for analysis was SKM's Power Tools for Windows® (“MODEL” - Version 6.5.2.8). This model was used to model the Erie VAMC electrical distribution system for Short Circuit, System (Relay) Coordination, and Arc Flash Hazard Survey.

Selection of model study option was “Standard” which utilizes IEEE 1584, The IEEE 1584 method uses equations published in the IEEE 1584 2002/2004a edition and NFPA 70E – 2009 Annex D.7 will be used to calculate the arcing fault current, incident energy, and flash boundary. The IEEE 1584 method is based on more recent and expanded test data, and is the preferred method. Since IEEE 1584 method is also part of the NFPA

70E, using the IEEE 1584 method could be considered as compliance with NFPA 70E as well.

2. The Power Factor Correction Capacitor Banks, if any, are assumed in circuit 100% of the time.
3. Assumed typical transformer impedances (Z) where no nameplate data was available.
4. Utility short circuit data was obtained from PENELEC by Wiley/Wilson in 2008.
5. Note that some equipment data was not available. Therefore, a conservative approximation was utilized in those cases. For example, when building access was denied or not practical, the service entrance details were assumed in regards to transformer and cable size. The building age and similar building construction were also used as factors in these assumptions.
6. Some motor loads, as noted on the study one-line, are estimated based on maximum HP size allowed compared to the cable ampacity or branch breaker trip rating.
7. Information provided by Erie VAMC is assumed correct. This includes information in the Wiley/Wilson and Square D studies.
8. Transformers are modeled center taped if no field data was available on tap settings.
9. Square D panels with 208V and 240V use Square D Std QO, 10kA breakers when unknown.
10. Square D panels with 480V use Square D Std EDB, 18kA breakers when unknown.
11. GE panels with 208V and 240V use GE Q-Line THQB, 10kA breakers when unknown.
12. GE panels with 480V use GE E150 TED, 18kA breakers when unknown.
13. SKM-PTW was contacted for library updates for FPE type circuit breakers. They provided library updates for FEDERAL PIONEER breaker types NB, NBH, NEJ, NH, NJL, HJL and FPE breaker types NE.
14. The SKM-PTW software has no FPE breaker type HEJ, 100A breaker nor was the NEJ available at 100A. A type NBH breaker is utilized instead for CB: B1 LS-3E
15. Used BUSS type NON for unknown fuse types with 240V or less.

16. Used BUSS type std SC for unknown fuse types 0-60A with 480V.
17. Used BUSS type FRS for unknown fuse types 61A to 599A with 480V.
18. Square D switch, 10kA, is used for unknown, unlabeled, or obsolete switches.

6. Analysis and Results

1. Short Circuit Analysis

The Equipment Evaluation module of SKM Power® Tools was used to compare system device component ratings against calculated values of short circuit currents.

The tables on the following pages provide detailed information comparing the ratings of equipment versus the calculated values of short circuit fault current at those locations.

The “Bus Evaluation Comprehensive Fault Report” shown below (Table 6.1.1) summarizes those Buses that did **NOT** result in a “PASS” Condition. The complete report can be found in Appendix II.

The “Device Evaluation – Comprehensive Bus Report” shown below (Table 6.1.2) summarizes those Devices (by Bus) that did **NOT** result in a “PASS” Condition. The complete report can be found in Appendix II.

In Section 8, recommendations for correction, as well as the probable cost to perform corrections have been summarized. We recommend the replacement of the equipment identified in Section 8 because the devices are not adequate for the actual conditions and may fail during a fault event. This type of failure, of course, could be catastrophic and very damaging to personnel as well as infrastructure. Each device listed should be replaced with equipment appropriately rated for the situation.

Table 6.1.1

SUMMARIZED BUSES FOR CONSIDERATION (Items not resulting in a PASS condition)					
Bus Evaluation Comprehensive Fault Report					
Bus Name	Status	EquipCategory	Calc Isc kA	Dev Isc kA	Isc Rating%
007 SWBD-1A	Marginal	LV Switchboard	64.89	65.00	99.83
007 SWBD-1B	Fail	LV Switchboard	65.08	65.00	100.12
014 ATS-1	Marginal	LV Panelboard	9.65	10.00	96.46
044 A-EE-200	Marginal	LV Panelboard	21.96	22.00	99.81
045 M-P/S	Fail	LV Panelboard	25.34	22.00	115.17
048 B-EE-200	Fail	LV Panelboard	23.38	22.00	106.28
053 LS-3E	Marginal	LV Panelboard	9.41	10.00	94.07
059 OUTPATIENT	Fail	LV Panelboard	55.95	10.00	559.47
BUS: 75T CH CP	Fail	LV Panelboard	10.34	10.00	103.40
BUS: ACCU-1	Marginal	LV Panelboard	9.31	10.00	93.05
PNL: B1 1BWA	Fail	LV Panelboard	11.90	10.00	118.96
PNL: B1 A (on ATS-EL)	Fail	LV Panelboard	14.41	10.00	144.06
PNL: B1 CC-E1-DWB	Fail	LV Panelboard	10.77	10.00	107.67
PNL: B1 CC1-4LW	Marginal	LV Panelboard	9.39	10.00	93.88
PNL: B1 CT Scan Rm	Marginal	LV Panelboard	9.29	10.00	92.92
PNL: B1 DP-CC-E	Fail	LV Panelboard	27.05	22.00	122.94
PNL: B1 DP-CC-E1	Fail	LV Panelboard	29.86	22.00	135.74
PNL: B1 DP-ES-E	Fail	LV Panelboard	30.60	22.00	139.08
PNL: B1 DP-LS-E	Marginal	LV Panelboard	21.59	22.00	98.14
PNL: B1 ES-2E	Marginal	LV Panelboard	21.43	22.00	97.42
PNL: B1 ES1-BW	Marginal	LV Panelboard	9.15	10.00	91.53
PNL: B1 ESE-1	Fail	LV Panelboard	10.33	10.00	103.25
PNL: B1 PP-11	Fail	LV Panelboard	10.59	10.00	105.91
PNL: B1 Tosh Rm	Marginal	LV Panelboard	9.29	10.00	92.92
PNL: B1 W1-72	Fail	LV Panelboard	14.56	10.00	145.64
Note: Excludes items where Status is "Unknown"					

Table 6.1.2 (1 of 2)

<i>Summarized Devices for Consideration</i>										
Device Evaluation - Comprehensive Bus Report										
Connected Bus	DevName	Bus Voltage	Frame Voltage	Frame/Trip	Status	Calc Int kA	Dev Int kA	Int Rating %	Series Rating	
007 SWBD-1A	008-2 SWBD-2A LSI	480	480	2,500	Marginal	64.891	65	0	65	
	008-3 DPG-1 LSI	480	480	400	Marginal	64.891	65	0	65	
	008-4 SPARE LSI	480	480	400	Marginal	64.891	65	0	65	
	008-5 SPARE LSI	480	480	400	Marginal	64.891	65	0	65	
	008-6 SPARE LSI	480	480	1,200 / 800	Marginal	64.891	65	0	65	
007 SWBD-1B	007-2 SWBD-2B LSI	480	480	2,500	Fail	65.076	65	0	65	
	007-3 DPG-2 LSI	480	480	400	Fail	65.076	65	0	65	
	007-4 SPARE LSI	480	480	400	Fail	65.076	65	0	0	
	007-5 SPARE LSI	480	480	400	Fail	65.076	65	0	65	
	007-6 SPARE LSI	480	480	1,200 / 800	Fail	65.076	65	0	65	
015 DP-BP-2	015-2 Mech Shops	208	240	200	Marginal	9.5205	10	0	0	
	015-4 H	208	240	200	Marginal	9.5205	10	0	0	
024 MP1	024-2	480	480	20	Fail	40.274	18	0	0	
029 SWBD-2A	029-5 SPARE	480	600	250	Fail	30.211	25	0	0	
041 P-4 (PP-4A)	CB: B1 PNL PP-4B	208	240	225 / 125	Fail	11.33	10	0	0	
	CB: B1 PNL PP-4C	208	240	225 / 125	Fail	11.33	10	0	0	
	CB: B1 RTU1	208	240	225 / 150	Fail	11.33	10	0	0	
044 A-EE-200	CB: B1 PNL A Main	208	240	225 / 125	Marginal	21.959	22	0	0	
045 M-P/S	CB: COND PUMP-1	208	240	15	Fail	25.338	22	0	0	
	CB: CW PUMP-1	208	240	30	Fail	25.338	22	0	0	
	CB: CW PUMP-2	208	240	30	Fail	25.338	22	0	0	
	CB: HW-PUMP-1	208	240	20	Fail	25.338	22	0	0	
048 B-EE-200	CB: B1 PNL B Main	208	240	225	Fail	23.382	22	0	0	
BUS: Laundry 12kV	FU: XF LAUNDRY	12470	15500	50	Fail	4.0863	2.5	0	0	
BUS: XRAY 12kV Tap	FU: XF XRAY_208V	12470	15500	50	Fail	4.0356	2.5	0	0	
PNL: B1 1BWA	CB: B1 AC COMP RM	208	240	100	Fail	11.896	10	0	0	
PNL: B1 CC1-2LW	CB: B1 CC1-2LW-MAIN	208	240	225	Fail	12.113	10	0	0	
PNL: B1 CC1-4LW	CB: B1 CC1-4LW-MAIN	208	240	225	Marginal	9.3879	0	0	10	
PNL: B1 CC1-5EA	CB: B1 CC1-5EA-MAIN	208	240	225 / 200	Fail	14.197	10	0	0	
PNL: B1 CC3-N	CB: B1 CC3-NB	208	240	100 / 60	Marginal	13.857	14	0	0	

Table 6.1.2, (2 of 2)

<i>Summarized Devices for Consideration</i>										
Device Evaluation - Comprehensive Bus Report										
Connected Bus	DevName	Bus Voltage	Frame Voltage	Frame/Trip	Status	Calc Int kA	Dev Int kA	Int Rating	Series Rating	
	CB: B1 CC3-NC	208	240	225 / 200	Fail	14.305	0	0	10	
PNL: B1 CCA-1	CB: B1 HTR	208	240	50 / 40	Marginal	9.5112	10	0	0	
PNL: B1 DP-CC-E	CB: B1 CC-2W-ER, 2WER6	208	240	400	Fail	27.047	22	0	0	
	CB: B1 CC3E	208	240	225 / 175	Fail	27.047	22	0	0	
	CB: B1 CC3-N, NB, NC	208	240	400	Fail	27.047	22	0	0	
	CB: B1 CCA	208	240	400 / 250	Fail	27.047	22	0	0	
PNL: B1 DP-CC-E	CB: B1 CCB	208	240	225 / 200	Fail	27.047	22	0	0	
	CB: B1 CC-W1, W2	208	240	225 / 150	Fail	27.047	22	0	0	
	CB: B1 LS1-EA, 2EB, LS2-E	208	240	400	Fail	27.047	22	0	0	
PNL: B1 DP-CC-E1	CB: B1 CC1-2LW, 4LW, 5LW	208	240	400	Fail	29.863	22	0	0	
	CB: B1 CC1-3E2, 4E2, 5EA, 6	208	240	400	Fail	29.863	22	0	0	
	CB: B1 CC1-EA	208	240	225 / 150	Fail	29.863	22	0	0	
	CB: B1 WH-207	208	240	225	Fail	29.863	22	0	0	
PNL: B1 DP-ES-E	CB: B1 ES-2	208	240	400	Fail	30.598	22	0	0	
	CB: B1 ES-BE	208	240	225	Fail	30.598	22	0	0	
	CB: B1 ES-BN	208	240	225 / 200	Fail	30.598	22	0	0	
	CB: B1 ES-BW	208	240	225	Fail	30.598	22	0	0	
	CB: B1 ES-PH	208	240	225	Fail	30.598	22	0	0	
	CB: B1 ES-SPD	208	240	225	Fail	30.598	22	0	0	
	CB: B1 MCC-EA	208	240	400	Fail	30.598	22	0	0	
PNL: B1 DP-LS-E	CB: B1 3E, 6E, 8N, LS-BE	208	240	225 / 150	Marginal	21.591	22	0	0	
	CB: B1 ESE-1-K-3	208	240	225	Marginal	21.591	22	0	0	
	CB: B1 LS-BW, 3W	208	240	225 / 125	Marginal	21.591	22	0	0	
	CB: B1 LSGR, LE-1C, SUB-	208	240	225 / 150	Marginal	21.591	22	0	0	
PNL: B1 ES-2E	CB: B1 AC	208	240	50 / 40	Fail	22.938	10	0	0	
PNL: B1 ES-2E	CB: B1 ES-2-MAIN	208	240	400	Marginal	21.433	22	0	0	
	CB: B1 GRILL	208	240	50	Fail	22.938	10	0	0	
	CB: B1 OVEN	208	240	100 / 70	Fail	22.938	10	0	0	
PNL: B1 ESE-1	CB: B1 ESE-1-MAIN	208	240	225	Fail	10.325	0	0	10	
PNL: B1 ES-PH	CB: B1 ES-PH2	208	240	100 / 60	Fail	19.38	10	0	0	
PNL: B1 LS2-BE	CB: B1 LS1-BEA	208	240	100 / 60	Fail	13.779	10	0	0	
PNL: B1 LS-3W	CB: B1 LS-3W	208	240	60	Fail	3.5111	0	0	0	
PNL: B1 LSGR	CB: B1 LSGR-MAIN	208	240	225	Fail	12.155	0	0	10	
	CB: B1 SUB-PNL	208	240	225 / 125	Fail	12.155	0	0	0	
PNL: B1 P2M	CB: B1 P2M--MAIN	208	240	225	Fail	4.3761	0	0	0	
PNL: B1 PP-11	CB: B1 ACC 2	208	240	30	Fail	10.563	10	0	0	
PNL: B1 XRAY 208	CB: B1 1N	208	240	200	Marginal	24.737	25	0	0	
	CB: B1 PNL 1BWA	208	240	200	Marginal	24.737	25	0	0	
	CB: B1 PNL PP	208	240	200	Marginal	24.737	25	0	0	

2. Device Coordination Analysis

The protective device coordination study examines the settings of protective devices. This examination provides an analysis of the existing settings and determines whether proper coordination is currently being achieved.

Where a lack of coordination exists, recommendations for improved settings are provided. In certain cases, due to limitations of the existing protective devices, improved coordination may not be possible.

The following table provides a summary of the existing settings for protective devices, where changes are recommended, and the recommended changes for consideration. The complete settings report can be found in [Appendix III](#).

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	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 S0/S1 Electronic	SQUARE D Sepam Series 40, 540-42 S0/S1 (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 Chiller 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 (I ² t 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 (I ² t 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 (I ² t 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 (I ² t 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 NUL, HUL, 2-3 Pole 70-400A	NUL 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 LI, 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. Arc Flash Hazard Analysis

TEAMWORKnet, Inc. has carefully reviewed the potentially Arc Flash hazardous working areas at the Project Site. The Modeled Arc Flash Study is designed to insure compliance with NFPA, NEC and OSHA safety standards and to better protect field personnel. Arc Flash provides the latest calculation procedures for determining potentially hazardous working areas and for applying proper flame resistant (FR) clothing requirements.

Model Arc Flash calculations are based on the IEEE 1584 "Standard for Electrical Safety Requirements for Employee Workplaces", IEEE papers on Arc Flash and applicable ANSI Standards. These calculations provide specific incident energies and arc flash boundaries for each protective equipment area at the studied facility. IEEE 1584 is used as a basis for evaluating and providing electrical safety in the workplace and is compatible with Occupational Safety and Health Administration (OSHA), Code 29 and the National Electrical Code requirements.

The Arc Flash Study determines the Limited, Prohibited and Restricted Approach Boundaries (distance from live parts). These minimum approach boundaries safeguard workers from the dangers of fire, shock, arc flash and arc blast. Additionally, this study states the necessary Personal Protective Equipment (PPE) qualified and unqualified personnel must wear when working within the approach boundaries.

The results of the Arc Flash Hazard Analysis have been provided in Section 4 of this report.

7. Field Observations and Recommendations

(See: Device Observations on Disk)

File: **Device Observations**

8. Recommendations, Costs and Five Year Plan

Budgetary Estimates (Part 1 of 2)		FIVE YEAR PLAN					
		2012	2013	2014	2015	2016	TOTALS
1 Thermal imaging of selected areas and buildings. Engineer three (3) day(s) on-site and four (4) day(s) office report generations and analysis.							
Estimate cost	\$6,000	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	
2 Grounding and lightning study of selected areas and buildings. Provide five (5) day(s) on site testing and five (5) day(s) report generation and analysis.							
Estimate cost	\$36,000		\$35,000				
3 Purchase Individual Arc Flash PPE for employees and class 4 suits.							
Estimate cost	\$10,000	\$10,000					
4 General maintenance and testing of 003-SWGR-1A & 003-SWGR-1B 15kV Switchgear, relays and circuit breaker. Level one (1) minimum maintenance on breaker to include removal from service, cleaning, testing, replace standard consumable parts and return to service. Critical part of maintenance and personnel safety.							
a. Eight (8) 15kV breakers, level 1 maintenance and testing.							
b. Relay Testing.							
c. SWGR, 15kV general maintenance, cleaning and torque of buss connections.							
Estimate cost	\$39,000	\$39,000				\$39,000	
5 Power system study update, including arc flash hazard analysis and load flow.							
Estimate cost	\$76,000					\$75,000	
6 General maintenance and testing of 480V Switchgear, Panels, Switch Board, relays and circuit breaker. Level one (1) minimum maintenance on breaker to include removal from service, cleaning, testing, replace standard consumable parts and return to service. Critical part of maintenance and personnel safety.							
a. 007-SWBD-1A.	\$15,900	\$7,950					
b. 007-SWBD-1B.	\$13,600		\$6,800				
c. 029-SWBD-2A.	\$10,800			\$5,400			
d. 009-SWBD-2B.	\$12,000				\$6,000		
e. Eight (8) ATS units.	\$15,160						
f. B1 Xray 480 Dist PNL.	\$4,600	\$2,300					\$7,580
g. B1 AA PNL.	\$3,900		\$1,950				
h. 010 DP-BP-1.	\$4,200			\$2,100			
Estimate cost	\$80,180						
7 General maintenance and testing of 208V Switchgear, Panels, Switch Board, relays and circuit breaker. Level one (1) minimum maintenance on breaker to include removal from service, cleaning, testing, replace standard consumable parts and return to service. Critical part of maintenance and personnel safety.							
a. B10A Distribution Panel.	\$4,250			\$4,250			
b. B1 Xray 208 Dist PNL.	\$3,550			\$3,550			
c. 032B MDP-2.	\$9,850			\$9,850			
d. 032A MDP-1.	\$8,450			\$8,450			
e. B7 BNE.	\$4,300			\$4,300			
f. 015 DP-BP-2.	\$2,850			\$2,850			
g. B1 EM-DP.	\$6,300			\$6,300			
h. B1 DP-CC-E1.	\$3,600					\$3,600	
i. B1 DP-CC-E.	\$4,650					\$4,650	
j. B1 CC-E1-DWB.	\$3,200					\$3,200	
k. B1 DP-ES-E.	\$5,000					\$5,000	
l. B1 PNL A.	\$3,550					\$3,550	
m. B1 DP-ES-E1.	\$5,000					\$5,000	
n. B1 DP-LS-E.	\$4,650					\$4,650	
o. Breaker B7 BNE.	\$1,285					\$1,285	
p. DP-BP-2.	\$2,200					\$2,200	
Estimate cost	\$72,885						
8 07 SWBD-1B & 1A, install arc flash mitigation system. As an example the required equipment would consist of: a custom enclosure, SEL-751A protection relay, CT's, fiber cable. See details in appendix.							
a. 07 SWBD-1A.	\$29,544	\$29,544					
b. 07 SWBD-1B.	\$29,544		\$29,544				
Estimate cost	\$68,088						
9 Replace panel 045 M-P/B, 208/120V, 225A, 22kA with a panel rated 208/120V, 225A, main breaker, fault current rating 35kA minimum. See details in appendix.							
Estimate cost	\$8,488		\$8,488				

Budgetary Estimates (Part 2 of 2)			FIVE YEAR PLAN (Cost Allocation)					
			2012	2013	2014	2015	2016	TOTALS
10 Replace panel B1 W1-72, 208/120V, 225A, 10kA with panel rated 208/120V, 225A, main breaker, fault current rating 22kA minimum. See details in appendix. Estimate cost		\$3,892			\$3,892			
11 Replace panel B1 1BWA, 208/120V, 225A, 10kA with panel rated 208/120V, 225A, main breaker, fault current rating 22kA minimum. See details in appendix. Estimate cost		\$6,316				\$5,315		
12 Replace panel B1 EGE-1, 208/120V, 225A, 10kA with panel rated 208/120V, 225A, main breaker, fault current rating 22kA minimum. See details in appendix. Estimate cost		\$8,744					\$8,744	
13 Replace panel B1 DP-E0-E, 208/120V, 800A, 22kA with a panel rated 208/120V, 800A, main breaker, fault current rating 35kA minimum. See details in appendix. Estimate cost		\$38,203		\$38,203				
14 Replace panel B1 DP-CC-E1, 208/120V, 800A, 22kA with a panel rated 208/120V, 800A, main breaker, fault current rating 35kA minimum. See details in appendix. Estimate cost		\$42,242			\$42,242			
15 Replace panel B1 DP-CC-E, 208/120V, 800A, 22kA with a panel rated 208/120V, 800A, main breaker, fault current rating 35kA minimum. See details in appendix. Estimate cost		\$42,242				\$42,242		
16 Replace panel B1 CC-E1-DWB, 208/120V, 400A, 10kA with panel rated 208/120V, 400A, main breaker, fault current rating 22kA minimum. See details in appendix. Estimate cost		\$4,117					\$4,117	
17 Replace panel B1 PP-11, 208/120V, 225A, 10kA with panel rated 208/120V, 225A, main breaker, fault current rating 22kA minimum. See details in appendix. Estimate cost		\$7,984		\$7,984				
18 Replace panel B1 A, 208/120V, 600A, 10kA with panel rated 208/120V, 600A, main breaker, fault current rating 22kA minimum. See details in appendix. Estimate cost		\$6,891			\$6,891			
19 Replace panel 048 B-EE-200, 208/120V, 225A, 10kA with panel rated 208/120V, 225A, main breaker, fault current rating 35kA minimum. See details in appendix. Estimate cost		\$10,031				\$10,031		
20 Replace individual breakers within power panels. The below list of breaker are not rated for the available fault current, but the panel they reside in are adequately rated. Replace breaker with properly fault current rating equipment. See details in appendix.								
CB: B1 WH-207	GE THQD 225A, 22kA	\$2,800		\$2,800				
CB: B1 SUB-PNL	FPE NEJ 125A, 10kA	\$2,800		\$2,800				
CB: B1 RTU1	GE TQD 150A, 10kA	\$2,800		\$2,800				
CB: B1 PNL PP-4C	GE TQD 225A, 10kA	\$2,800		\$2,800				
CB: B1 PNL PP-4B	GE TQD 225A, 10kA	\$2,800		\$2,800				
CB: B1 PNL B Main	CH CAH, 225A, 22kA	\$2,800						
CB: B1 OVEN	GE THQB 100A, 10kA	\$374			\$2,800			
CB: B1 LGGR-MAIN	FPE NEJ 225A, 10kA	\$2,800			\$374			
CB: B1 LB1-BEA	GE THQB 60A, 10kA	\$374			\$2,800			
CB: B1 GRILL	GE THQB 60A, 10kA	\$374			\$374			
CB: B1 E0-PH2	GE THQL 50A, 10kA	\$374			\$374			
CB: B1 EGE-1-MAIN	FPE NEJ 225A, 10kA	\$2,800				\$2,800		
CB: B1 CC3-NC	FPE NEJ 200A, 10kA	\$2,800				\$2,800		
CB: B1 CC1-SLW-MAIN	FPE NEJ 225A, 10kA	\$2,800				\$2,800		
CB: B1 CC1-SEA-MAIN	GE TQD 200A, 10kA	\$2,800				\$2,800		
CB: B1 CC1-ALW-MAIN	FPE NEJ 225A, 10kA	\$2,800				\$2,800		
CB: B1 CC1-2LW-MAIN	GE TQD 225A, 10kA	\$2,800				\$2,800		
CB: B1 AC COMP RM	CH BAB, 100A, 10kA	\$374					\$374	
CB: B1 AC	GE THQB 50A, 10kA	\$374					\$374	
029-5 SPARE	Square D JJ 250A, 25kA	\$3,125					\$3,125	
024-2	Square D ED 20A, 18kA	\$675					\$675	
Estimate cost		\$42,444						
21 Electric Equipment New Labeling - revise nomenclatures and create phenolic labels for Swgr, panelboards, panels, and transformers Estimate cost		\$46,360		\$46,360				
TOTAL BUDGETARY ESTIMATE			\$139,144	\$146,969	\$111,171	\$118,523	\$143,989	\$659,796

9. Closing Statement

TEAMWORKnet appreciates the opportunity to work with the Department of Veteran Affairs, VA MEDICAL CENTER – ERIE, PA. We look forward to reviewing the information in this report.

Respectfully submitted,
TEAMWORKnet, Inc.