How to read an SKM Power*Tools Arc Flash Analysis Report

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Mr. Brian Antosh
Manager of Critical Facilities Infrastructure
305 E. Eisenhower, Suite 300
Ann Arbor, MI 48108

RE: Online Tech - Ann Arbor AA-1
Arc Flash Study

Dear Mr. Antosh:

This letter introduces the Arc Flash Study for Online Tech - Ann Arbor AA-1 energized by the Utility and the generators. The study, itself, addresses some assumptions and describes some recommendations.

The study was made utilizing the SKM software and includes the following:

1. Fault Calculations
2. Arc Flash Calculations
3. SKM One Line Diagram
4. Labels

Assumptions:

The following assumptions have been made:

- The rating of the lugs was not available. To determine the proper wire size, the 75 degree centigrade table in the NEC was used.
- UPS Maintenance by-pass mode was used.
- Information for the UPS-2 transformer was not available. 150 kVA transformer with 5% impedance was used.
- Information for the PDU-A transformer was not available. 225 kVA transformer with 5% impedance was used.
- Information for the PDU-B transformer was not available. 225 kVA transformer with 5% impedance was used.

Cover Letter

Mostly boilerplate; however, the 5th paragraph notes engineering findings that are unique to the system. A follow-up phone meeting is always recommended.

Project
Utility

DAPPER Fault Analysis Input Report (English)

Utilities

Contribution From Name	Bus Name	In/Out Service	Nominal Voltage	Contribution Data				PU (100 MVA Base)	
					Duty	Units	X/R	R PU	X PU
UTIL-AA1	UTILITY AA1	In	13,200	3P:	3,166	Amps	1.42	Pos: 0.797	1.129
				SLG:	2,224	Amps	1.96	Zero: 1.089	2.997

Generators

Contribution From Name	Bus Name	In/Out Service	Nominal Voltage	Contribution Data			PU (100 MVA Base)	
				Base kVA	X"	X/R	R PU	X PU
GEN-DIESEL	7319 DIESEL	In	480	625.00	0.15	20.00	0.00	0.00
					0.15	20.00	0.00	0.00
					0.15	20.00	0.00	0.00
GEN-GAS	7320 GAS GENERATOR	In	480	312.50	0.15	20.00	0.00	0.00
					0.15	20.00	0.00	0.00
					0.15	20.00	0.00	0.00

Cables

Cable Name	From Bus To Bus	In/Out Service	Qty /Ph	Length Feet	Cable Description				Per Unit (100 MVA Base)		
					Size	Cond. Type	Duct Type	Insul		R pu	jX pu
CBL-A-1	PDU-A (7332) A-1	In	1	5	225	Copper	Busway	Epoxy	Pos:	0.4912	0.3733
									Zero:	2.9204	1.9982
CBL-A-2	PDU-A (7332) A-2	In	1	5	225	Copper	Busway	Epoxy	Pos:	0.4912	0.3733
									Zero:	2.9204	1.9982
CBL-A-3	PDU-A (7332) A-3	In	1	5	225	Copper	Busway	Epoxy	Pos:	0.4912	0.3733
									Zero:	2.9204	1.9982

DAPPER Fault Analysis Input Report

This is the raw data broken down by type of data point—Utility, Motors, Cables, Transformers, etc.

Once the field data is inputted into SKM, the engineer will double check and cross reference the field data to ensure accuracy and code violations.

Project:
Utility

DAPPER Fault Contribution Brief Report

Comprehensive Short Circuit Study Settings

Three Phase Fault	Yes	**Faulted Bus**	All Buses
Single Line to Ground	Yes	**Bus Voltages**	First Bus From Fault
Line to Line Fault	No	**Branch Currents**	First Branch From Fault
Line to Line to Ground	No	**Phase or Sequence**	Report phase quantities
Motor Contribution	Yes	**Fault Current Calculation**	Asymmetrical RMS (with DC offset and Decay)
Transformer Tap	Yes	**Asym Fault Current at Time**	0.50 **Cycles**
Xformer Phase Shift	Yes		

				Initial Symmetrical Amps				Asymmetrical Amps			
Bus Name	**Contributions**			**3 Phase**	**SLG**	**LLG**	**LL**	**3 Phase**	**SLG**	**LLG**	**LL**
A-1				**7,902**	**8,743**	**0**	**0**	**8,715**	**9,635**	**0**	**0**
	CBL-A-1	CABLE	In	7,902	8,743	0	0	8,715	9,635	0	0
A-2				**7,902**	**8,743**	**0**	**0**	**8,715**	**9,635**	**0**	**0**
	CBL-A-2	CABLE	In	7,902	8,743	0	0	8,715	9,635	0	0
A-3				**7,902**	**8,743**	**0**	**0**	**8,715**	**9,635**	**0**	**0**
	CBL-A-3	CABLE	In	7,902	8,743	0	0	8,715	9,635	0	0
ACC-5 (7347)				**6,894**	**5,005**	**0**	**0**	**6,899**	**5,005**	**0**	**0**
	CBL-ACC-5	CABLE	In	6,894	5,005	0	0	6,899	5,005	0	0
ACC-6 (7354)				**6,449**	**4,581**	**0**	**0**	**6,452**	**4,581**	**0**	**0**
	CBL-ACC-6	CABLE	In	6,449	4,581	0	0	6,452	4,581	0	0
AIR COND #1 (7344)				**4,469**	**2,912**	**0**	**0**	**4,469**	**2,912**	**0**	**0**
	CBL-AIR COND #1	CABLE	In	4,469	2,912	0	0	4,469	2,912	0	0
AIR COND #2 (7343)				**3,489**	**2,199**	**0**	**0**	**3,489**	**2,199**	**0**	**0**

DAPPER Fault Contribution Brief Report

This section takes into consideration the protective device, cable impedance, motor contribution, and the available fault current to calculate the short- circuit energy at each device.

Project:
Utility

Device Evaluation A_FAULT Report

Connected Bus	DevName	Bus Voltage	Frame Voltage	Frame/Trip	Status	Calc Int kA	Dev Int kA	Int Rating %	Series Rating	Calc Mom kA	Dev Mom kA	Mom Rating %
7319 DIESEL	PD DIESEL GENERATOR	480	600	800	Unknown	0.00	0.0	0.00				
7320 GAS GENERATOR	PD GAS GENERATOR	480	480	600	Unknown	0.00	0.0	0.00				
BUS-0061	PD PDU-A MAIN	480	480	250 / 200	Pass	0.00	35.0	0.00				
BUS-0062	PD PDU-B MAIN	480	480	250 / 200	Pass	0.00	35.0	0.00				
DP-AA (7316)	PD ATS-1	480	480	1,000 / 800	Pass	0.00	65.0	0.00				
	PD ATS-2	480	480	400 / 350	Pass	0.00	35.0	0.00				
DP-AA MAIN	PD DP-AA	480	480	1,200 / 800	Pass	0.00	35.0	0.00				
DP-BB (7337)	PD ACC-5	480	480	70	Pass	0.00	25.0	0.00				
	PD ACC-6	480	480	70	Pass	0.00	25.0	0.00				
	PD CACU-5	480	480	15	Pass	0.00	25.0	0.00				
	PD CACU-6	480	480	15	Pass	0.00	25.0	0.00				
	PD DP-MB	480	480	400 / 300	Pass	0.00	30.0	0.00				

1

Device Evaluation A_FAULT Report

With the information from the previous report section, the Engineer will evaluate the device rating in kA vs. the Calculated Interrupting kA.

The product is displayed in a % Rating. If the % exceeds 100%, the device is in jeopardy of catastrophic failure. This can be due to low impedance from the transformer.

Correction options can vary, but often a protective device with a higher AIC rating is recommended.

For a complete solution, further engineering may be required.

Project:
Utility

Arc Flash Evaluation Report

Arc Flash Evaluation Study Options

Standard:	IEEE 1584	**Max Arcing Duration:**	2.0 seconds
Unit:	English	**Include Transformer Phase Shift:**	No
Clear Fault Threshold:	80 %	**Define Grounded as SLG/3P Fault >= :**	5.0 %
Check Upstream Miscoordination:	Yes		

---------- Flash Boundary Calculation Adjustment Option ----------

For voltage above 1 kV and trip time <= 0.1s, use 1.2 cal/cm^2 *(5.0 J/cm^2) for flash boundary calculation.

---------- Incident Energy Report Option for Equipment Below 240 V ----------

Report calculated incident energy from equation

---------- Generator and Synchronous Motor Decay Option ----------

---------- Induction Motor Decay Option ----------

Include induction motors for 5 cycles.

---------- Fuse Current Limiting Option ----------

Specify fuses as current limiting in the protective device library, manufacturer's equipment-specific Incident Energy equations will be used if available.

---------- Report Option ----------

Report Bus Results

(Utility) Arc Flash Evaluation Report

Bus Name	Bus kV	Protective Device Name	Bus Bolted Fault (kA)	Bus Arcing Fault (kA)	Prot Bolted Fault (kA)	Prot Arcing Fault (kA)	Trip/ Delay Time (sec.)	Breaker Opening Time	Equip Type	Gap (mm)	ArcFlash Boundary (in)	Working Distance (in)	Incident Energy (cal/cm2)	Required Protective FR Clothing Level
A-1	0.208	PD A-1	7.90	3.13	7.90	3.13	2.000	0.000	PNL	25	96.94	18.00	18.94	Level 3 - AR long sleeve shirt & pants & coverall, AR arc flash suit jacket & pants & hood, AR jacket, hard hat
A-2	0.208	PD A-2	7.90	3.13	7.90	3.13	2.000	0.000	PNL	25	96.94	18.00	18.94	Level 3 - AR long sleeve shirt & pants & coverall, AR arc flash suit jacket & pants & hood, AR jacket, hard hat
A-3	0.208	PD A-3	7.90	3.13	7.90	3.13	2.000	0.000	PNL	25	96.94	18.00	18.94	Level 3 - AR long sleeve shirt & pants & coverall, AR arc flash suit jacket & pants & hood, AR jacket, hard hat
ACC-5 (7347)	0.480	PD ACC-5	6.89	4.77	6.89	4.77	0.017	0.000	PNL	25	6.92	18.00	0.25	Level 0 - Long sleeve shirt, long pants, safety glasses, hearing protection, leather gloves
ACC-6 (7354)	0.480	PD ACC-6	6.45	4.51	6.45	4.51	0.017	0.000	PNL	25	6.67	18.00	0.23	Level 0 - Long sleeve shirt, long pants, safety glasses, hearing protection, leather gloves
AIR COND #1 (7344)	0.480	PD AIR COND #1	4.47	3.30	4.47	3.30	0.015	0.000	PNL	25	5.08	18.00	0.15	Level 0 - Long sleeve shirt, long pants, safety glasses, hearing protection, leather gloves
AIR COND #2 (7343)	0.480	PD AIR COND #2	3.49	2.67	3.49	2.67	0.016	0.000	PNL	25	4.63	18.00	0.13	Level 0 - Long sleeve shirt, long pants, safety glasses, hearing protection, leather gloves
AIR COND #3 (7342)	0.480	PD AIR COND #3	4.47	3.30	4.47	3.30	0.015	0.000	PNL	25	5.08	18.00	0.15	Level 0 - Long sleeve shirt, long pants, safety glasses, hearing protection, leather gloves
AIR COND #4 (7341)	0.480	PD AIR COND #4	2.92	2.29	2.92	2.29	0.017	0.000	PNL	25	4.34	18.00	0.12	Level 0 - Long sleeve shirt, long pants, safety glasses, hearing protection, leather gloves
AIR COND #5 (7345)	0.480	PD AIR COND #5	4.35	3.22	4.35	3.22	0.011	0.000	PNL	25	4.21	18.00	0.11	Level 0 - Long sleeve shirt, long pants, safety glasses, hearing protection, leather gloves
ATS-1 (7321)	0.480	PD DP-AA	12.11	7.72	12.11	7.72	0.060	0.000	PNL	25	20.73	18.00	1.51	Level 1 - AR long sleeve shirt , AR pants, AR face shield, AR jacket, hard hat, safety glasses, hearing
ATS-2 (7318)	0.480	PD ATS-2	11.99	7.66	11.99	7.66	0.017	0.000	PNL	25	9.55	18.00	0.42	Level 0 - Long sleeve shirt, long pants, safety glasses, hearing protection, leather gloves

Arc Flash Evaluation Report

This sections is a record of all the label information for the study.

A. Orange header and the word "WARNING" tell you that an Arc Flash / Shock hazard is present and that PPE exists to protect you from the hazard level.

B. The Flash Protection Boundary (FPB) is defined as the distance at which a worker is exposed to 1.2 calories/cm^2 of incident energy or greater.

C. Flash Hazard was calculated using 18 inches to represent a working distance.

D. FPB is the product of the calculation showing how far the flash will project out.

E. Glove Class is determined by the actual voltage present in the device.

F. Clothing Class identifies the Personal Protective Equipment that SHALL be worn according to the hazard category rating.

G. Bus ID represents a unique identifier used to reference the panel and track it as it is audited. The label is on the panel you are investigating.

H. Prot ID is the protective device panel that is on the line side of the panel you are investigating.

I. Shock Protection boundaries are based on the voltages of the energized equipment and provide approach limits based on the experience and qualification of the worker.

J. Shock Hazard with no cover is the actual voltage present for the device.

K. Limited Approach: Qualified or Unqualified Persons* – PPE Required * Only if accompanied by Qualified Person

L. Restricted Approach: Qualified Persons Only – PPE Required.

M. Date the study was completed and by who.

N. Warning that if the system changes or maintenance lapses the findings are invalid.