SKM vs ETAP vs EasyPower

An Engineer's View to Engineering Analysis Software

IEEE IAS Atlanta

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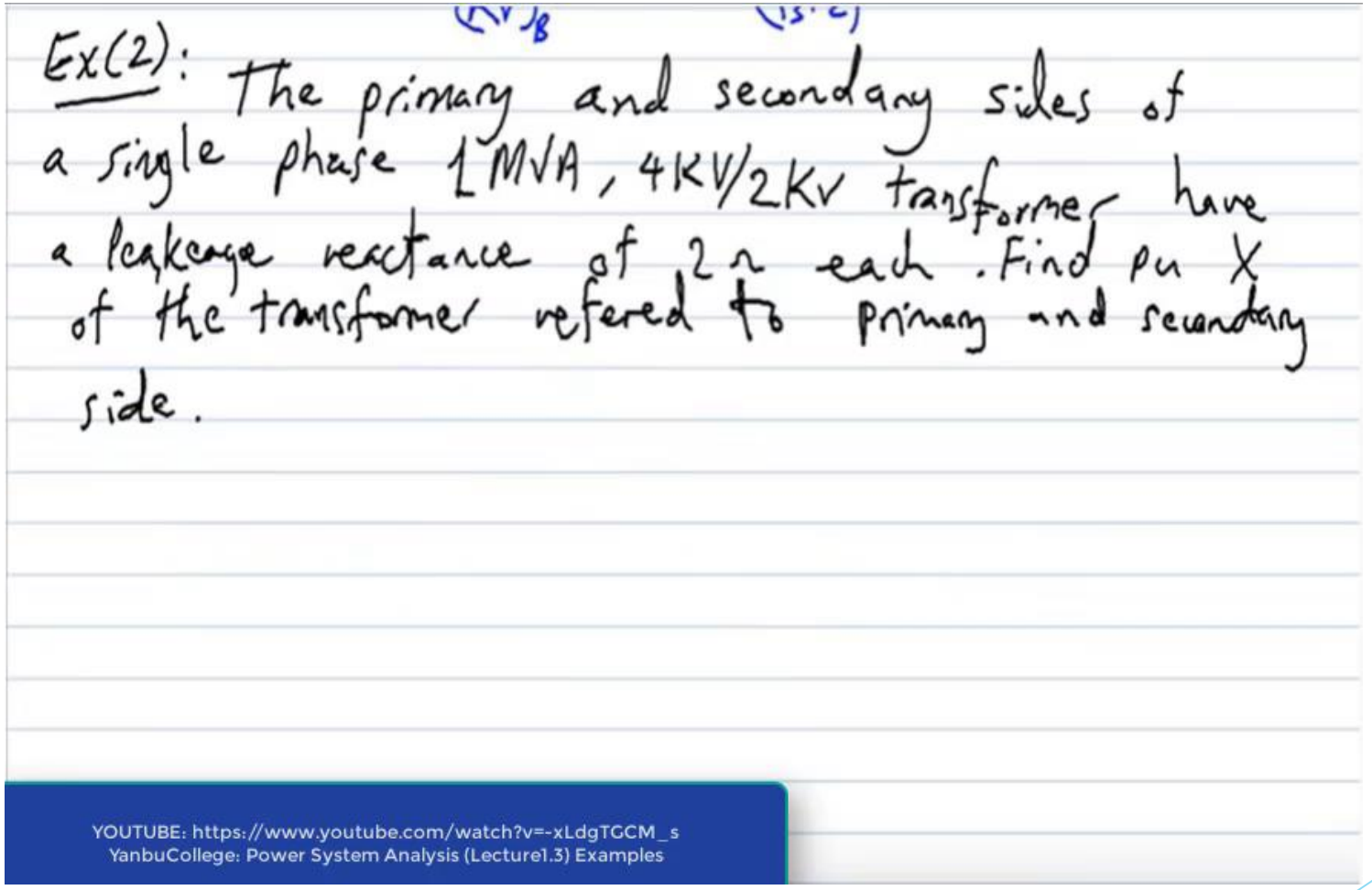
May 18, 2020

How calculations were done before software:



Agenda

- Criteria for Choosing Software
- IEEE Standards
- Software Pakages:
  - SKM
  - ETAP
  - EasyPower

Criteria for Choosing Software:

- COST
  - Product Cost?
  - Maintenance Fee?
- Training or Consulting Costs?
- Learning curve?
- Number of users?

Additional Criteria for Choosing Engineering Software:

- Component library
  - Does it include the latest protection components from all the major industry players?
- Technical Support
- Features vs Price

Features:

- Load Flow
- Short-Circuit
- Arc Flash
- Harmonics
- Motor Starting
- Duct Bank Heating
- Step & Touch Potential
- Device Protection and Coordination

IEEE Standards

- **IEEE Standard 80-2013** - IEEE Guide for Safety in AC Substation Grounding
- **IEEE Standard 141-1993** – Recommended Practice for Electric Power Distribution for Industrial Plants
- **IEEE Standard 241-1990** – Recommended Practice for Electric Power Systems in Commercial Buildings
- **IEEE Standard 242-2001** – IEEE Recommended Practice for Protection and Coordination of Industrial Power Systems
- **IEEE 551-2006** – Recommended Practice for Calculating AC Short-Circuit Currents in Industrial and Commercial Power Systems
- **IEEE 1584-2018** - IEEE Guide for Performing Arc-Flash Hazard Calculations

Equation Slide:

$$V = I(R\cos\emptyset + X\sin\emptyset)$$

Approximate Voltage Drop Formula:

Voltage System	Multiply By
Single Phase	2
Three Phase	$\sqrt{3}$

V = voltage drop, line to neutral

I = current flowing in conductor

R = line resistance for one conductor, in ohms (Ω)

X = line reactance for one conductor, in ohms (Ω)

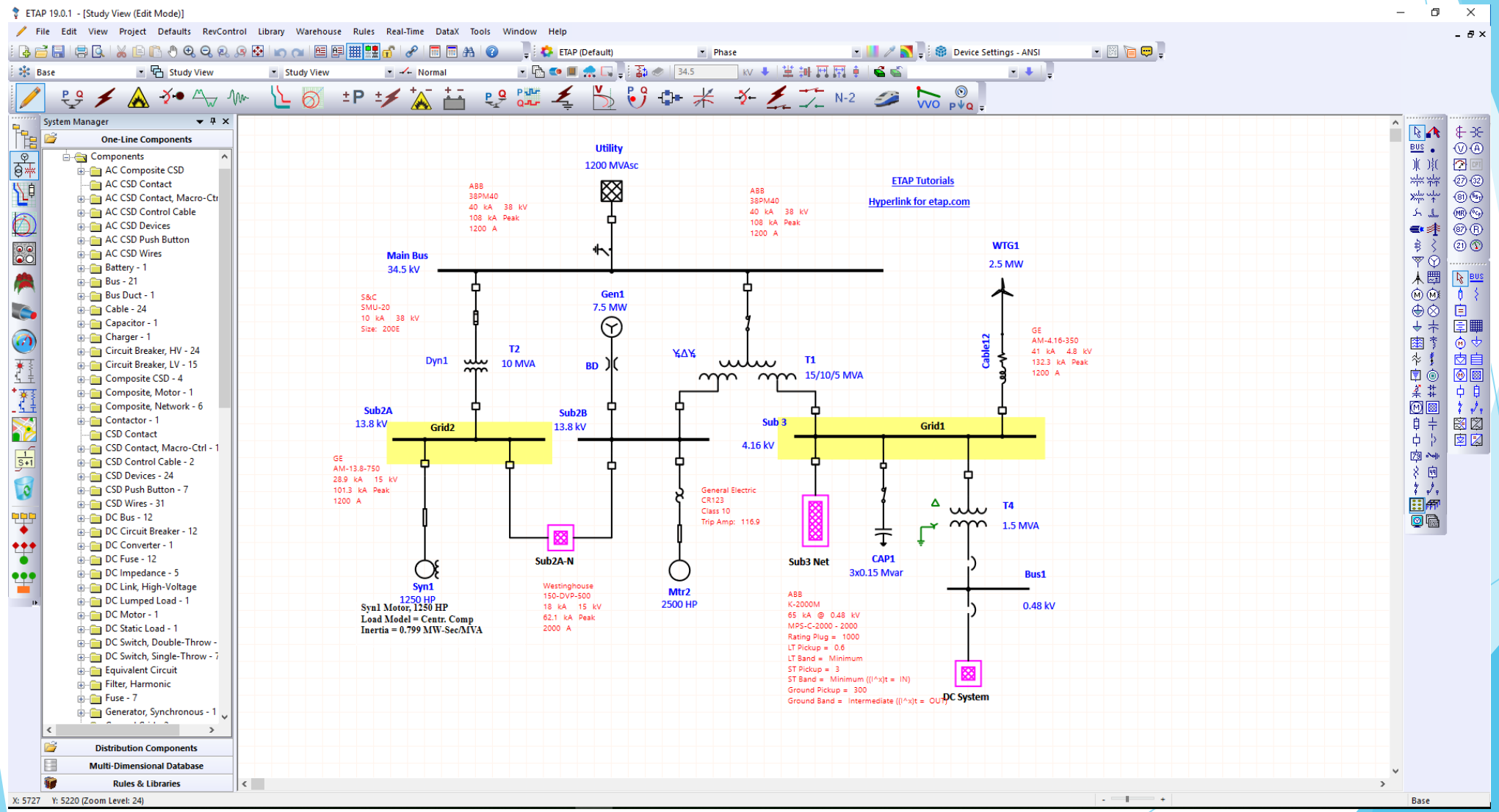
$\emptyset$ = angle whose cosine is the load power factor

$\cos\emptyset$ = load power factor, in decimals

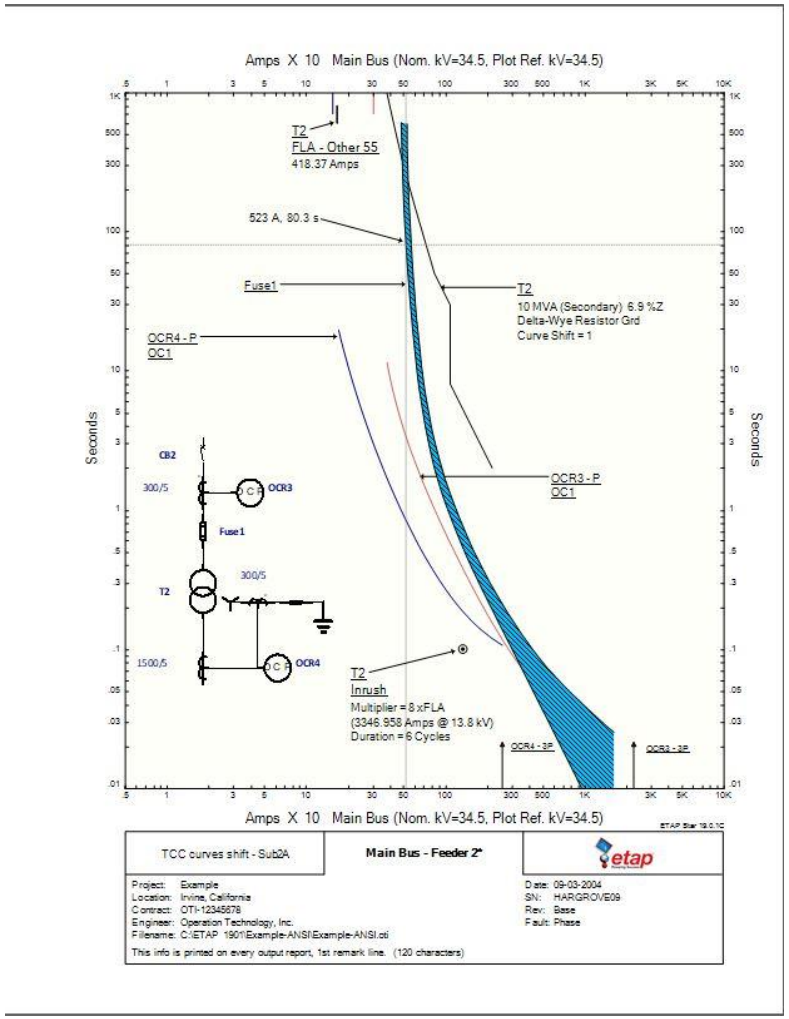
$\sin\emptyset$ = load reactive factor, in decimals

Reference: IEEE Std 141-1993 Chapter 3, p97

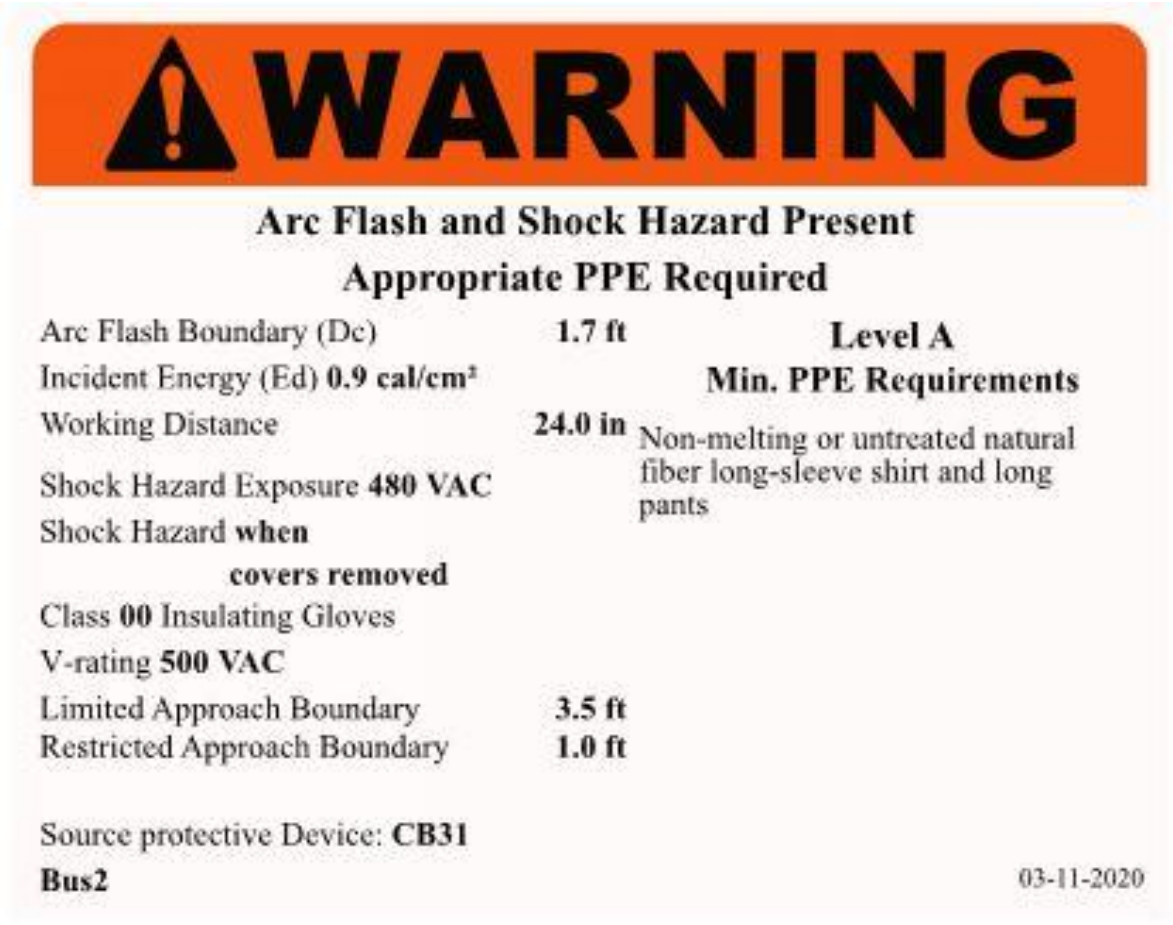
ETAP 19.0.1 – Edit Mode



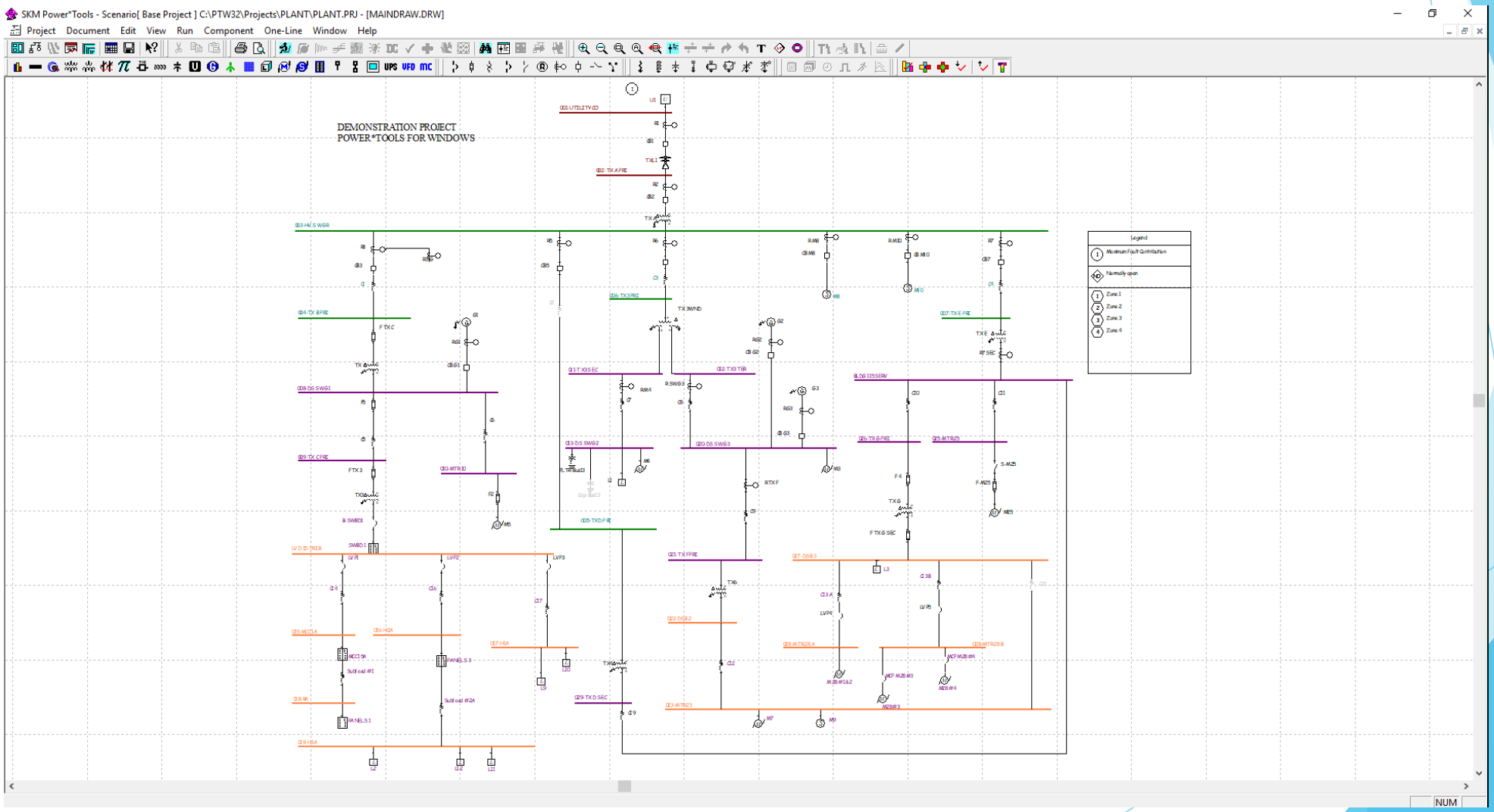
ETAP 19.0.1 – Time Current Curve (TCC)



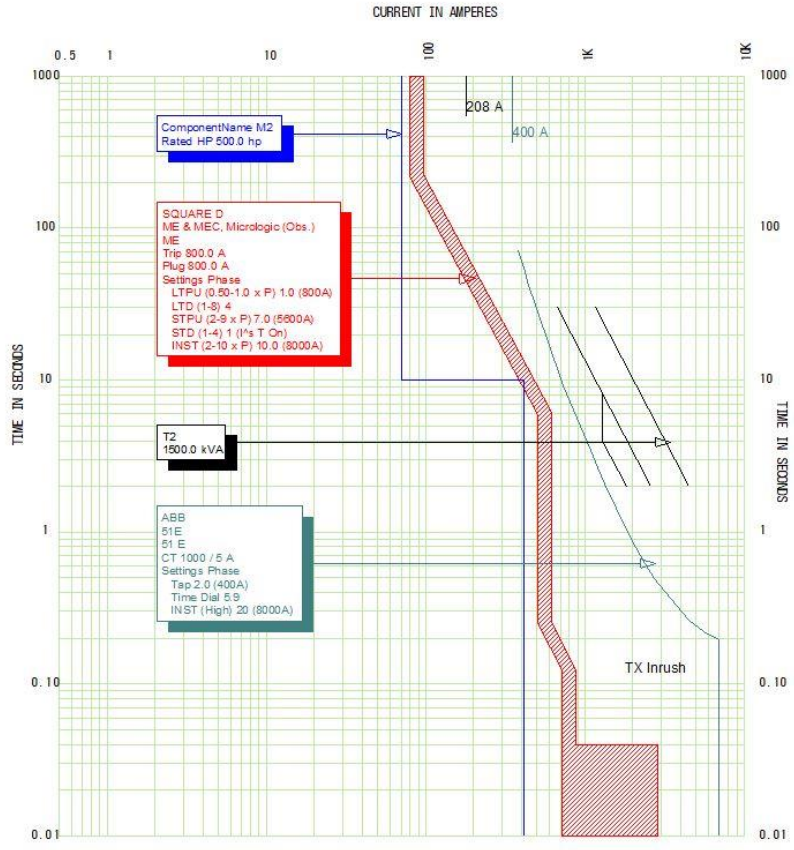
ETAP 19.0.1 – Arc Flash Label



SKM Power Tools 8.0.2.5



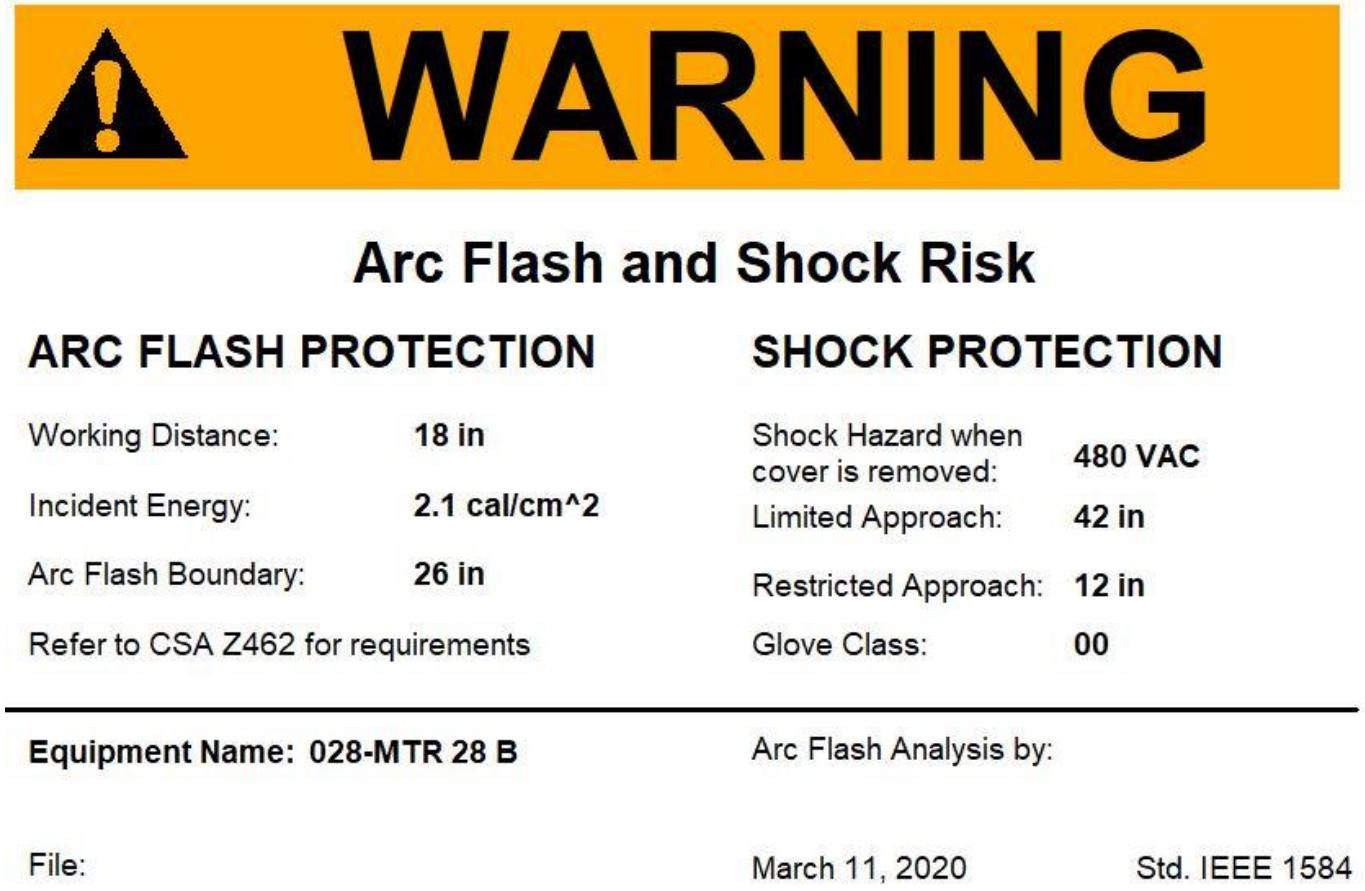
SKM Power Tools 8.0.2.5 – TCC



TCC Name: MTRAND XFMR COORDINATI Current Scale x 10
Oneline: DRAW2
March 11, 2020 10:02 PM

Reference Voltage: 480
SKM Systems Analysis, Inc.

SKM Power Tools 8.0.2.5 – Arc Flash Label



WARNING

Arc Flash and Shock Risk

ARC FLASH PROTECTION		SHOCK PROTECTION	
Working Distance:	**18 in**	Shock Hazard when cover is removed:	**480 VAC**
Incident Energy:	**2.1 cal/cm^2**	Limited Approach:	**42 in**
Arc Flash Boundary:	**26 in**	Restricted Approach:	**12 in**
Refer to CSA Z462 for requirements		Glove Class:	**00**

Equipment Name: 028-MTR 28 B

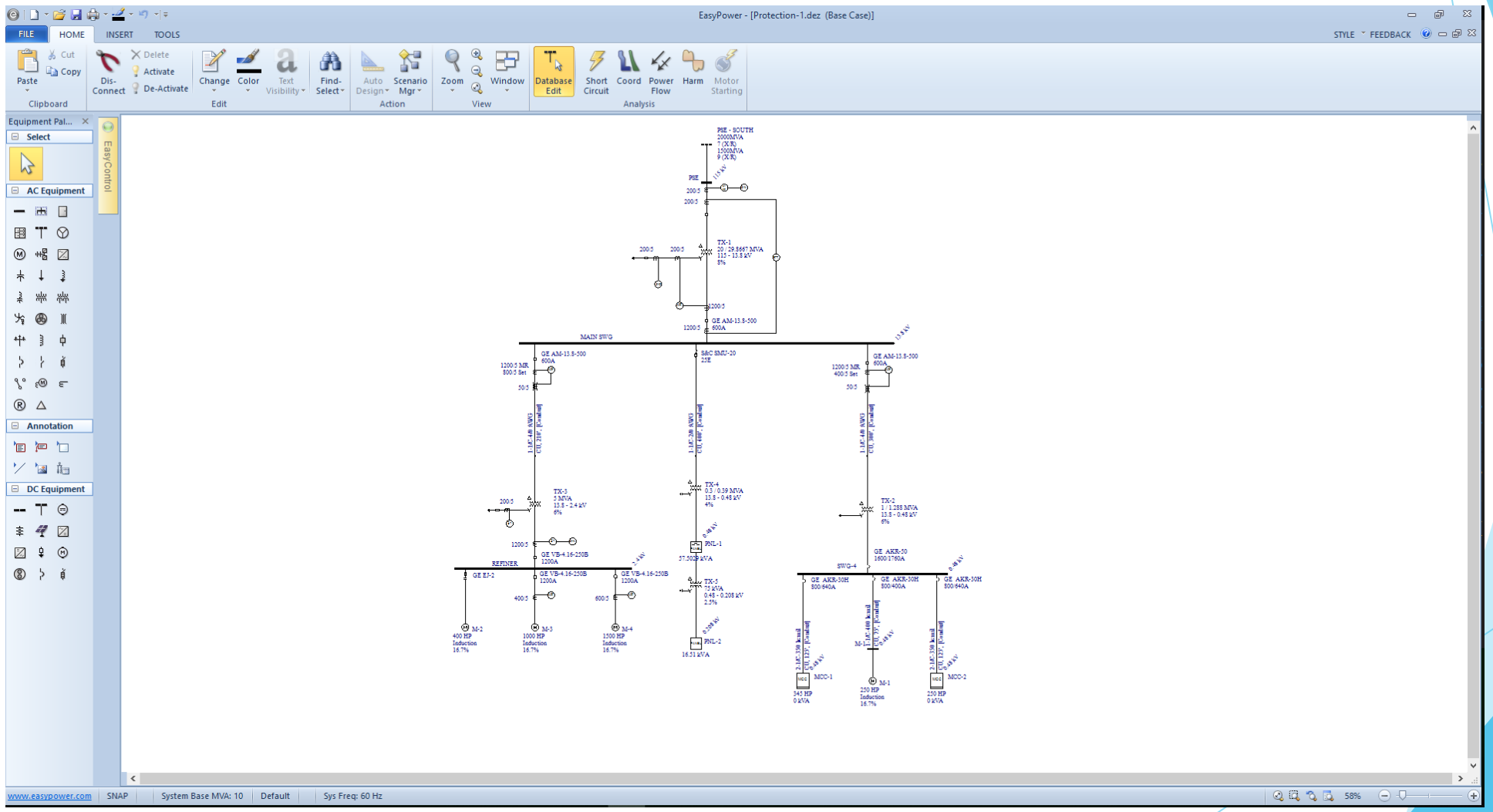
Arc Flash Analysis by:

File:

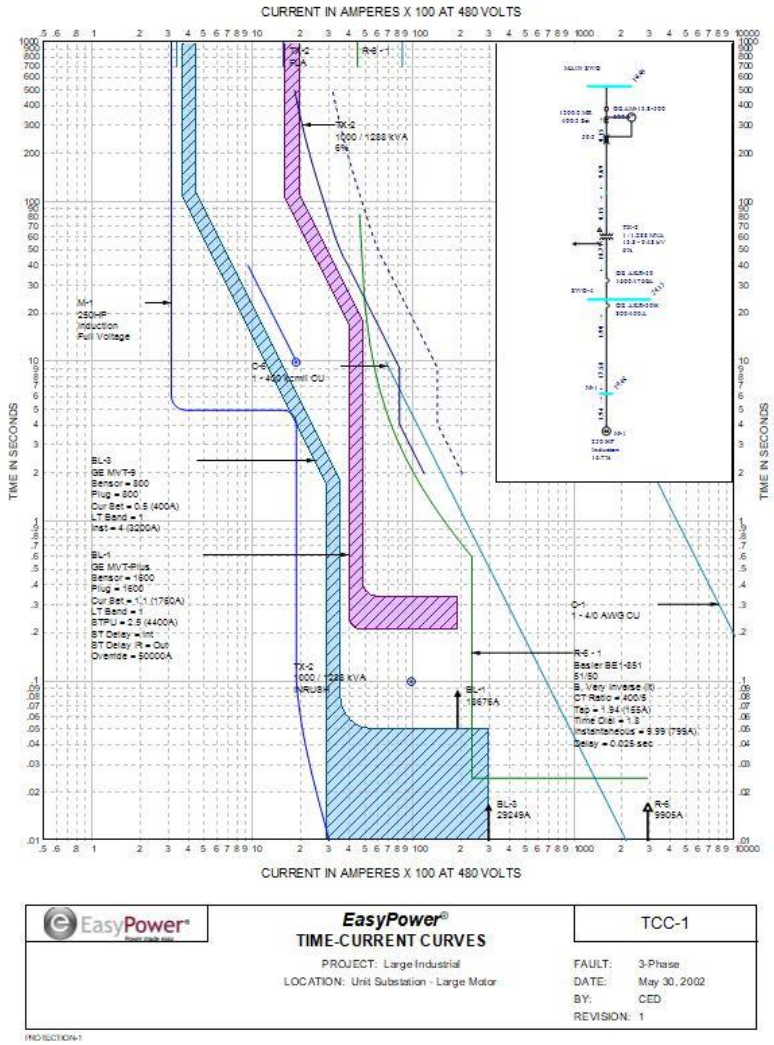
March 11, 2020

Std. IEEE 1584

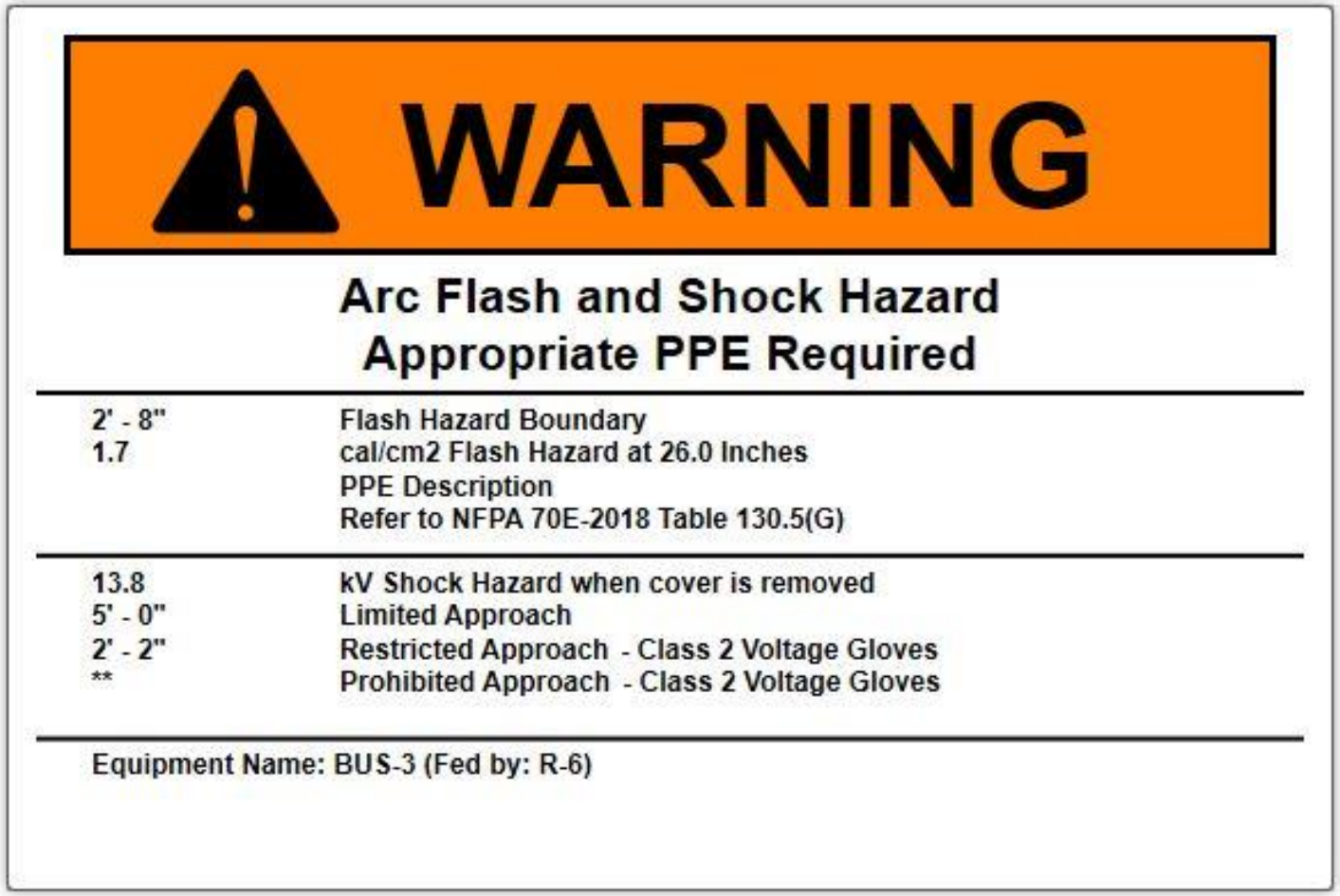
EasyPower 10.2 – Database Edit



EasyPower 10.2 – TCC



EasyPower 10.2 – Arc Flash Label



Reports – Typical File Formats

- SKM
  - Filetype: *.rpt
- ETAP
  - Filetype: *dosx, *.xlsx, *.pdf
- Easypower
  - Filetype: *.xlsx, *.csv

Sample Reports – SKM, ETAP, EASYPOWER

SKM

SC_AFLT - Notepad

File Edit Format View Help

```
DEMONSTRATION STUDY FOR POWER*TOOLS FOR WINDOWS


Apr 05, 2007     13:19:40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INTERPRETATION AND APPLICATION BY A REGISTERED ENGINEER ONLY
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--------------------------------------------------------------------------------
SKM POWER*TOOLS FOR WINDOWS
A_FAULT SHORT CIRCUIT ANALYSIS REPORT
COPYRIGHT SKM SYSTEMS ANALYSIS, INC. 1996-2007
--------------------------------------------------------------------------------

Apr 05, 2007     13:19:40              THREE PHASE LOW VOLTAGE DUTY PAGE    1
DEMONSTRATION STUDY FOR POWER*TOOLS FOR WINDOWS


              T H R E E   P H A S E   F A U L T   R E P O R T
                 (FOR APPLICATION OF LOW VOLTAGE BREAKERS)
                       PRE FAULT VOLTAGE: 1.0000
                       MODEL TRANSFORMER TAPS: NO
================================================================================

 015-MCC 1A      FAULT:    8.853 KA AT  -76.78 DEG (   7.36 MVA)  X/R:     4.89
                 VOLTAGE:    480.   EQUIV. IMPEDANCE=  0.0072 + J  0.0305  OHMS
                 LOW VOLTAGE POWER CIRCUIT BREAKER    8.853 KA
                 MOLDED CASE CIRCUIT BREAKER < 20KA   9.842 KA
                 MOLDED CASE CIRCUIT BREAKER > 20KA   8.853 KA
                 CONTRIBUTIONS:  M6-A              0.168 KA      ANG:   -86.19
                                 M6-B              0.219 KA      ANG:   -73.09
                                 M6-C              0.168 KA      ANG:   -86.19
                                 M6-D              0.168 KA      ANG:   -86.19
                 C14             LV DISTRIB        8.137 KA      ANG:   -76.30

 016-H2A         FAULT:    7.197 KA AT  -61.69 DEG (   5.98 MVA)  X/R:     1.92
                 VOLTAGE:    480.   EQUIV. IMPEDANCE=  0.0183 + J  0.0339  OHMS
                 LOW VOLTAGE POWER CIRCUIT BREAKER    7.197 KA
                 MOLDED CASE CIRCUIT BREAKER < 10KA   7.392 KA
                 MOLDED CASE CIRCUIT BREAKER < 20KA   7.197 KA
                 MOLDED CASE CIRCUIT BREAKER > 20KA   7.197 KA
                 C16             LV DISTRIB        7.197 KA      ANG:   -61.69

 017-H1A         FAULT:    4.601 KA AT  -40.26 DEG (   3.83 MVA)  X/R:     0.86
                 VOLTAGE:    480.   EQUIV. IMPEDANCE=  0.0460 + J  0.0389  OHMS
                 LOW VOLTAGE POWER CIRCUIT BREAKER    4.601 KA
                 MOLDED CASE CIRCUIT BREAKER < 10KA   4.601 KA
                 MOLDED CASE CIRCUIT BREAKER < 20KA   4.601 KA
                 MOLDED CASE CIRCUIT BREAKER > 20KA   4.601 KA
```

ETAP

Project:	Example	ETAP		Page:	1
Location:	Irvine, California	19.0.1C		Date:	05-17-2020
Contract:				SN:	
Engineer:		Study Case: ANSI Duty		Revision:	Base
Filename:	Example-ANSI			Config.:	Normal

This info is printed on every output report, 1st remark line. (120 characters)
Second line of remarks for "ANSI Duty" study case.

Electrical Transient Analyzer Program

Short-Circuit Analysis

ANSI Standard

3-Phase Fault Currents

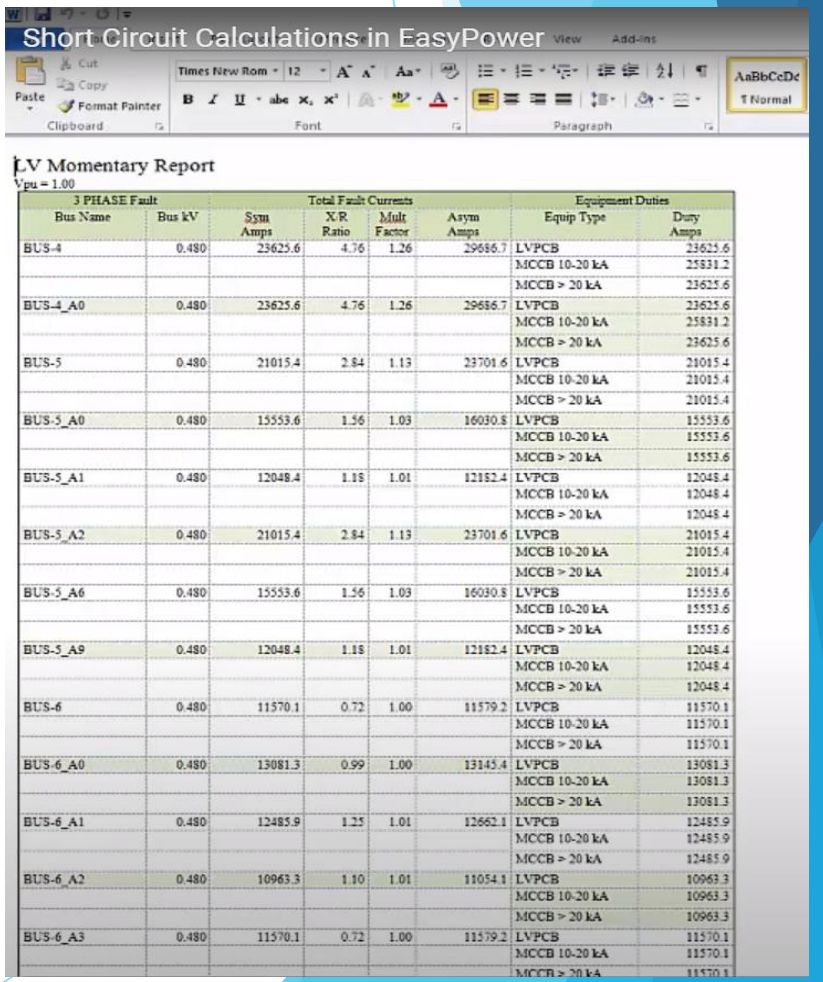
	Swing	V-Control	Load	Total
Number of Buses:	3	1	16	20

	XFMR2	XFMR3	Reactor	Line/Cable/ Busway	Impedance	Tie PD	Total
Number of Branches:	7	1	0	6	0	0	14

	Synchronous Generator	Power Grid	Synchronous Motor	Induction Machines	Lumped Load	Total
Number of Machines:	1	1	1	9	5	17

System Frequency:	60.00
Unit System:	English
Project Filename:	Example-ANSI
Output Filename:	C:\ETAP 1901\Example-ANSI\ANSI-Duty.SA1S

EASYPOWER



LV Momentary Report

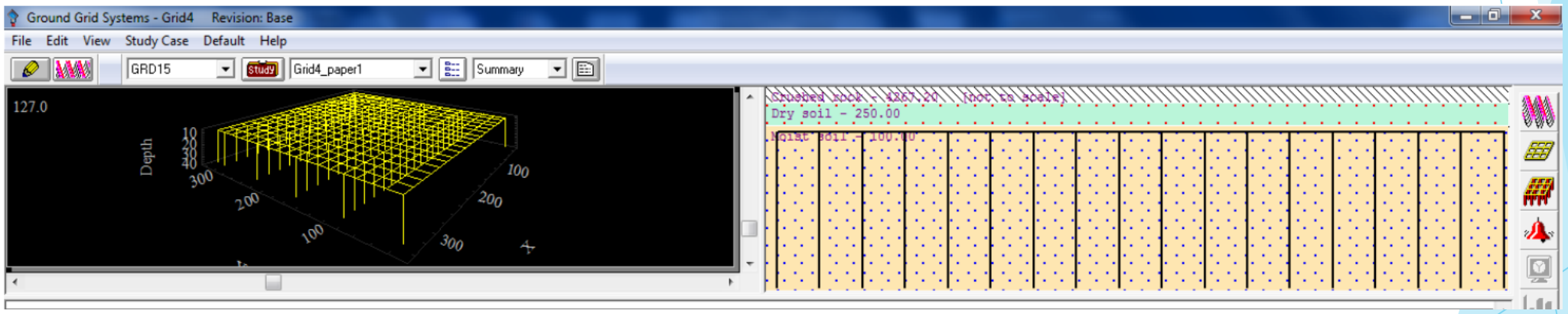
Vpu = 1.00

3 PHASE Fault		Total Fault Currents				Equipment Duties	
Bus Name	Bus kV	Sym Amps	X/R Ratio	Mult Factor	Asym Amps	Equip Type	Duty Amps
BUS-4	0.480	23625.6	4.76	1.26	29686.7	LVPCB	23625.6
						MCCB 10-20 kA	25831.2
						MCCB > 20 kA	23625.6
BUS-4_A0	0.480	23625.6	4.76	1.26	29686.7	LVPCB	23625.6
						MCCB 10-20 kA	25831.2
						MCCB > 20 kA	23625.6
BUS-5	0.480	21015.4	2.84	1.13	23701.6	LVPCB	21015.4
						MCCB 10-20 kA	21015.4
						MCCB > 20 kA	21015.4
BUS-5_A0	0.480	15553.6	1.56	1.03	16030.8	LVPCB	15553.6
						MCCB 10-20 kA	15553.6
						MCCB > 20 kA	15553.6
BUS-5_A1	0.480	12048.4	1.18	1.01	12182.4	LVPCB	12048.4
						MCCB 10-20 kA	12048.4
						MCCB > 20 kA	12048.4
BUS-5_A2	0.480	21015.4	2.84	1.13	23701.6	LVPCB	21015.4
						MCCB 10-20 kA	21015.4
						MCCB > 20 kA	21015.4
BUS-5_A6	0.480	15553.6	1.56	1.03	16030.8	LVPCB	15553.6
						MCCB 10-20 kA	15553.6
						MCCB > 20 kA	15553.6
BUS-5_A9	0.480	12048.4	1.18	1.01	12182.4	LVPCB	12048.4
						MCCB 10-20 kA	12048.4
						MCCB > 20 kA	12048.4
BUS-6	0.480	11570.1	0.72	1.00	11579.2	LVPCB	11570.1
						MCCB 10-20 kA	11570.1
						MCCB > 20 kA	11570.1
BUS-6_A0	0.480	13081.3	0.99	1.00	13145.4	LVPCB	13081.3
						MCCB 10-20 kA	13081.3
						MCCB > 20 kA	13081.3
BUS-6_A1	0.480	12485.9	1.25	1.01	12662.1	LVPCB	12485.9
						MCCB 10-20 kA	12485.9
						MCCB > 20 kA	12485.9
BUS-6_A2	0.480	10963.3	1.10	1.01	11054.1	LVPCB	10963.3
						MCCB 10-20 kA	10963.3
						MCCB > 20 kA	10963.3
BUS-6_A3	0.480	11570.1	0.72	1.00	11579.2	LVPCB	11570.1
						MCCB 10-20 kA	11570.1
						MCCB > 20 kA	11570.1

Screenshot: https://youtu.be/QHlvLBOh2ys

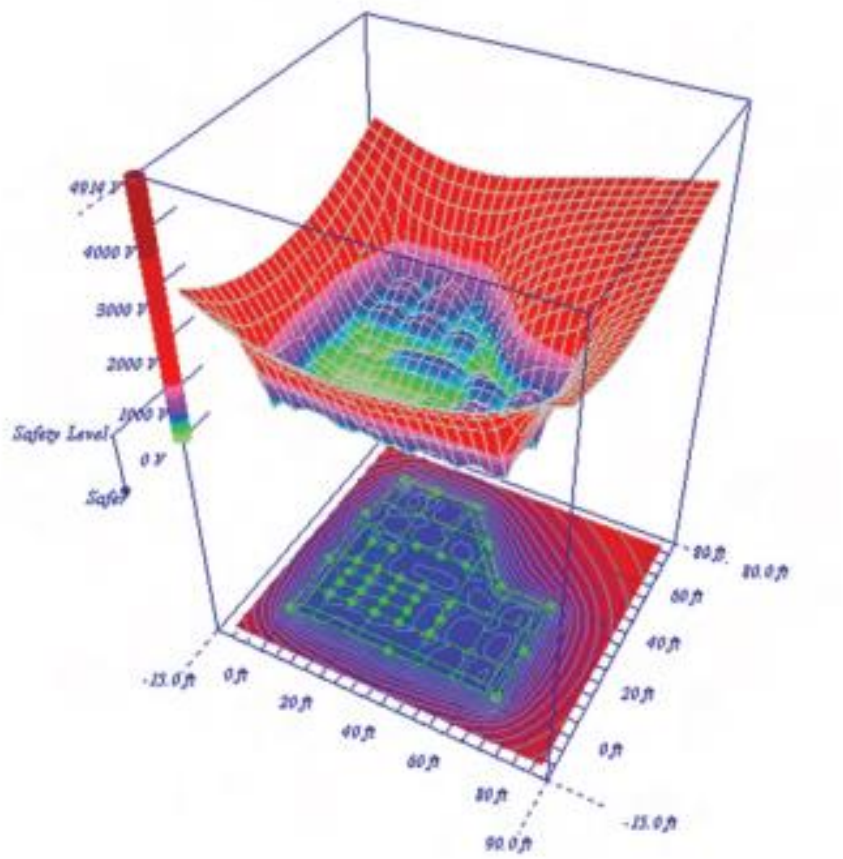
Other Modules Built-in ETAP:

- ETAP:
  - Duct bank heating calculation
  - Cable Ampacity Calculation
  - Ground Grid / Step & Touch Potential

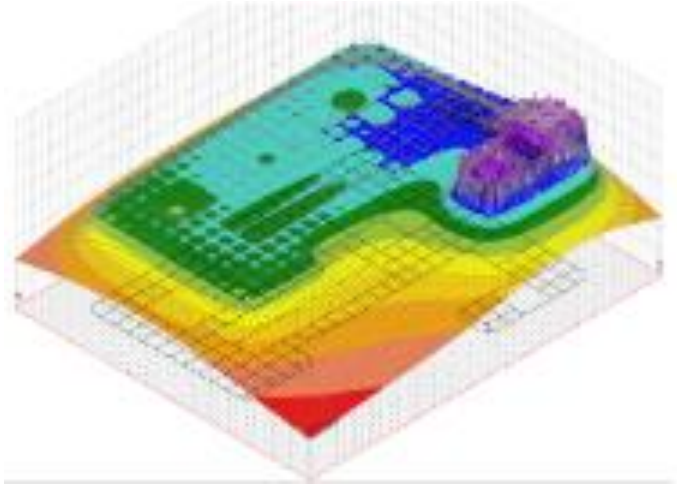


SKM Power*Tools:

- PTW GroundMAT
  - IEEE Std 80
  - Sunde Method
  - Gradient Method



EasyPower:



- Partner firm SINT Ingegneria
  - Software: XGSLab
  - Includes several modules:
    - GSA (GROUNDING SYSTEM ANALYSIS)
    - GSA_FD (GROUNDING SYSTEM ANALYSIS in the FREQUENCY DOMAIN)
    - XGSA_FD (OVER AND UNDERGROUND SYSTEM ANALYSIS in the FREQUENCY DOMAIN
    - XGSA_TD (OVER AND UNDERGROUND SYSTEM ANALYSIS in the TIME DOMAIN)
    - NETS (NETWORK SOLVER)

Software Experiences: SKM, ETAP & EasyPower

- USER Interface
- Developing the electrical model
  - Adding equipment:
    - Buses, Motors, Fuses, VFDs
    - Relays and current transformers
- Performing Studies:
  - Load Flow Analysis, Short-Circuit Analysis, Protection and Coordination Analysis

Q & A