



ETAP Arc Flash Analysis

The ETAP V&V process for the Arc Flash program has over 900 test case scenarios that are run before each ETAP release. The following cases are excerpts from the Arc Flash V&V documentation.

Arc Flash Comparison Case # 1

Comparison of ETAP Arc Flash Results against hand calculated results based on IEEE Standards

Excerpts from Validation Cases and Comparison Results (TCS-SC-120)

Highlights:

- Comparison of ETAP Arc-Flash analysis results against hand calculated results based on the equations listed in IEEE standard 1584 2002.
- The calculations include both open air and enclosed equipment
- The calculation results are within the specified range of validity of the IEEE 1584 Equations.
- The hand calculated results were developed based on a program developed in Matlab version 6.5.0 Release 13.0.1
- ETAP results and the Matlab hand calculated results have a percent difference less than 0.001% in all cases.

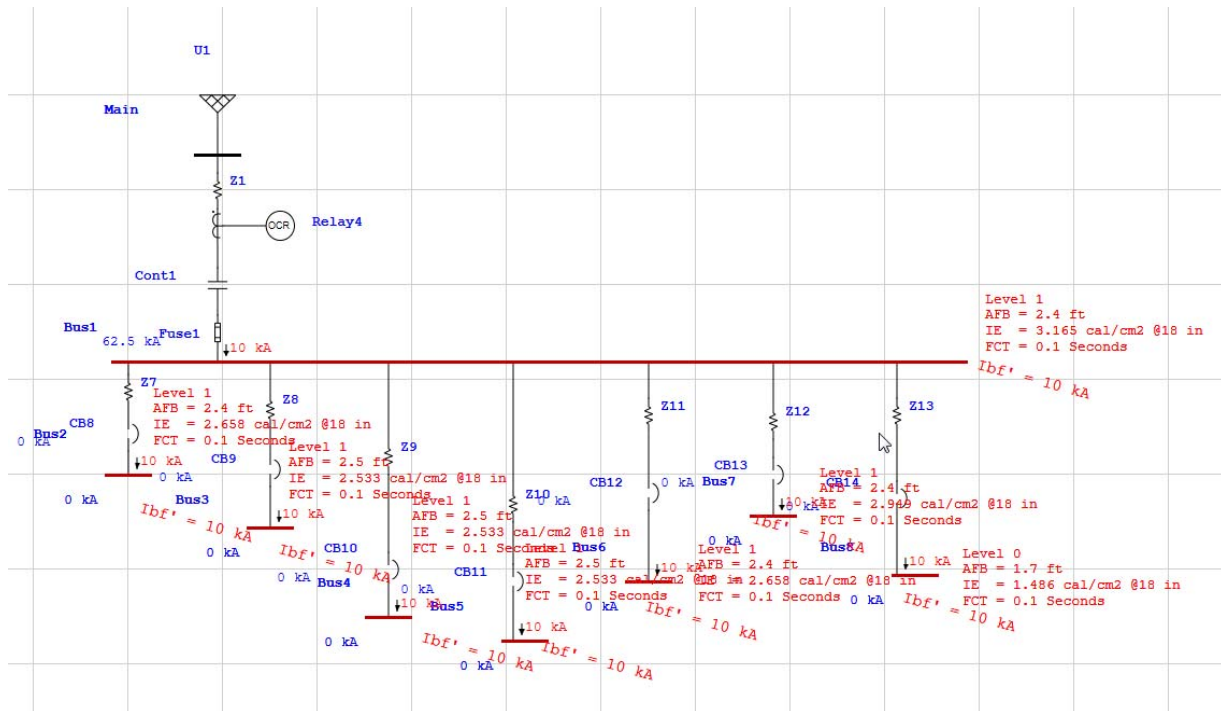
System Description:

The Arc-Flash calculation in ETAP for different bus voltages and input parameters was entered into different Buses in the program. Each bus had a different type of equipment as described in the IEEE standard. The following types of equipment were described for each bus at different voltage levels.

- MCC
- Switchgear
- Switchboard
- Switchrack
- Panelboard
- Cable Bus
- Open Air

Typical Gaps and X-factors were used for the calculation.

The Incident energy and the Flash Protection Boundary were calculated based on a Fault Clearing Time (arc fault clearing time) of 0.1 seconds.





Bus ID	Type	Hand Calculated (Matlab)				ETAP results (Editors)				%Diff (Hand Calcs vs. ETAP)			
		Ia (kA)	E (Cal/cm^2)	FPB (ft)	Level	Ia (kA)	E (Cal/cm^2)	FPB (ft)	Level	Ia %	E	FPB	Level
Bus2	MCC	6.2952	2.6575	2.4412	1	6.29518	2.65848	2.43507	1	0.0	0.0	0.3	0.0
Bus3	Switchgear	6.2952	2.5319	2.4972	1	6.29518	2.53268	2.49017	1	0.0	0.0	0.3	0.0
Bus4	Switchboard	6.2952	2.5319	2.4972	1	6.29518	2.53268	2.49017	1	0.0	0.0	0.3	0.0
Bus5	Switchrack	6.2952	2.5319	2.4972	1	6.29518	2.53268	2.49017	1	0.0	0.0	0.3	0.0
Bus6	Panelboard	6.2952	2.6575	2.4412	1	6.29518	2.65848	2.43507	1	0.0	0.0	0.3	0.0
Bus7	Cable Bus	6.2952	2.9474	2.3557	1	6.29518	2.94864	2.35082	1	0.0	0.0	0.2	0.0
Bus8	Open Air	5.5336	1.4856	1.6724	0	5.53361	1.48623	1.66898	0	0.0	0.0	0.2	0.0
Bus10	MCC	14.4556	2.713	4.6449	1	14.45560	2.71354	4.62515	1	0.0	0.0	0.4	0.0
Bus11	Switchgear	14.4556	2.713	4.6449	1	14.45560	2.71354	4.62515	1	0.0	0.0	0.4	0.0
Bus12	Switchboard	14.4556	2.713	4.6449	1	14.45560	2.71354	4.62515	1	0.0	0.0	0.4	0.0
Bus13	Switchrack	14.4556	2.713	4.6449	1	14.45560	2.71354	4.62515	1	0.0	0.0	0.4	0.0
Bus14	Panelboard	14.4556	2.713	4.6449	1	14.45560	2.71354	4.62515	1	0.0	0.0	0.4	0.0
Bus15	Cable Bus	14.4556	2.7148	3.0145	1	14.45560	2.71596	3.00822	1	0.0	0.0	0.2	0.0
Bus16	Open Air	14.4556	1.573	2.2946	0	14.45560	1.57371	2.28986	0	0.0	0.0	0.2	0.0
Bus19	Cable Bus	23.8881	2.1736	4.0459	1	23.88808	2.17448	4.03754	1	0.0	0.0	0.2	0.0
Bus20	Open Air	23.8881	1.1923	3.0798	0	23.88808	1.19277	3.07338	0	0.0	0.0	0.2	0.0
Bus21	MCC	23.8881	2.9731	8.5052	1	23.88808	2.97367	8.46903	1	0.0	0.0	0.4	0.0
Bus22	Switchgear	23.8881	2.4898	8.5052	1	23.88808	2.49028	8.46903	1	0.0	0.0	0.4	0.0
Bus23	Switchboard	23.8881	3.294	8.5052	1	23.88808	3.29469	8.46903	1	0.0	0.0	0.4	0.0
Bus24	Switchrack	23.8881	4.2065	8.5052	2	23.88808	4.20738	8.46903	2	0.0	0.0	0.4	0.0
Bus25	Panelboard	23.8881	3.294	8.5052	1	23.88808	3.29469	8.46903	1	0.0	0.0	0.4	0.0
Bus26	Other	23.8881	2.1736	4.0459	1	23.88808	2.17448	4.03754	1	0.0	0.0	0.2	0.0
Bus37	Cable Bus	71.737	81.5412	33.0399	4	71.73701	81.56799	33.03988	4	0.0	0.0	0.0	0.0
Bus38	Open Air	71.737	36.2405	33.0399	4	71.73701	36.25244	33.03988	4	0.0	0.0	0.0	0.0
Bus39	MCC	71.737	18.7871	33.0399	3	71.73701	18.79327	33.03988	3	0.0	0.0	0.0	0.0
Bus40	Switchgear	71.737	13.0466	33.0399	3	71.73701	13.05088	33.03988	3	0.0	0.0	0.0	0.0
Bus41	Switchboard	71.737	81.5412	33.0399	4	71.73701	81.56799	33.03988	4	0.0	0.0	0.0	0.0
Bus42	Switchrack	71.737	23.7181	33.0399	3	71.73701	23.72587	33.03988	3	0.0	0.0	0.0	0.0
Bus43	Panelboard	71.737	92.7758	33.0399	4	71.73701	92.80625	33.03988	4	0.0	0.0	0.0	0.0
Bus44	Other	71.737	8.3498	33.0399	3	71.73701	8.35256	33.03988	3	0.0	0.0	0.0	0.0

Reference:

1. IEEE standard 1584 2002 Pages 4-13
2. ETAP Short Circuit ANSI V&V Documents, Case Number TCS-SC-120