Arc-Flash Analysis Validation Case # 1

This document provides an ETAP validation case. This is just one of many test case scenarios for Arc-Flash Analysis (AF) which are part of ETAP V&V program. This case is a validation case based on comparisons against published IEEE Standards on AF analysis.

Comparison of ETAP Arc-Flash Results Against IEEE Std. 1584-2018™ Published Results

Excerpt from Validation Cases and Comparison Results (TCS-SC-512)

Highlights

- Comparison between ETAP Arc-Flash Analysis results and sample calculations published in 1584-2018™ Annex D page. 57-74 [1].
- Comparisons include:
  - Medium and low voltage enclosed equipment.
  - Result comparisons with and without arcing current variation.

System Description

The ETAP model generated for [2] and the input data used is shown in Figure 1 below. The model and input data applied is based on the sample AF calculations provided in Annex D of the 1584-2018 for a 4.16kV and 0.48kV bus respectively. The equipment is modeled using a VCB electrode configuration. Figures 2 to 5 show the time current curves published in [1] for reference and Figure 6 to 7 show the ETAP results for each case covered in [2].

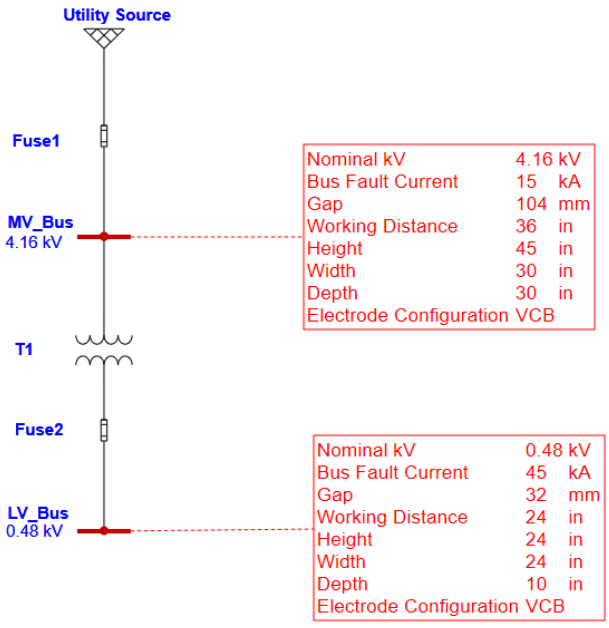

Fig 1: ETAP One-Line Diagram

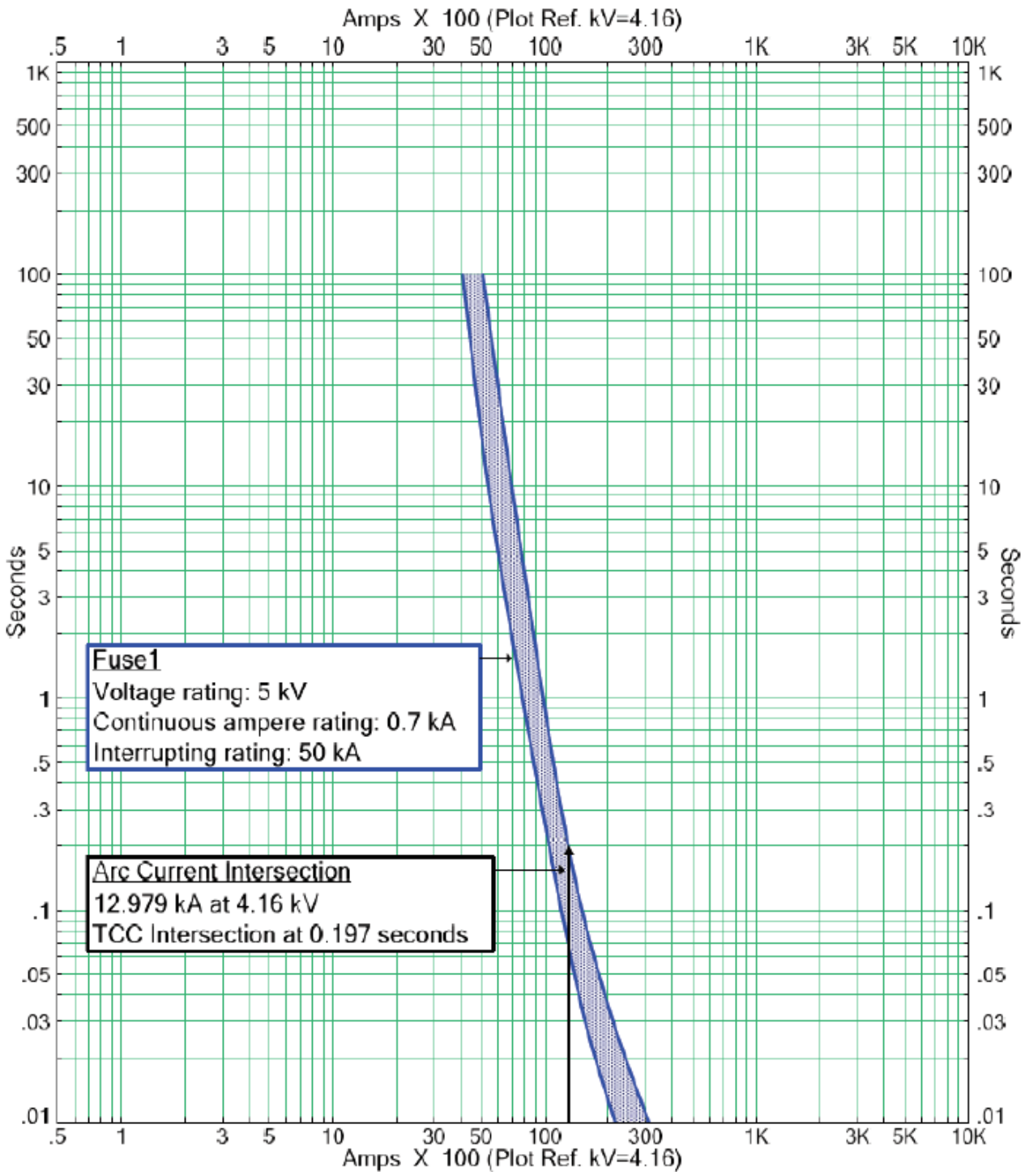

Fig 2: TCC Curve from [1] for MV Case without Arc Current Variation

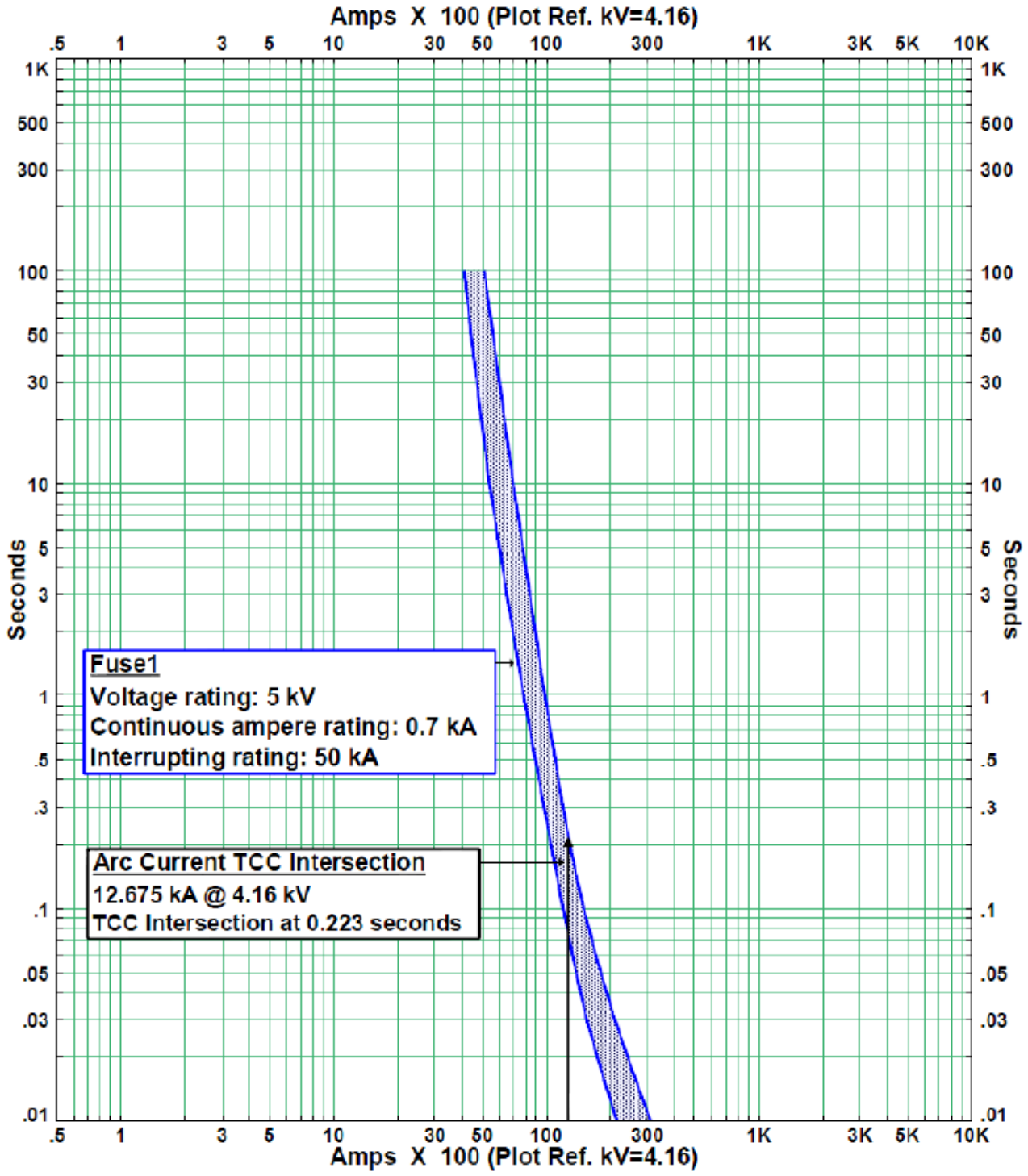

Fig 3: TCC Curve from [1] for MV Case with Arc Current Variation

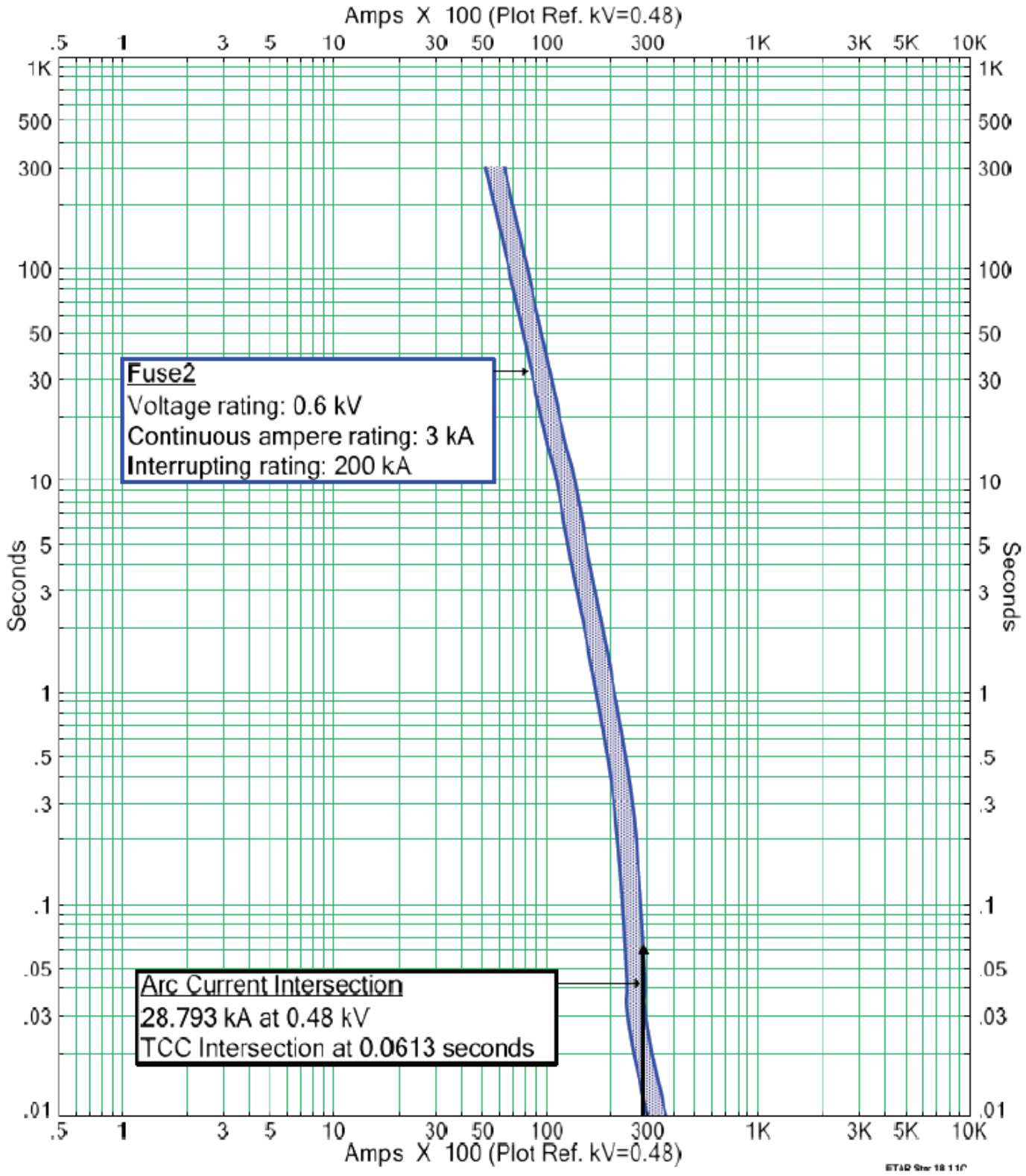

Fig 4: TCC Curve from [1] for LV Case without Arc Current Variation

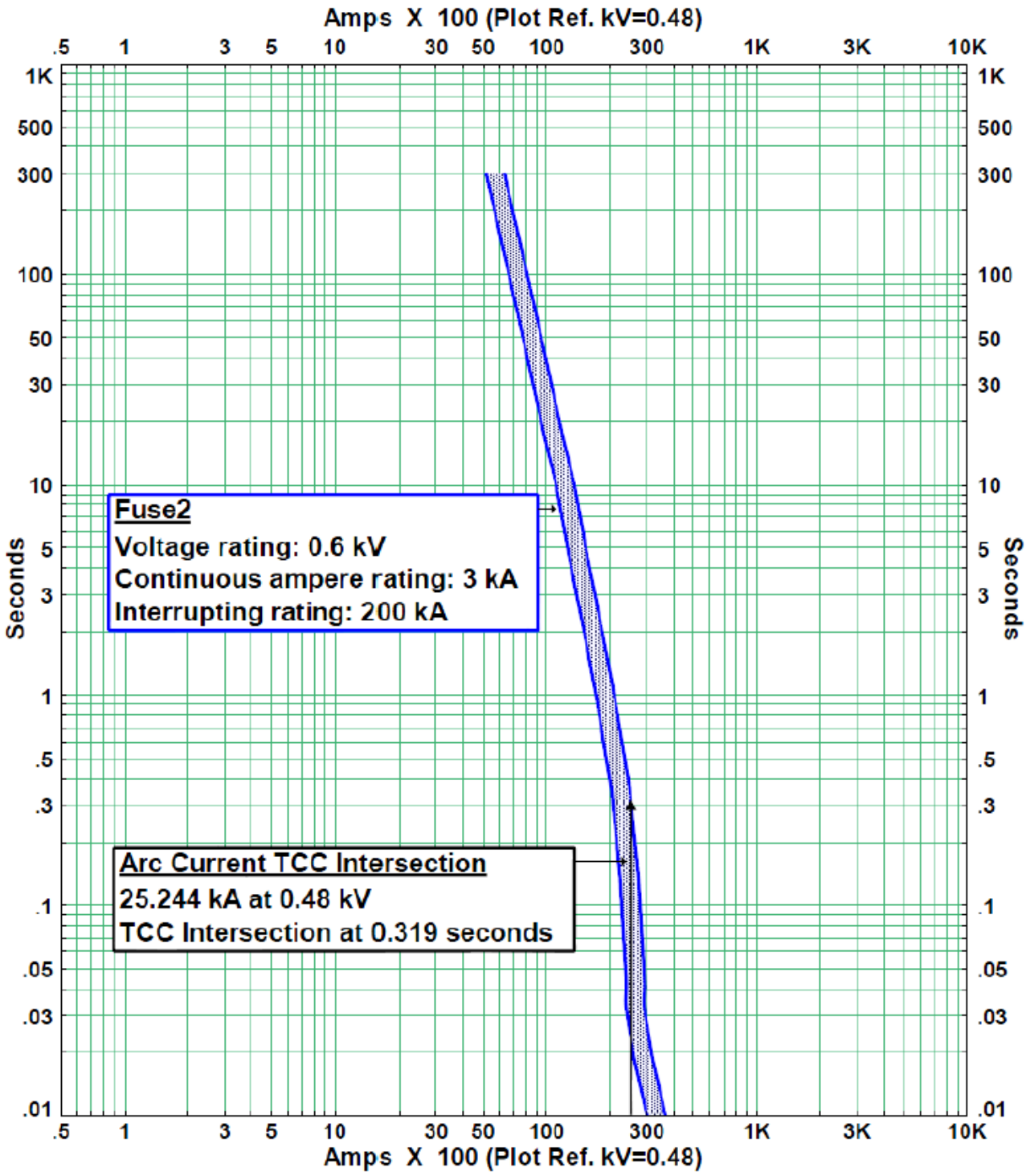

Figure D.4—Determination of arc duration using reduced arcing current

Fig 4: TCC Curve from [1] for LV Case with Arc Current Variation

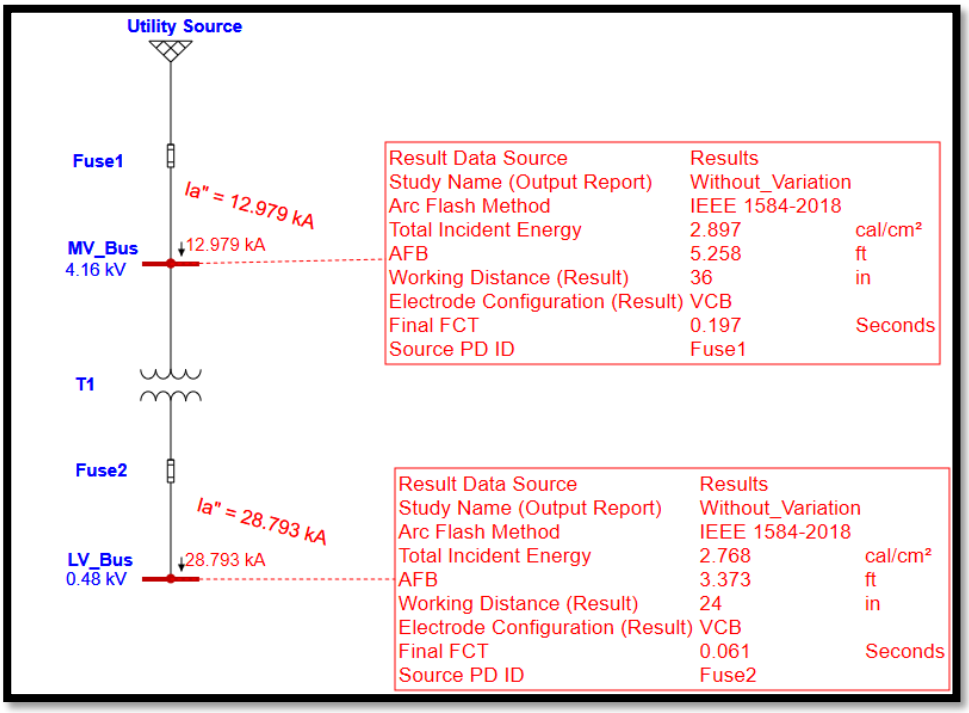

Fig 5: ETAP AF results without arcing current variation.

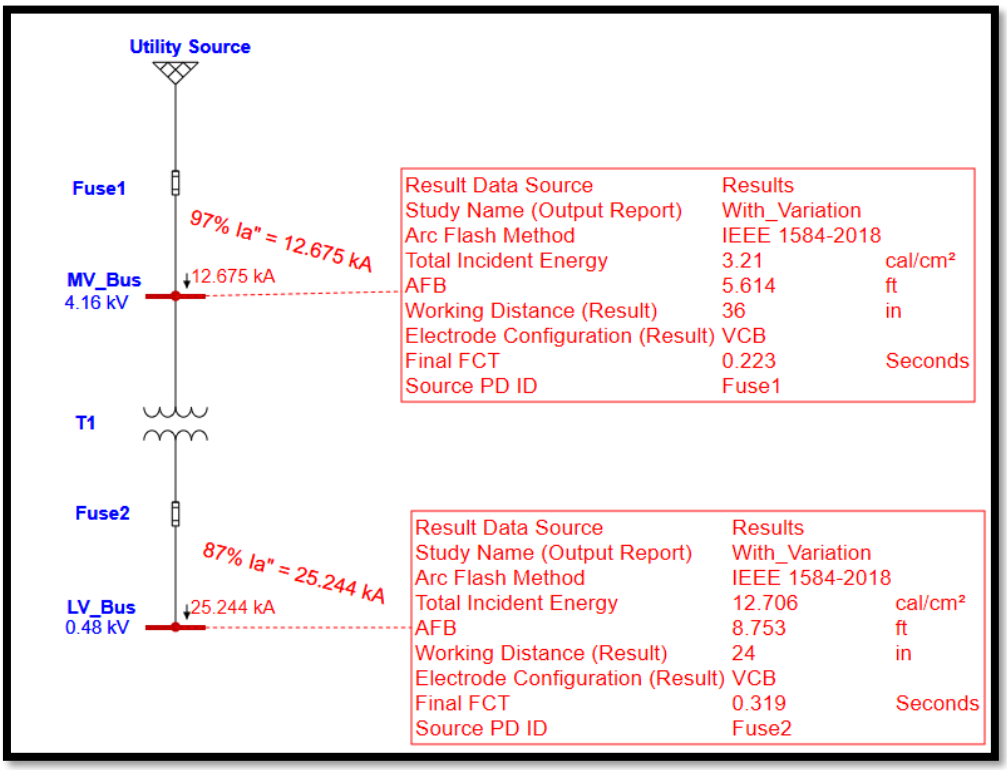

Fig 6: ETAP AF results with arcing current variation enabled.

Comparison of Results

Table 1 and Table 2 below list comparisons of the published IEEE results (referred to as "BM") against ETAP with and without arcing current variation. The maximum percent difference observed in the comparison tables below is 0.411%. This is acceptable as the sample results published in Annex D of [1] are rounded off introducing small differences in the result comparisons.

Table 1: Comparison of Arc Flash Results for Scenario1 using 100% Iarc

Bus ID	Arcing Current-BM	Arcing Current-ETAP	Arcing Current-%Diff	Fault Clearing Time-BM	Fault Clearing Time-ETAP	Fault Clearing Time-%Diff	Incident Energy-BM	Incident Energy-Etap	Incident Energy-%Diff	Arc Flash Boundary-BM	Arc Flash Boundary-ETAP	Arc Flash Boundary-%Diff
	kA	kA	%	Sec	Sec	%	cal/cm²	cal/cm²	%	ft	ft	%
MV_Bus	12.979	12.979	0.000	0.197	0.197	0.000	2.904	2.897	0.241	5.269	5.258	0.209
LV_Bus	28.793	28.793	0.000	0.0613	0.0613	0.000	2.769	2.767	0.072	3.376	3.372	0.118

Table 2: Comparison of Arc Flash Results for Scenario2 using Iarc Min

Bus ID	Arcing Current-BM	Arcing Current-ETAP	Arcing Current-%Diff	Fault Clearing Time-BM	Fault Clearing Time-ETAP	Fault Clearing Time-%Diff	Incident Energy-BM	Incident Energy-Etap	Incident Energy-%Diff	Arc Flash Boundary-BM	Arc Flash Boundary-ETAP	Arc Flash Boundary-%Diff
	kA	kA	%	Sec	Sec	%	cal/cm²	cal/cm²	%	ft	ft	%
MV_Bus	12.675	12.675	0.000	0.223	0.223	0.000	3.189	3.21	0.659	5.591	5.614	0.411
LV_Bus	25.244	25.244	0.000	0.319	0.319	0.000	12.705	12.706	0.008	8.757	8.753	0.046

References

[1] IEEE 1584-2018, IEEE Guide for Performing Arc-Flash Hazard Calculations, New York, NY: IEEE

[2] ETAP Arc-Flash Analysis V&V Documents, Case Number TCS-SC-512.