## Short Circuit Analysis

**Aim: To perform SC calculation by IEC-61363 standard**

In order to ensure that an overtly conservative approach is not taken, that could increase equipment requirements leading to weight and space constraints on mobile or fixed offshore installations, IEC 61363 standard is also being used for short circuit studies in shipping and offshore industry as per the title of the IEC 61363 standard which is '**Electrical installations of ships and mobile and fixed offshore units – Part 1: Procedures for calculating short-circuit currents in three-phase a.c.**'

The IEC 61363 standard is known to evaluate short-circuit currents within sufficient accuracy that is suitable for practical applications after allowing for generator pre-loading and appropriate fault current attenuation based on actual data of generator impedance and time constants.

IEC 60909 is used for both meshed and unmeshed systems whereas IEC 61363 is applicable only for unmeshed systems.

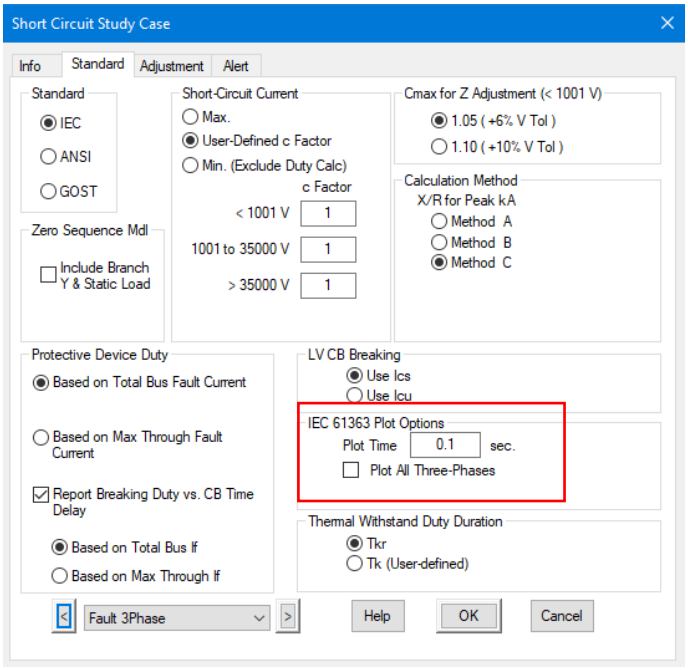
To start the IEC-61363 calculation in Etap set the briefcase with revised C factor value which need to be use for IEC 61363 calculations. This is because the current version of ETAP software for Short Circuit calculation using IEC 61363 is only suited for unloaded generator fault calculation. For loaded generator cases, the multiplying factor for voltage behind Xd'', Xd' have to be worked out separately and adjusted as a correction factor (by suitable adjustment of c factor) on the ETAP IEC 61363 results of Ik'' (subtransient Id''& Ipeak) and transient Id' for evaluating the net peak make short circuit current and asymmetric break short circuit current.

IEC 61363 calculates and plots of $i_{inst}$, $I_{ac\ rrms}$, $i_{dc}$, $i_{dc}$ (%) & $i_{env}$ at various instants of time from 0 to selected plot time in the study case editor (as shown below) in the Etap 14 and above version.

**Note:** In previous versions of Etap the plot time was fixed to 0.1 sec.

Typically 0.1 sec plot time is adequate unless the CB opening time is more than that 0.1 sec. However the plot step is fixed at 1msec.

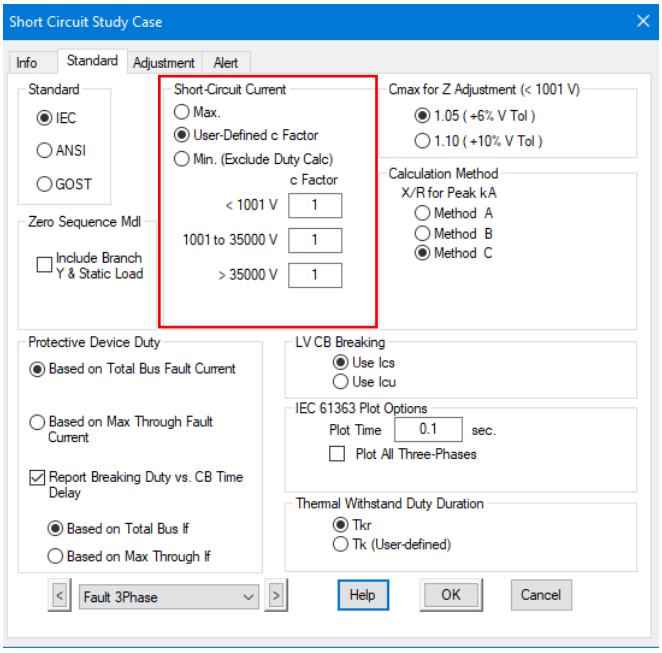
## Short Circuit Analysis



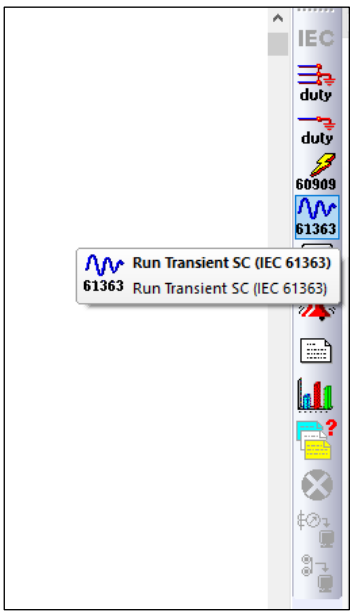

C factor for ETAP IEC 60909 is taken as maximum value (1.05) as mentioned in IEC 60909 and this also is seen to match with the Ik'' of ETAP IEC 61363 as seen in the table above. Results from ETAP IEC-61363 have been multiplied by appropriate factors to account for appropriate voltages behind Xd'', Xd' and Xd with bus/generator terminal voltage as 1 p.u. This is required because ETAP's IEC 61363 software module does not consider change in fault level due to generator loading. No such factors will be applicable for motor contribution on ETAP IEC 61363 results with the main bus voltage maintained at 1 p.u. Typically average factor of 1.15 have been consider for IEC -61363 calculation in this exercise. However this has to be worked out separately.

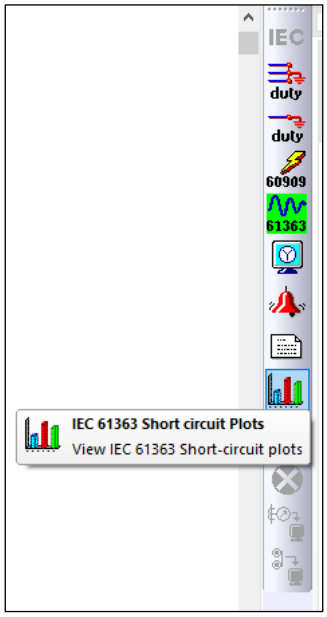
To achieve this c factor for calculation can be set as 1 and factor of 1.15 need to be applied on all the SC current results, for the present version of Etap.

## Short Circuit Analysis



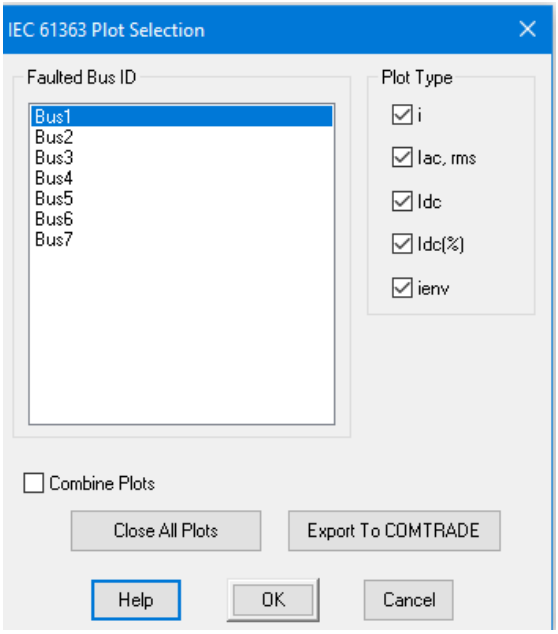

16. To see the plots of short circuit currents, run transient short circuit as per standard IEC-61363.



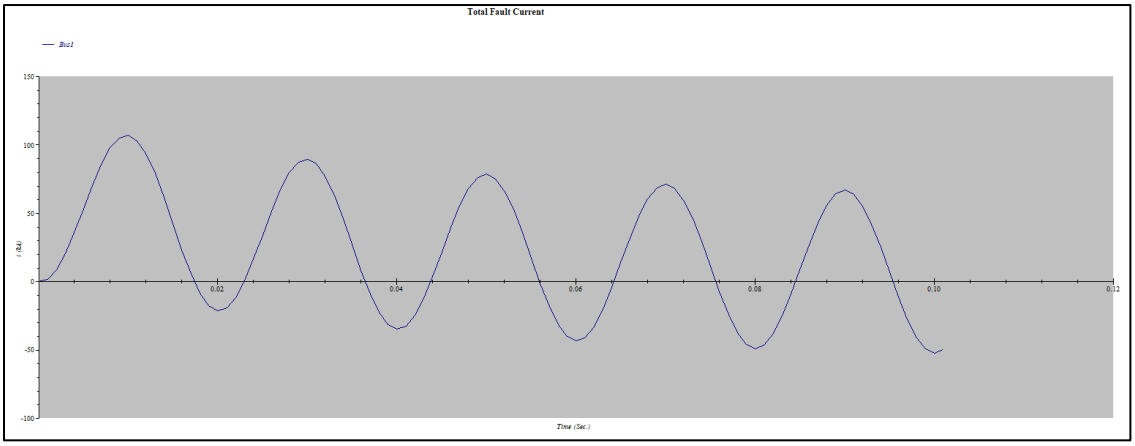

17. The following window will get pop up.

## Short Circuit Analysis



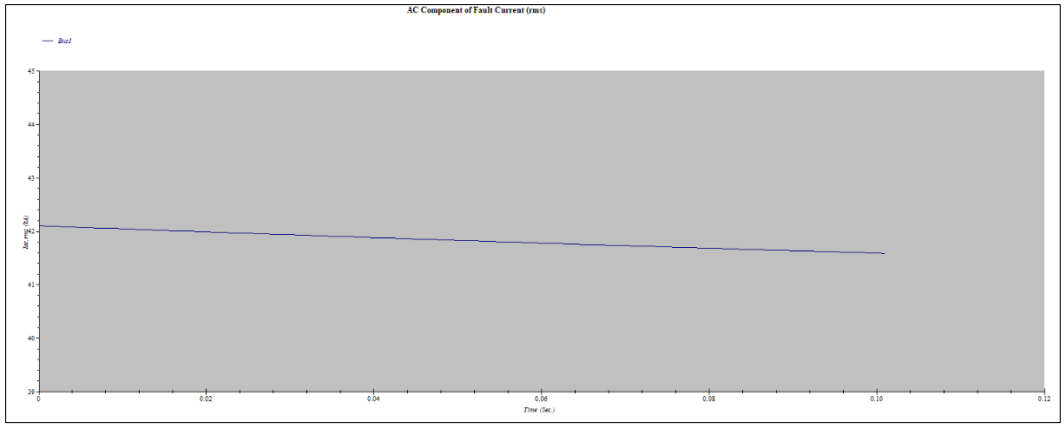

18. The plots of i, Iac rrms, idc, Idc (%) & I env for bus 1 are as below. This is graphical representation of the fault currents.

### a. i (total fault current)

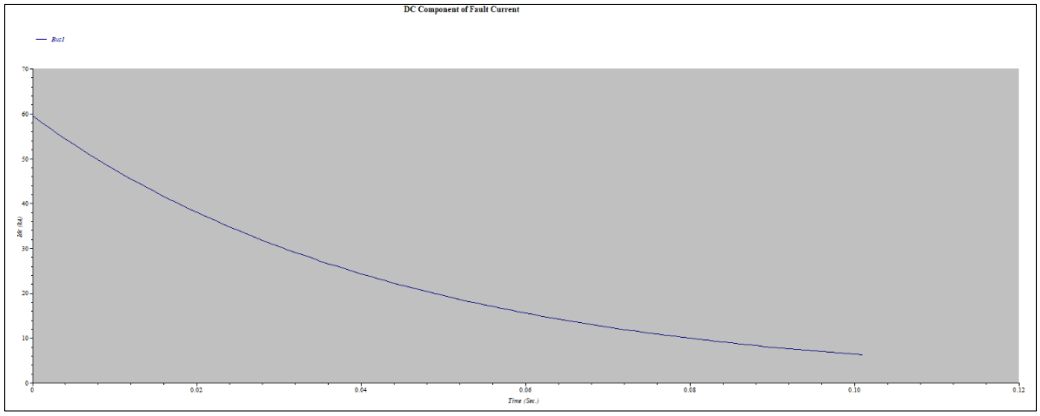


## Short Circuit Analysis

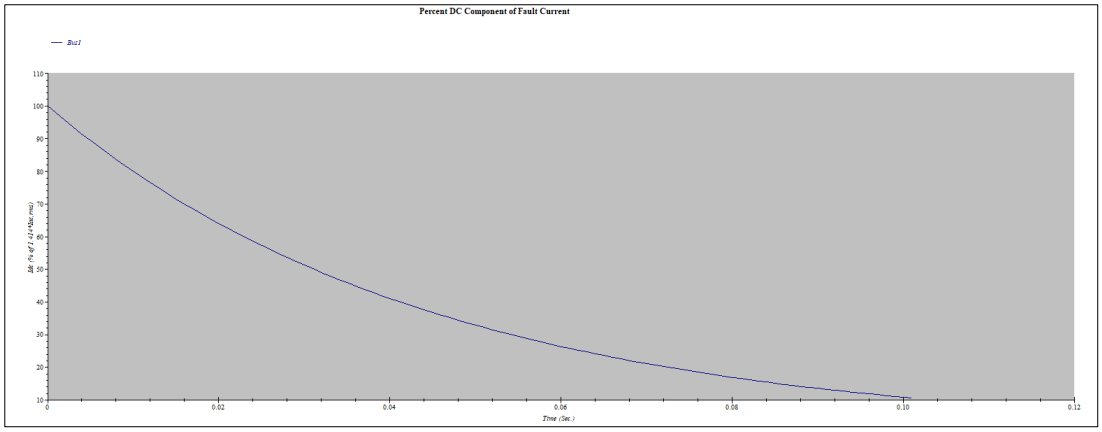
### b. Iac rms (AC component of fault current in rms)



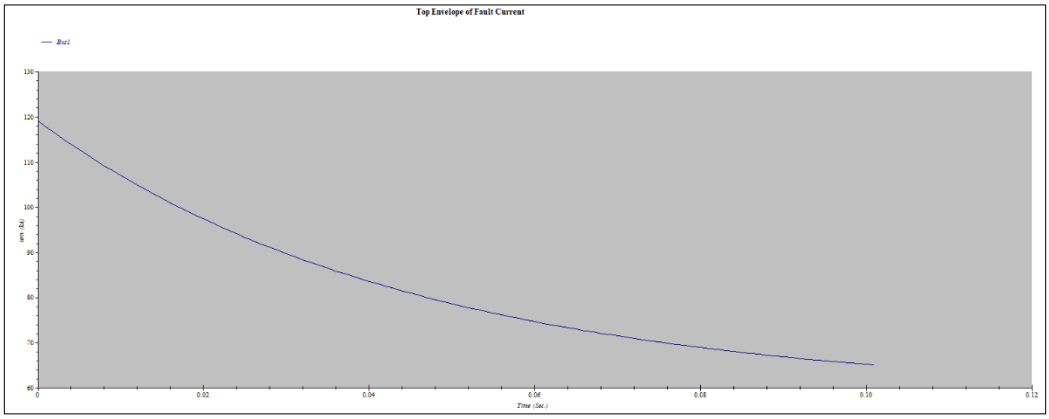

### c. Idc (Dc component of fault current)




### d. Idc (%) (Percentage dc component of fault current)



### e. ienv (Top envelop of fault current)




19. However, to check the tabulated results of above fault currents, go to Report Manager >> Result >> Short Circuit Report. The below results are shown for bus 1.

# Short Circuit Analysis

## SHORT-CIRCUIT REPORT

3-Phase fault at bus : Bus1

Nominal kV = 33.000 Voltage c Factor = 1.00 (User-Defined)

i = total fault current,
Idc = dc component,
isnv = top envelope of current-wave,
Iac(rms) = rms value of ac component,
Idc(%) = percentage value of dc component

| t (s) | i (kA) | Idc (kA) | isnv (kA) | Iac (kA, rms) | Idc (%) | t (s) | i (kA) | Idc (kA) | isnv (kA) | Iac (kA, rms) | Idc (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 59.544 | 119.089 | 42.104 | 100.00 | 0.001 | 1.595 | 58.217 | 117.753 | 42.098 | 97.79 |
| 0.002 | 8.762 | 56.921 | 116.449 | 42.092 | 95.62 | 0.003 | 20.669 | 55.654 | 115.174 | 42.087 | 93.51 |
| 0.004 | 36.026 | 54.416 | 113.927 | 42.081 | 91.44 | 0.005 | 53.207 | 53.207 | 112.710 | 42.075 | 89.42 |
| 0.006 | 70.409 | 52.025 | 111.520 | 42.069 | 87.44 | 0.007 | 85.835 | 50.869 | 110.356 | 42.063 | 85.51 |
| 0.008 | 97.860 | 49.740 | 109.219 | 42.058 | 83.63 | 0.009 | 105.197 | 48.637 | 108.107 | 42.052 | 81.78 |
| 0.010 | 107.021 | 47.558 | 107.021 | 42.046 | 79.98 | 0.011 | 103.048 | 46.504 | 105.958 | 42.041 | 78.22 |
| 0.012 | 93.567 | 45.473 | 104.920 | 42.035 | 76.49 | 0.013 | 79.403 | 44.466 | 103.904 | 42.029 | 74.81 |
| 0.014 | 61.846 | 43.481 | 102.912 | 42.024 | 73.16 | 0.015 | 42.519 | 42.519 | 101.941 | 42.018 | 71.55 |
| 0.016 | 23.217 | 41.577 | 100.992 | 42.012 | 69.98 | 0.017 | 5.739 | 40.657 | 100.064 | 42.007 | 68.44 |
| 0.018 | -8.297 | 39.758 | 99.156 | 42.001 | 66.93 | 0.019 | -17.606 | 38.878 | 98.269 | 41.996 | 65.46 |
| 0.020 | -21.364 | 38.019 | 97.402 | 41.990 | 64.02 | 0.021 | -19.291 | 37.178 | 96.553 | 41.985 | 62.62 |
| 0.022 | -11.673 | 36.356 | 95.723 | 41.979 | 61.24 | 0.023 | 0.662 | 35.552 | 94.912 | 41.974 | 59.89 |
| 0.024 | 16.426 | 34.767 | 94.118 | 41.968 | 58.58 | 0.025 | 33.998 | 33.998 | 93.342 | 41.963 | 57.29 |
| 0.026 | 51.583 | 33.247 | 92.583 | 41.957 | 56.03 | 0.027 | 67.385 | 32.513 | 91.841 | 41.952 | 54.80 |
| 0.028 | 79.786 | 31.794 | 91.115 | 41.946 | 53.60 | 0.029 | 87.502 | 31.092 | 90.405 | 41.941 | 52.42 |
| 0.030 | 89.711 | 30.406 | 89.711 | 41.935 | 51.27 | 0.031 | 86.130 | 29.734 | 89.032 | 41.930 | 50.14 |
| 0.032 | 77.044 | 29.078 | 88.368 | 41.925 | 49.04 | 0.033 | 63.281 | 28.436 | 87.718 | 41.919 | 47.97 |
| 0.034 | 46.125 | 27.808 | 87.083 | 41.914 | 46.91 | 0.035 | 27.194 | 27.194 | 86.462 | 41.909 | 45.88 |
| 0.036 | 8.281 | 26.594 | 85.854 | 41.903 | 44.88 | 0.037 | -8.821 | 26.007 | 85.259 | 41.898 | 43.89 |
| 0.038 | -22.498 | 25.433 | 84.678 | 41.893 | 42.93 | 0.039 | -31.467 | 24.871 | 84.109 | 41.887 | 41.99 |
| 0.040 | -34.908 | 24.322 | 83.553 | 41.882 | 41.06 | 0.041 | -32.539 | 23.786 | 83.009 | 41.877 | 40.16 |
| 0.042 | -24.646 | 23.261 | 82.476 | 41.872 | 39.28 | 0.043 | -12.054 | 22.747 | 81.956 | 41.867 | 38.42 |
| 0.044 | 3.951 | 22.246 | 81.446 | 41.861 | 37.58 | 0.045 | 21.755 | 21.755 | 80.948 | 41.856 | 36.75 |
| 0.046 | 39.564 | 21.275 | 80.461 | 41.851 | 35.95 | 0.047 | 55.590 | 20.805 | 79.984 | 41.846 | 35.16 |
| 0.048 | 68.217 | 20.346 | 79.518 | 41.841 | 34.39 | 0.049 | 76.166 | 19.897 | 79.062 | 41.836 | 33.63 |
| 0.050 | 78.616 | 19.459 | 78.616 | 41.831 | 32.89 | 0.051 | 75.284 | 19.029 | 78.179 | 41.825 | 32.17 |
| 0.052 | 66.457 | 18.610 | 77.752 | 41.820 | 31.47 | 0.053 | 52.958 | 18.199 | 77.335 | 41.815 | 30.78 |
| 0.054 | 36.069 | 17.798 | 76.926 | 41.810 | 30.10 | 0.055 | 17.405 | 17.405 | 76.527 | 41.805 | 29.44 |
| 0.056 | -1.246 | 17.021 | 76.136 | 41.800 | 28.79 | 0.057 | -18.097 | 16.646 | 75.753 | 41.795 | 28.16 |
| 0.058 | -31.534 | 16.279 | 75.379 | 41.790 | 27.54 | 0.059 | -40.281 | 15.920 | 75.013 | 41.785 | 26.94 |
| 0.060 | -43.518 | 15.569 | 74.655 | 41.780 | 26.35 | | | | | | |

# Short Circuit Analysis

(Cont.)

3-Phase fault at bus : **Bus1**

Nominal kV = 33.000 Voltage c Factor = 1.00 (User-Defined)

i = total fault current,
Idc = dc component,
ienv = top envelope of current-wave,
Iac(rms) = rms value of ac component,
Idc(%) = percentage value of dc component

| t (s) | i (kA) | Idc (kA) | ienv (kA) | Iac (kA, rms) | Idc (%) | t (s) | i (kA) | Idc (kA) | ienv (kA) | Iac (kA, rms) | Idc (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.061 | -40.962 | 15.225 | 74.304 | 41.775 | 25.77 | 0.062 | -32.901 | 14.889 | 73.962 | 41.770 | 25.21 |
| 0.063 | -20.157 | 14.561 | 73.626 | 41.765 | 24.65 | 0.064 | -4.010 | 14.240 | 73.298 | 41.761 | 24.11 |
| 0.065 | 13.926 | 13.926 | 72.977 | 41.756 | 23.58 | 0.066 | 31.865 | 13.619 | 72.663 | 41.751 | 23.07 |
| 0.067 | 48.020 | 13.319 | 72.356 | 41.746 | 22.56 | 0.068 | 60.782 | 13.025 | 72.056 | 41.741 | 22.06 |
| 0.069 | 68.873 | 12.738 | 71.762 | 41.736 | 21.58 | 0.070 | 71.474 | 12.457 | 71.474 | 41.731 | 21.11 |
| 0.071 | 68.304 | 12.182 | 71.192 | 41.727 | 20.64 | 0.072 | 59.648 | 11.914 | 70.917 | 41.722 | 20.19 |
| 0.073 | 46.328 | 11.651 | 70.648 | 41.717 | 19.75 | 0.074 | 29.623 | 11.394 | 70.384 | 41.712 | 19.32 |
| 0.075 | 11.143 | 11.143 | 70.126 | 41.707 | 18.89 | 0.076 | -7.328 | 10.897 | 69.874 | 41.703 | 18.48 |
| 0.077 | -24.005 | 10.657 | 69.627 | 41.698 | 18.07 | 0.078 | -37.280 | 10.422 | 69.385 | 41.693 | 17.68 |
| 0.079 | -45.879 | 10.192 | 69.149 | 41.689 | 17.29 | 0.080 | -48.982 | 9.968 | 68.917 | 41.684 | 16.91 |
| 0.081 | -46.311 | 9.748 | 68.691 | 41.679 | 16.54 | 0.082 | -38.148 | 9.533 | 68.470 | 41.674 | 16.17 |
| 0.083 | -25.315 | 9.323 | 68.253 | 41.670 | 15.82 | 0.084 | -9.091 | 9.117 | 68.041 | 41.665 | 15.47 |
| 0.085 | 8.916 | 8.916 | 67.833 | 41.661 | 15.13 | 0.086 | 26.924 | 8.720 | 67.630 | 41.656 | 14.80 |
| 0.087 | 43.150 | 8.528 | 67.431 | 41.651 | 14.48 | 0.088 | 55.989 | 8.340 | 67.237 | 41.647 | 14.16 |
| 0.089 | 64.164 | 8.156 | 67.047 | 41.642 | 13.85 | 0.090 | 66.860 | 7.976 | 66.860 | 41.638 | 13.55 |
| 0.091 | 63.797 | 7.800 | 66.678 | 41.633 | 13.25 | 0.092 | 55.256 | 7.628 | 66.500 | 41.629 | 12.96 |
| 0.093 | 42.060 | 7.460 | 66.325 | 41.624 | 12.67 | 0.094 | 25.484 | 7.296 | 66.155 | 41.619 | 12.40 |
| 0.095 | 7.135 | 7.135 | 65.987 | 41.615 | 12.12 | 0.096 | -11.207 | 6.978 | 65.824 | 41.610 | 11.86 |
| 0.097 | -27.761 | 6.824 | 65.664 | 41.606 | 11.60 | 0.098 | -40.924 | 6.674 | 65.507 | 41.602 | 11.34 |
| 0.099 | -49.422 | 6.526 | 65.354 | 41.597 | 11.09 | 0.100 | -52.438 | 6.383 | 65.204 | 41.593 | 10.85 |
| 0.101 | -49.694 | 6.242 | 65.057 | 41.588 | 10.61 | | | | | | |

| t (cycle) | i (kA) | Idc (kA) | ienv (kA) | Iac (kA, rms) | Idc (%) | t (cycle) | i (kA) | Idc (kA) | ienv (kA) | Iac (kA, rms) | Idc (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 59.544 | 119.089 | 42.104 | 100.00 | 0.100 | 8.762 | 56.921 | 116.449 | 42.092 | 95.62 |
| 0.200 | 36.026 | 54.416 | 113.927 | 42.081 | 91.44 | 0.300 | 70.409 | 52.025 | 111.520 | 42.069 | 87.44 |
| 0.400 | 97.860 | 49.740 | 109.219 | 42.058 | 83.63 | 0.500 | 107.021 | 47.558 | 107.021 | 42.046 | 79.98 |
| 0.600 | 93.567 | 45.473 | 104.920 | 42.035 | 76.49 | 0.700 | 61.846 | 43.481 | 102.912 | 42.024 | 73.16 |
| 0.800 | 23.217 | 41.577 | 100.992 | 42.012 | 69.98 | 0.900 | -8.297 | 39.758 | 99.156 | 42.001 | 66.93 |
| 1.000 | -21.364 | 38.019 | 97.402 | 41.990 | 64.02 | 1.100 | -11.673 | 36.356 | 95.723 | 41.979 | 61.24 |