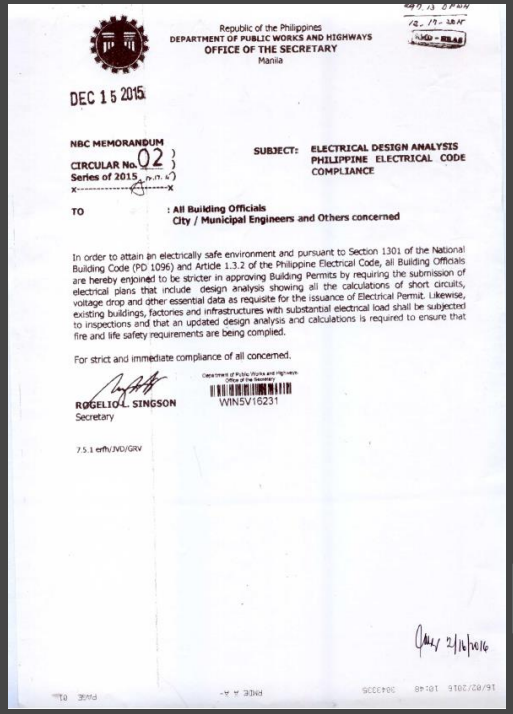


Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Manila

DEC 15 2015

NBC MEMORANDUM
CIRCULAR No. 02
Series of 2015

SUBJECT: ELECTRICAL DESIGN ANALYSIS PHILIPPINE ELECTRICAL CODE COMPLIANCE

TO : All Building Officials
City / Municipal Engineers and Others concerned

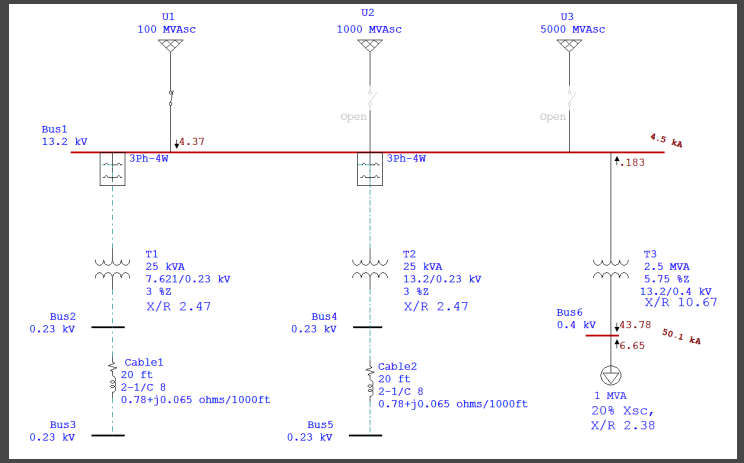
In order to attain an electrically safe environment and pursuant to Section 1301 of the National Building Code (PD 1096) and Article 1.3.2 of the Philippine Electrical Code, all Building Officials are hereby enjoined to be stricter in approving Building Permits by requiring the submission of electrical plans that include design analysis showing all the calculations of short circuits, voltage drop and other essential data as requisite for the issuance of Electrical Permit. Likewise, existing buildings, factories and infrastructures with substantial electrical load shall be subjected to inspections and that an updated design analysis and calculations is required to ensure that fire and life safety requirements are being complied.

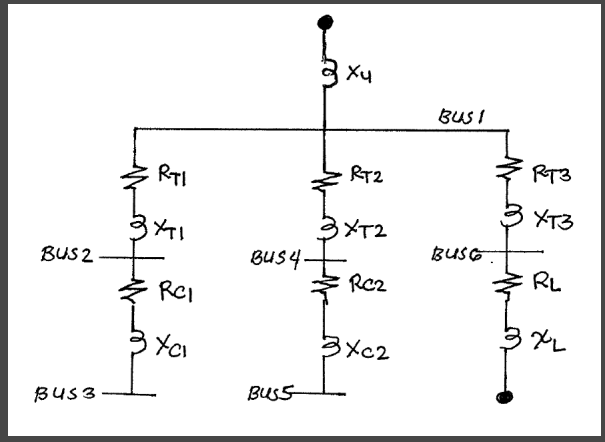
For strict and immediate compliance of all concerned.

ROGELIO L. SINGSON
Secretary

WINSV16231

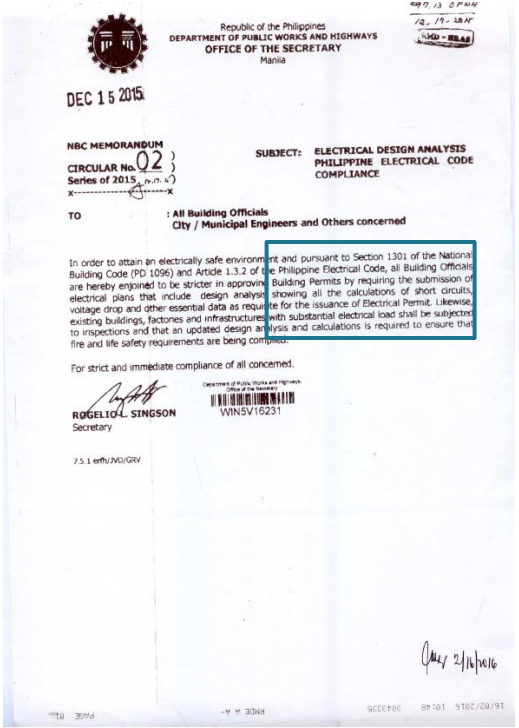
7.5.1 erfh/JVD/GRV





FAULT ANALYSIS PER DPWH REQUIREMENT

DPWH767 Memorandum



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WIN5V16231

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Utility Supply Voltage

Low Voltage (Secondary Nominal Voltage)

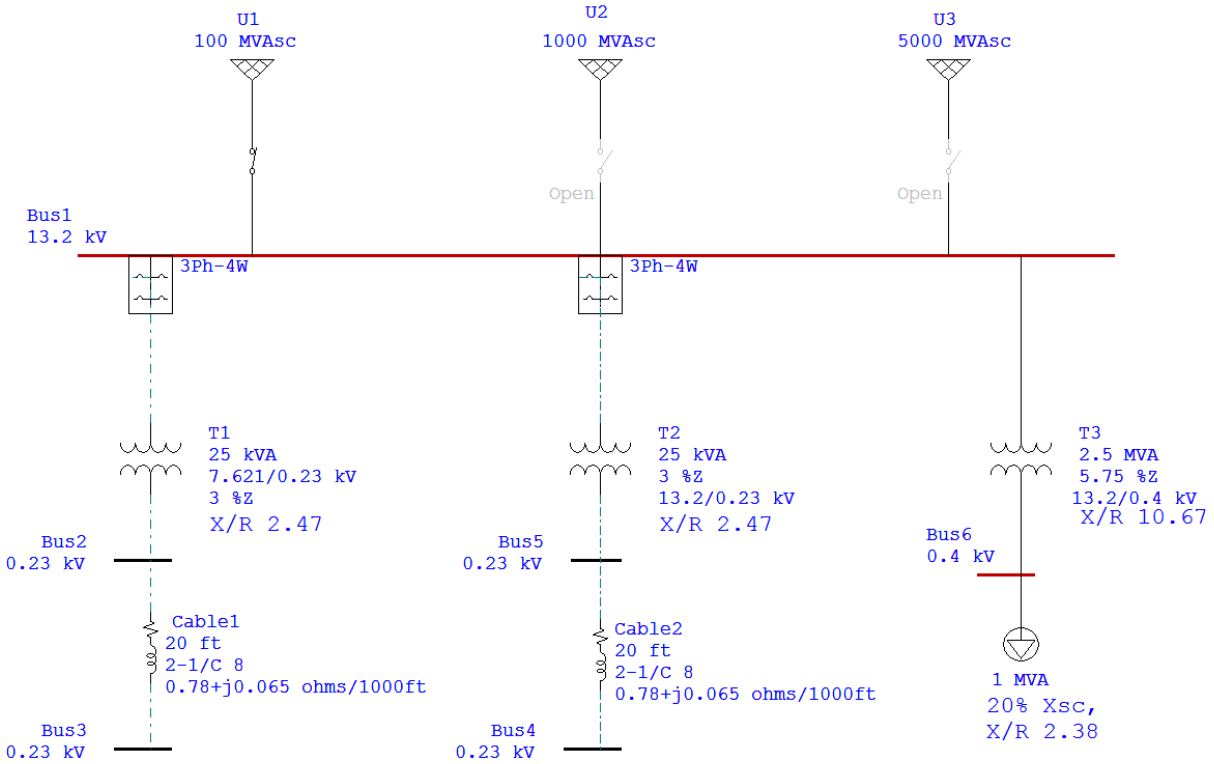
- 230 Volts, Single Phase, Three(3)-Wire
- 230 Volts, Three(3) Phase, Four(4)-Wire
- 460/265 Volts, Three(3) Phase, Four(4)-Wire (Grounded Wye)
- **400Y/230-volt, three-phase, four-wire service voltage (New)**

Medium Voltage (Primary Nominal Voltage)

- 13.2/7.62 kV, Three(3) Phase, Four(4)-Wire (Grounded Wye)
- 34.5/19.92 kV, Three(3) Phase, Four(4)-Wire (Grounded Wye)

http://corporate-downloadables-electric-service-standards-hmb.s3.amazonaws.com/c85435c1e2bf7fc09237b75482ac1605.pdf

DISTRIBUTION MODEL



PER UNIT METHOD CALCULATION

$$Zpu = \frac{PB(Z_{\Omega})}{V_L^{\,2}}$$

$$I_{F3\theta} = \frac{PB}{\sqrt{3}\ x\ V_L\ x\ Zpu}$$

$$Zpu_N = Zpu_O\, x\, \frac{PB_N}{PB_O}\, x\, \frac{V_{LN}^{\,2}}{V_{LO}^{\,2}}$$

$$I_F = I_B(\frac{1}{Zpu})$$

PB - power base

V_L - line voltage

Zpu - per unit impedance

Zpu_N - new per unit impedance

Zpu_O - old per unit impedance

PB_N - new power base

PB_O - old power base

$I_{F3\theta}$ - 3-phase bolted short circuit current

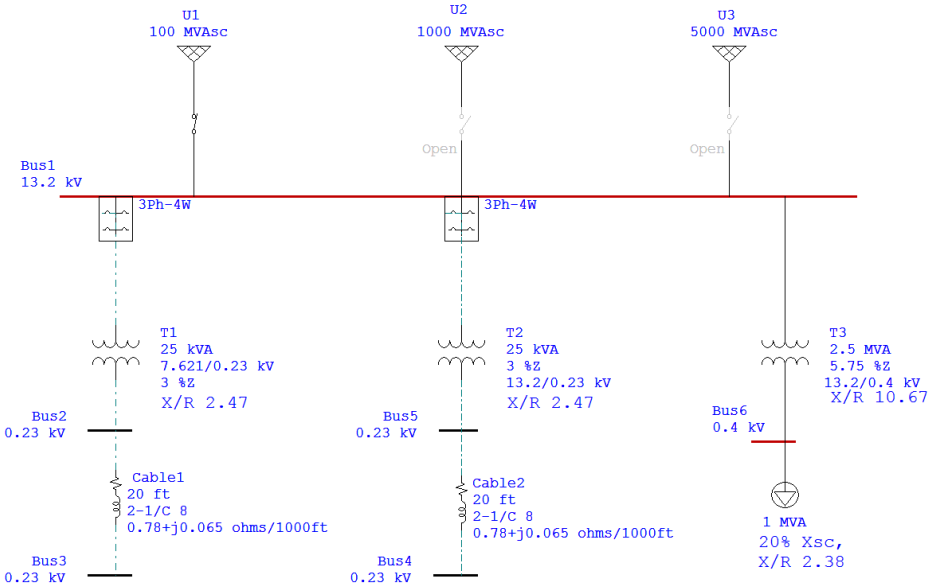
V_{LN} - new voltage base

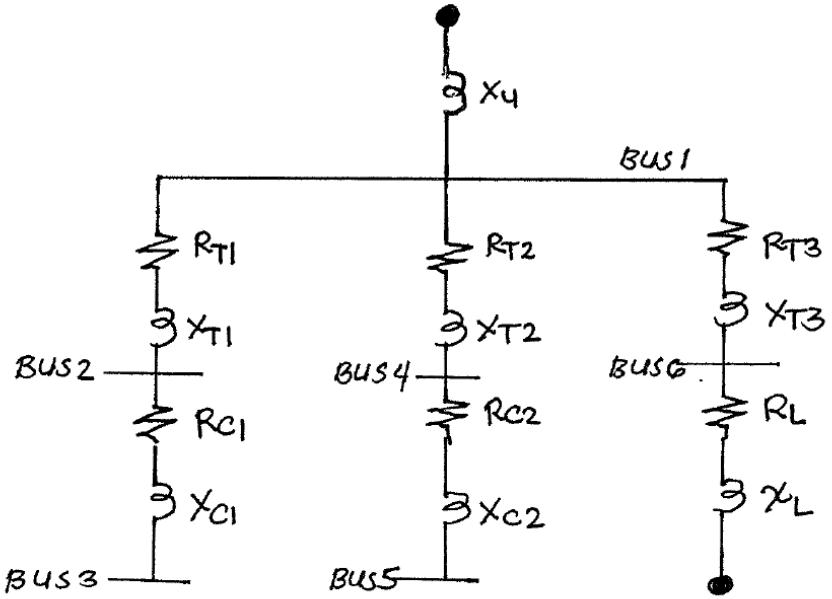
V_{LO} - old voltage base

I_F - Fault or short circuit current

I_B - current base

Impedance diagram





Calculation of Per Unit Impedances

At common power base - 100MVA

Calculate for all per unit quantities

$X_u = j1.0$

$R_{T1} = 0.03\left(\frac{100}{0.025}\right)\cos(\tan^{-1}2.47) = 45.03$

$X_{T1} = j0.03\left(\frac{100}{0.025}\right)\sin(\tan^{-1}2.47) = j111.23$

$R_{T2} = R_{T1}$

$X_{T2} = X_{T1}$

$R_{T3} = 0.0575\left(\frac{100}{2.5}\right)\cos(\tan^{-1}10.67) = 0.21$

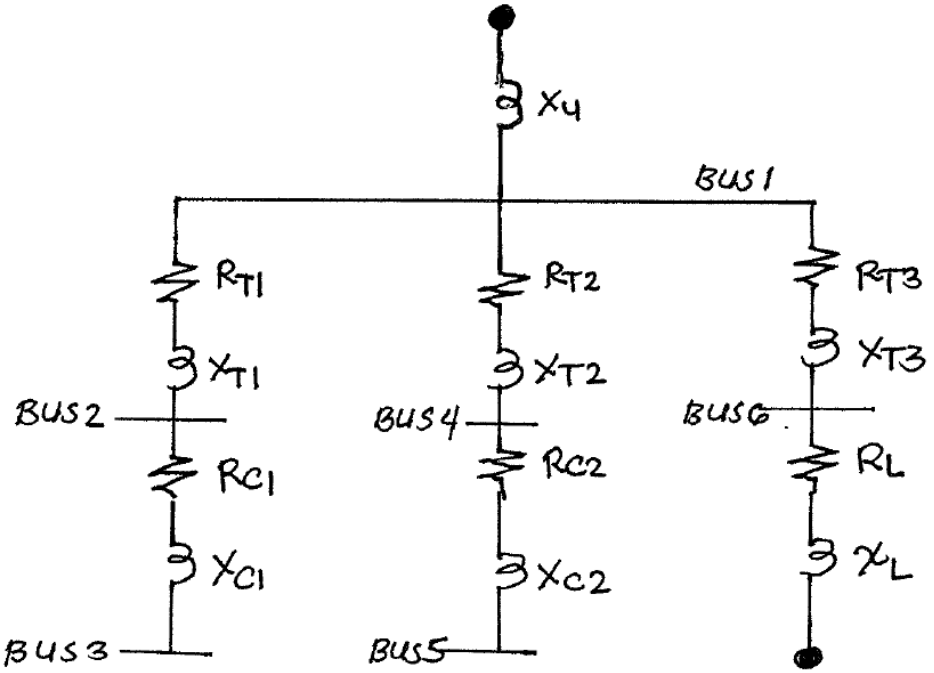
$X_{T3} = j0.0575\left(\frac{100}{2.5}\right)\sin(\tan^{-1}10.67) = j2.29$

$$R_{C1} = \frac{100\times10^6\left(0.78\times\frac{1}{1000}\right)(20)}{230^2} = 29.49$$

$$X_{C1} = j\frac{100\times10^6\left(0.065\times\frac{1}{1000}\right)(20)}{230^2} = j2.46$$

$R_L = 0.2\left(\frac{100}{1}\right)\cos(\tan^{-1}2.38) = 7.75$

$X_L = j0.2\left(\frac{100}{1}\right)\sin(\tan^{-1}2.38) = j18.44$



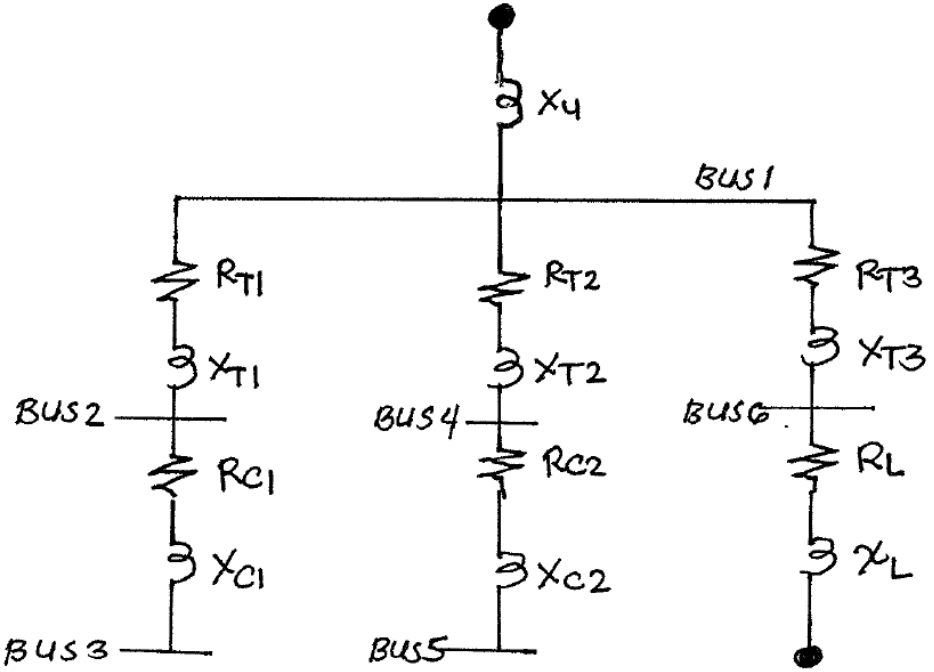
Thevenin Equivalent Imp. & SCC

$$Z_{TH}\ (\text{BUS 1}) = Z_4 \,//\, (Z_{T3} + Z_L)$$

$$= (j1.0) \,//\, (0.21 + j2.29 + 7.75 + j18.44)$$

$$Z_{TH}\ (\text{BUS 1}) = 0.01 + j0.96 \approx 0.96 \angle 89.14^\circ$$

$$I_{F3\phi}\ (\text{BUS 1}) = \frac{100}{\sqrt{3}\,(13.2)(0.96)} = 4.5\ kA_{\text{rms sym.}}$$



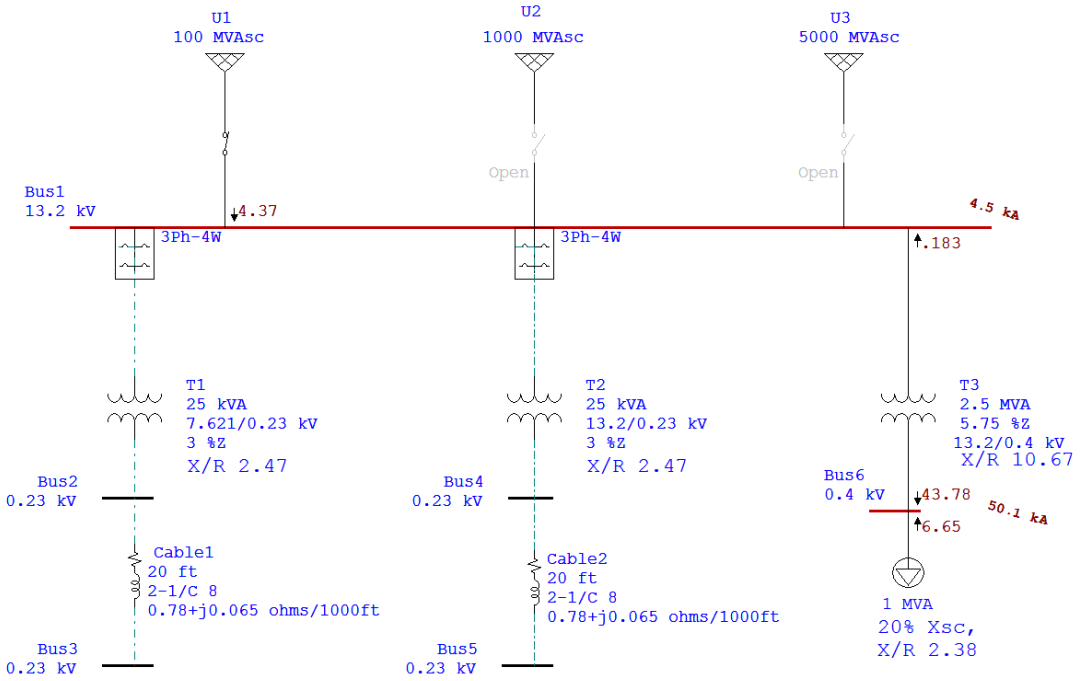
Manual Calc. versus Software Result

$$Z_{TH\,(BUS\,1)} = Z_U \,//\, (Z_{T3} + Z_L)$$

$$= (j1.0) \,//\, (0.21 + j2.29 + 7.75 + j18.44)$$

$$Z_{TH\,(BUS\,1)} = 0.01 + j0.96 \approx 0.96 \angle 89.14^\circ$$

$$I_{F3\phi\,(BUS\,1)} = \frac{100}{\sqrt{3}\,(13.2)(0.96)} = 4.5\ kA_{rms\ sym.}$$



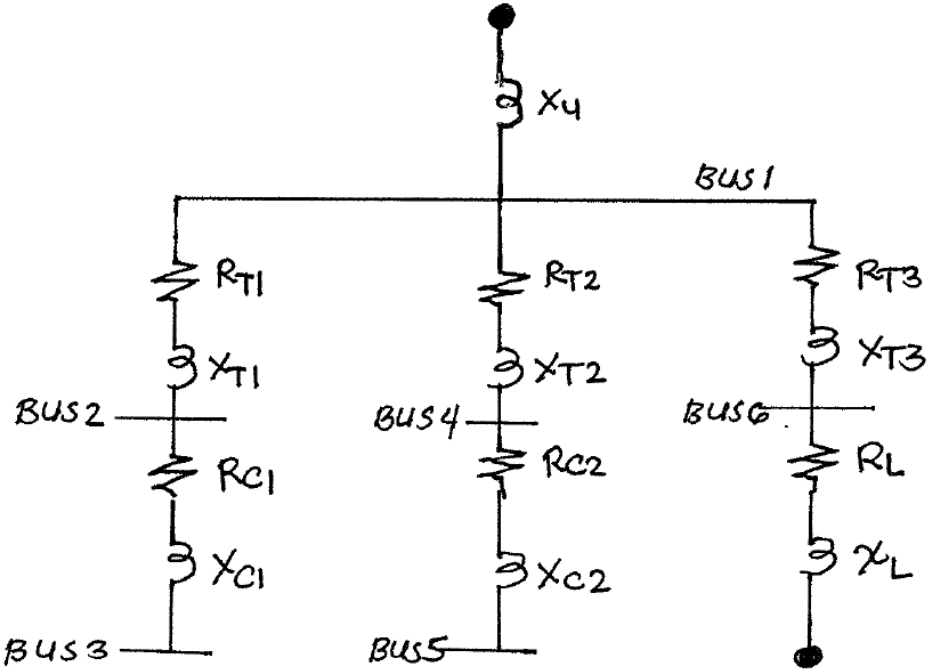
Thevenin Equivalent Imp. & SCC

$$Z_{TH}\ (\text{BUS } 6) = (Z_4 + Z_{T3}) /\!/ Z_L$$

$$= \left[j1.0 + (0.21 + j2.29)\right] /\!/ (7.75 + j18.44)$$

$$Z_{TH}\ (\text{BUS } 6) = 0.31 + j2.83 = 2.85 \angle 83.67^\circ$$

$$I_{F3\phi}\ (\text{BUS } 6) = \frac{100}{\sqrt{3}\,(0.4)(2.85)} = 50.6\ kA_{rms\ sym}$$



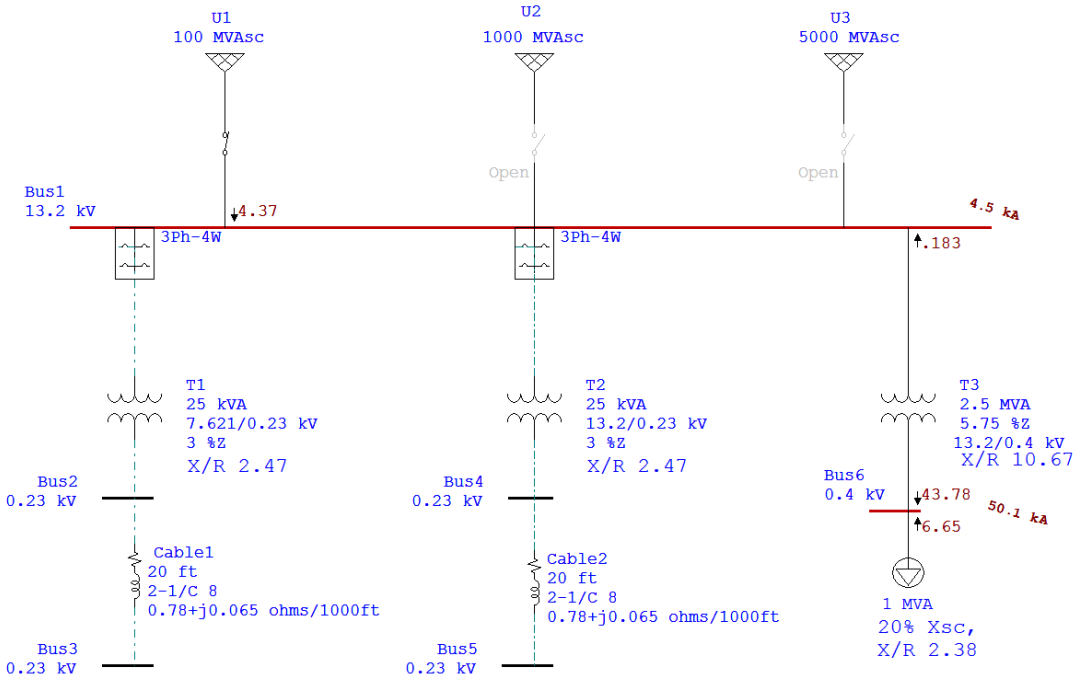
Manual Calc. versus Software Result

$$Z_{TH\ (BUS\ 6)} = (Z_4 + Z_{T3}) /\!/ Z_L$$

$$= [j1.0 + (0.21 + j2.29)] /\!/ (7.75 + j18.44)$$

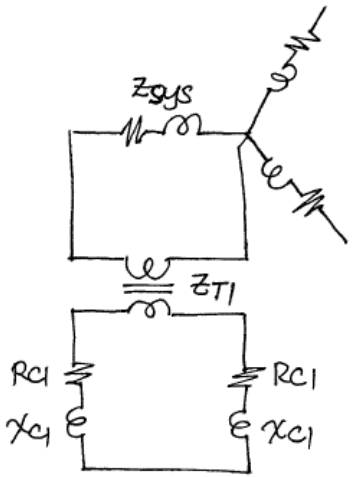
$$Z_{TH\ (BUS\ 6)} = 0.31 + j2.83 = 2.85 \angle 83.67^\circ$$

$$I_{F3\phi\ (BUS\ 6)} = \frac{100}{\sqrt{3}\,(0.4)(2.85)} = 50.6\ kA_{rms\ sym}$$



Manual Calc. versus Software Result

Fault Current at Bus 3



per unit impedances

$$Z_{TH} = Z_{sys} + Z_{T1} + Z_{C1}\,(2)$$

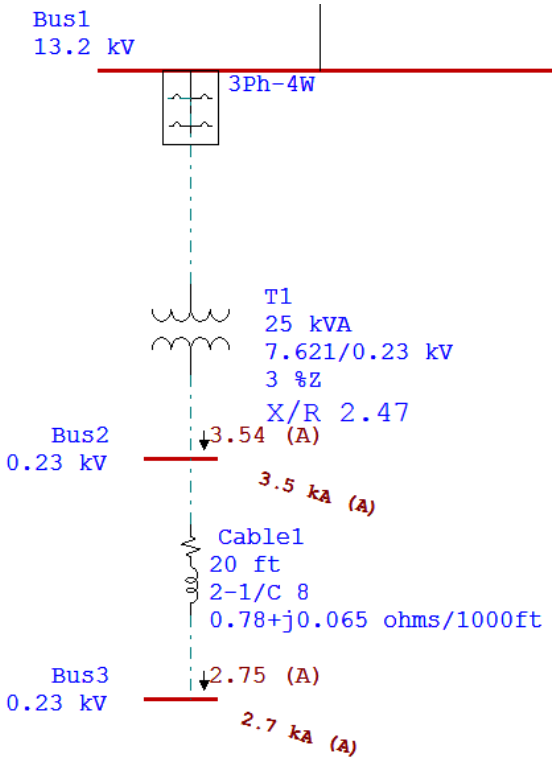
$$Z_{sys} = 0.01 + j\,0.96$$

$$Z_{T1} = 45.03 + j\,111.23$$

$$Z_{C1} = 29.49 + j\,2.46$$

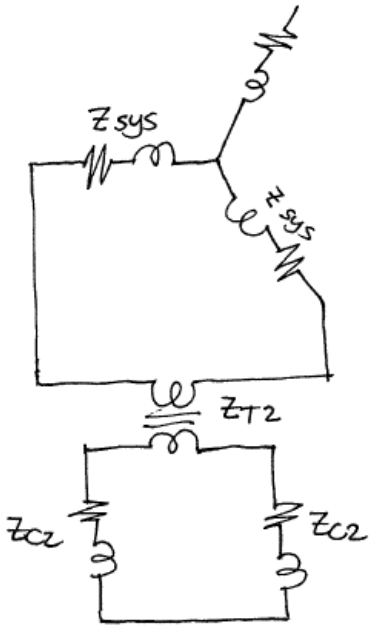
$$Z_{TH} = 104.02 + j\,117.11 = 156.64\angle 48^{\circ}$$

$$I_{F\,(Bus\,3)} = \frac{100 \times 10^{6}}{230}\left(\frac{1}{156.64}\right) = 2.7\,kA$$



Manual Calc. versus Software Result

Fault Current at Bus5



per unit impedances

$$Z_{TH} = 2Z_{sys} + Z_{T2} + 2Z_{c2}$$

$$Z_{sys} = 0.01 + j0.96$$

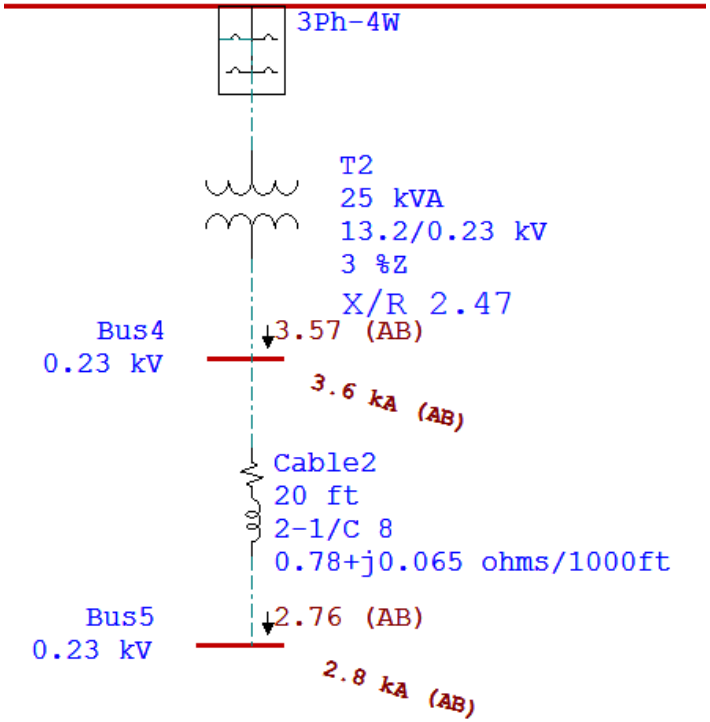
$$Z_{T2} = 45.03 + j111.23$$

$$Z_{c2} = 29.43 + j2.46$$

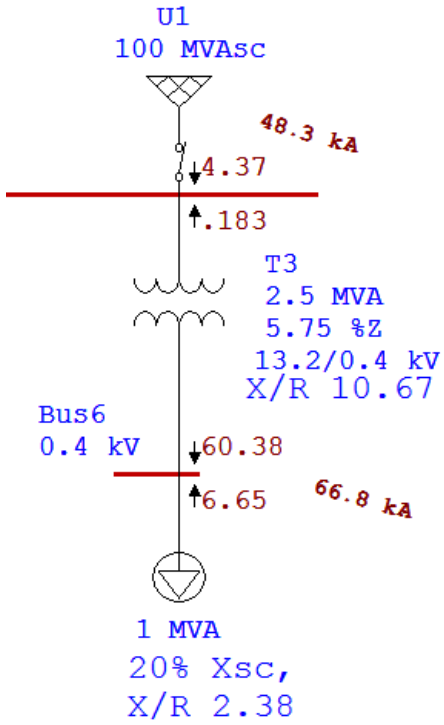
$$Z_{TH} = 104.03 + j118.07 = 157.36$$

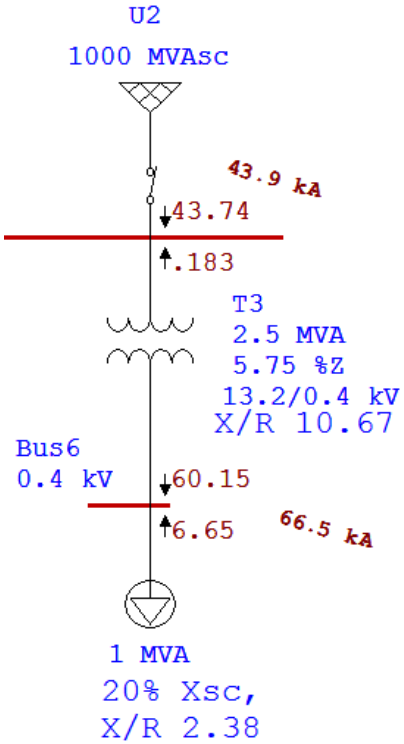
$$\bar{I}_F = \frac{100 \times 10^6}{230}\left(\frac{1}{157.36}\right) = 2.8\,kA$$

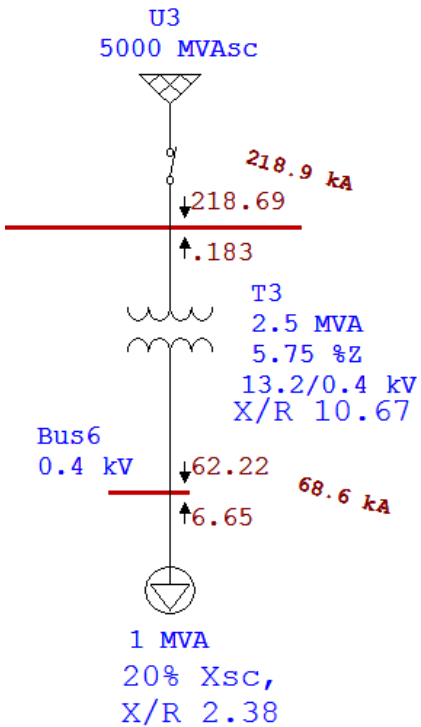
(Bus5)



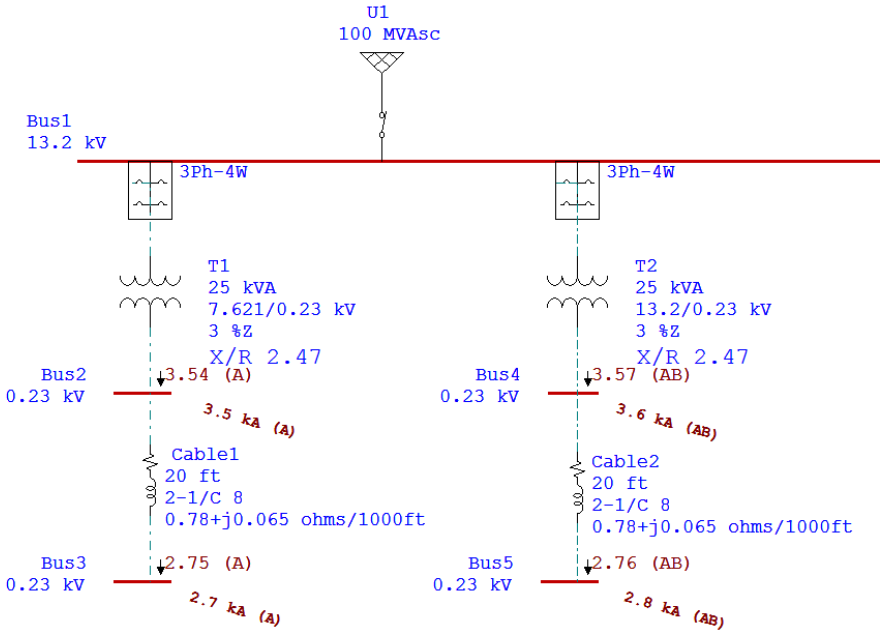
SCC Comparisons

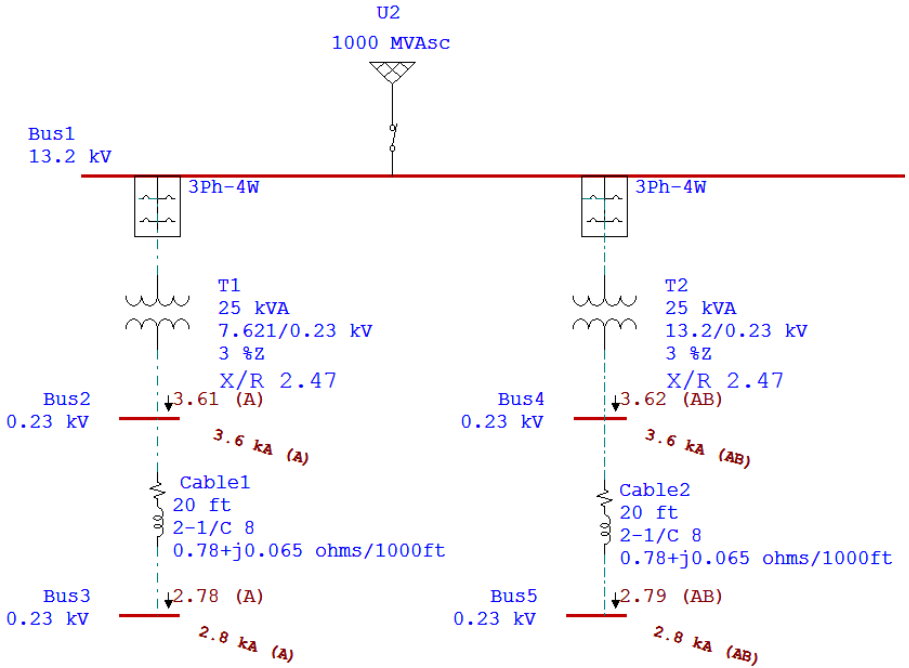






SCC Comparisons





SCC Comparisons