Problem Set #7 Symmetrical faults

7-1 (Grainger and Stevenson, Jr. Chapter 10, Prob 10.2)

10.2 A generator connected through a 5-cycle circuit breaker to a transformer is rated 100 MVA, 18 kV, with reactances of $X''_d = 19\%$, $X'_d = 26\%$ and $X_d = 130\%$. It is operating at no load and rated voltage when a three-phase short circuit occurs between the breaker and the transformer. Find (a) the sustained short-circuit current in the breaker, (b) the initial symmetrical rms current in the breaker and (c) the maximum possible dc component of the short-circuit current in the breaker.

7-2 (Grainger and Stevenson, Jr. Chapter 10, Prob 10.3)

10.3 The three-phase transformer connected to the generator described in Prob. 10.2 is rated 100 MVA, 240Y/18Δ kV, $X = 10\%$. If a three-phase short circuit occurs on the high-voltage side of the transformer at rated voltage and no load, find (a) the initial symmetrical rms current in the transformer windings on the high-voltage side and (b) the initial symmetrical rms current in the line on the low-voltage side.

7-3 (Grainger and Stevenson, Jr. Chapter 10, Prob 10.6)

10.6 Two synchronous motors having subtransient reactances of 0.80 and 0.25 per unit, respectively, on a base of 480 V, 2000 kVA are connected to a bus. This motor is connected by a line having a reactance of 0.023 Ω to a bus of a power system. At the power-system bus the short-circuit megavoltamperes of the power system are 9.6 MVA for a nominal voltage of 480 V. When the voltage at the motor bus is 440 V, neglect load current and find the initial symmetrical rms current in a three-phase fault at the motor bus.

7-4 (Grainger and Stevenson, Jr. Chapter 10, Prob 10.7)

10.7 The bus impedance matrix of a four-bus network with values in per unit is

$$\mathbf{Z}_{\text{bus}} = \begin{bmatrix} j0.15 & j0.08 & j0.04 & j0.07 \\ j0.08 & j0.15 & j0.06 & j0.09 \\ j0.04 & j0.06 & j0.13 & j0.05 \\ j0.07 & j0.09 & j0.05 & j0.12 \end{bmatrix}$$

Generators connected to buses ① and ② have their subtransient reactances included in $\mathbf{Z}_{\text{bus}}$. If prefault current is neglected, find the subtransient current in per unit in the fault for a three-phase fault on bus ④. Assume the voltage at the fault is $1.0\angle 0°$ per unit before the fault occurs. Find also the per-unit current from generator 2 whose subtransient reactance is 0.2 per unit.