KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

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EE-463

Key Solution

Quiz # 4 Serial # Name: I.D.#

A generator having a solidly grounded neutral and rated 50-MVA, 30-kV has positive-, negative-, and zero-sequence reactances of 25, 15, and 5 percent, respectively. What reactance must be placed in the generator neutral to limit the magnitude of the fault current for a bolted (i.e., solidly grounded) double line-to-ground fault to that for a bolted three-phase fault.

The generator base impedance is

$$Z_B = \frac{(30)^2}{50} = 18 \ \Omega$$

From (10.86) the positive sequence component of fault current is

$$I_a^1 = \frac{1}{0.25 + \frac{(0.15)(0.05+3X_n)}{0.2+3X_n}} = \frac{0.2 + 3X_n}{0.0575 + 1.2X_n}$$

and from (10.86) the zero sequence component of fault current is

$$I_a^0 = -\frac{1 - \frac{(0.25)(0.2+3X_n)}{0.0575+1.2X_n}}{0.05 + 3X_n} = -\frac{0.0075 + 0.45X}{3.6X^2 + 0.2325X + 0.002875}$$

The double line-to-ground fault current is

$$I_{f\,DLG} = 3I_a^0$$

Since the magnitude of the fault current is to be equal to 4, we get

$$|I_a^0| = \frac{4}{3}$$

Substituting for I_a^0, we have

$$\frac{4}{3} = \frac{0.0075 + 0.45X}{3.6X^2 + 0.2325X + 0.002875}$$

which results in the following second-order polynomial equation

$$14.4x^2 - 0.42X - 0.011 = 0$$

The positive root of the above polynomial is $X = 0.0458333$ or

$$X_n = (0.0458333)(18) = 0.825 \ \Omega$$