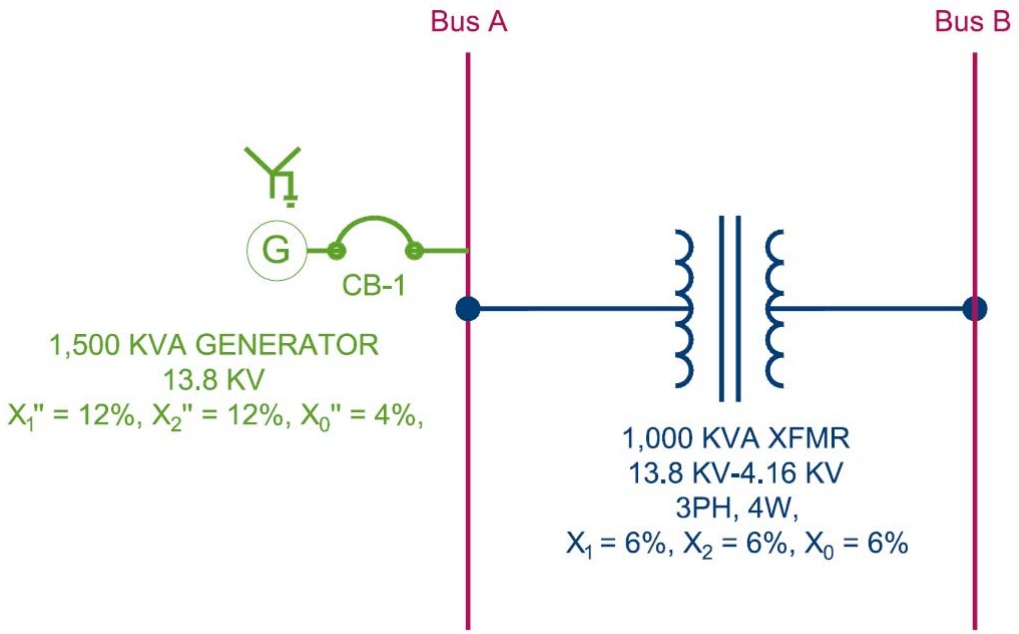
Power PE Full Exam Errata

This product has been updated to incorporate all changes shown in the comments on the webpage and email comments as of January, 01 2020. If you have purchased this product prior to this date and wish for the latest version then please email Justin Kauwale at contact@engproguides.com.

The following changes have not been incorporated into the product as of the date above and should be noted.

PROBLEM 1 – PROTECTION

What is the fault current through phase A, during a single phase (A) to ground fault? The percent values are shown for each individual equipment's base. Find the fault current at Bus B. The fault voltage is 1.0 pu and this is a 3 phase circuit. Assume wye grounded – wye grounded transformer.



(A) 450 A

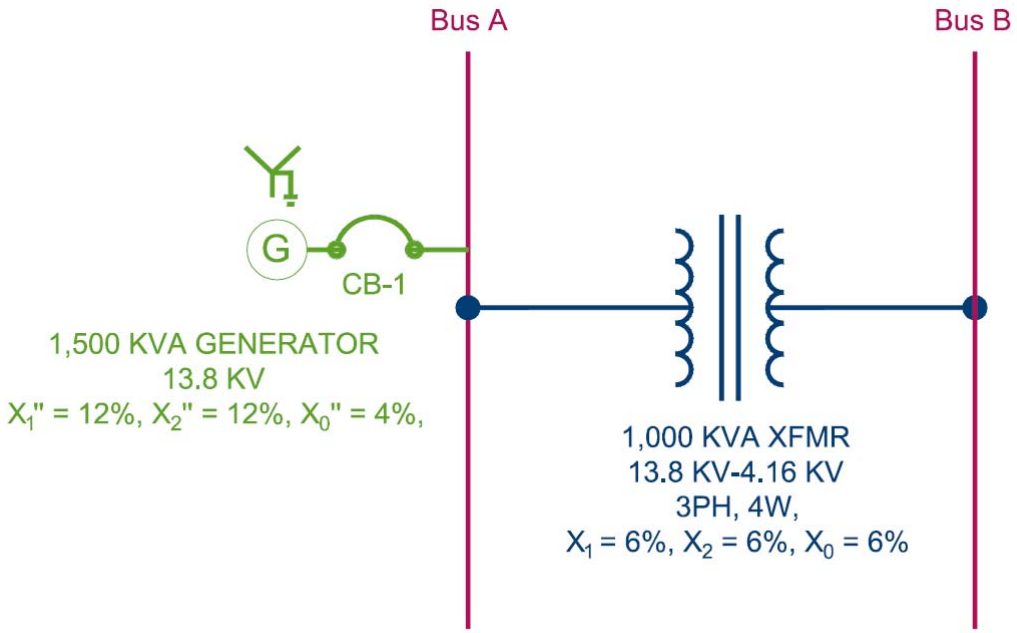
(B) 900 A

(C) 1,100 A

(D) 1,900 A

SOLUTION 1 – PROTECTION

What is the fault current through phase A, during a single phase (A) to ground fault? The percent values are shown for each individual equipment's base. Find the fault current at Bus B. The fault voltage is 1.0 pu and this is a 3 phase circuit. Assume wye grounded – wye grounded transformer.



(A) 450 A

(B) 900 A

(C) 1,100 A

(D) 1,900 A

First, choose a base. In this solution the generator is selected as the base. Then convert the transformer percent impedance values to per unit on the generator base.

$$X_1 = X_2 = X_0 = .06\,pu * \left(\frac{1{,}500\,KVA}{1{,}000\,KVA}\right) = 0.09\,pu$$

~~Now combine the impedances for each sequence as shown below, by adding up the per unit values in series of the generator and transformer.~~

$$~~X_{1,total} = X_{2,total} = 0.12\,pu + 0.09\,pu = 0.21\,pu~~$$

The zero sequence will contribute to the circuit, because of the wye-wye grounded.

Next, use the single line to ground fault equation to find the fault current.

$$Single\ Line\ to\ Ground\ Fault \rightarrow I_{fault} = \frac{3 * V_{fault}}{X_{0,gen} + X_{1,gen} + X_{2,gen} + X_{0,trans} + X_{1,trans} + X_{2,trans}}$$

$$I_{fault} = \frac{3 * 1.0\ pu}{0.04 + 0.12 + 0.12 + .09 + .09 + .09} = 5.45\ pu$$

Now you need the base current at Bus B. The base voltage at bus B is 4160 V. The base power was determined earlier as 1,500 KVA.

$$I_{base} = \frac{1{,}500\ KVA * 1{,}000}{4{,}160\ V * \sqrt{3}}$$

$$I_{base} = \frac{1{,}500\ KVA * 1{,}000}{4{,}160\ V * \sqrt{3}} = 208.4\ A$$

Finally, use the base current to find the fault current.

$$I_{fault} = 5.45\ pu * 208\ A = 1{,}134\ A$$

The correct answer is most nearly, (C) 1,500 A.

SOLUTION 2 – CIRCUIT ANALYSIS

A three-phase, wye connected, balanced load consumes 100 kW and is rated at 480 V (line voltage). If one of the load's phases is lost ~~($Z_{phase\ A} = 0$),~~ what is the new power consumption? Assume a power factor of 1.0.

The first step is to calculate the impedance of a single phase, given voltage and power. So we should use the phase power equation. Since the power factor is 1.0, the apparent power is equal to the real power.

$$S = P = 3 * V_{phase} * I_{phase} = \frac{3 * V_{phase}^2}{Z_{phase}}$$

$$100{,}000\ W = \frac{3 * \left(\frac{480}{\sqrt{3}}\right)^2}{Z_{phase}}$$

$$Z_{phase} = 2.3\ \Omega$$

PROBLEM 36 – TRANSMISSION AND DISTRIBUTION

A waveform has a voltage of 480V with a THD of 20%. What is the RMS of the fundamental frequency?

(A) 305V

(B) 332V

(C) 384V

(D) 471V

PROBLEM 37 – TRANSMISSION AND DISTRIBUTION

A 100 kVA, 480V generator has the following zero, positive and negative sequence impedances, $Z_0 = 0.15\,pu$, $Z_1 = 0.05\,pu$ and $Z_2 = 0.05\,pu$. What is the short circuit current in a single line to ground fault. Assume the rated voltage of the generator is equal to 1 pu and the rated current of the generator is equal to 1 pu.

(A) 1.3 pu

(B) 4 pu

(C) 10 pu

(D) 12 pu

PROBLEM 45 – TRANSMISSION AND DISTRIBUTION

A 3-phase generator is connected to an infinite bus. The infinite bus is operating at a phase voltage of 132 KV$\angle 0°$. The generator is operating at a phase voltage of 134 KV$\angle 30°$. The internal reactance is Xa = j10 ohms per phase and the internal resistance of the generator is negligible. What is the total power produced by the generator?

(A) 920 MVA

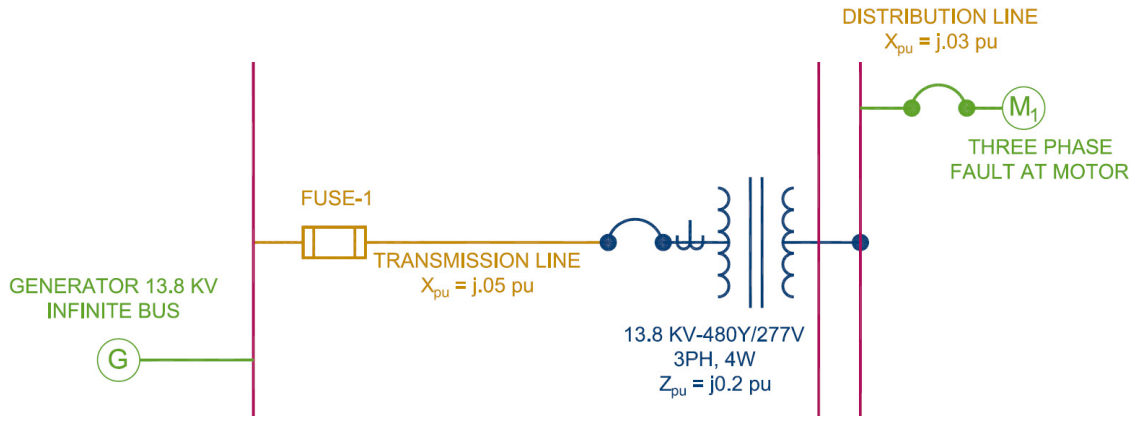
(B) 1,600 MVA

(C) 2,000 MVA

(D) 2,800 MVA

PROBLEM 46 – TRANSMISSION AND DISTRIBUTION

An infinite bus, with a voltage of $1\angle 0° \; pu$, supplies power to a motor load. A three phase fault occurs at the motor. The impedances of the transmission line, transformer and distribution line are shown below for the same base. Assume there are no other impedances and the generator operates as an infinite bus. What is the voltage at the bus in between the transformer and the distribution line?



(A) 0.11 pu

(B) 0.18 pu

(C) 0.71 pu

(D) 0.82 pu

PROBLEM 64 – APPLICATIONS

A new machine is installed in order to increase productivity. This new machine costs $160,000 and has an ongoing operating and maintenance cost of $500 per month. The new machine will save $2,000 per month and will have a salvage value of $15,000 after 10 years. If the interest rate is 4%, then what is the annual cost of the new machine?

(A) $500

(B) $6,500

(C) $11,500

(D) $19,000

PROBLEM 65 – APPLICATIONS

A wall mounted light produces 10,000 candelas in all directions and is used to illuminate a walkway. The walkway is 10 feet wide, with one side of the walkway butted against the wall. The walkway runs the entire length of the wall. If a minimum of 25 foot candles are required at all points on the walkway, what is the maximum height that the light can be located on the wall? Assume each light along the length of the walkway is 10 feet apart and assume the foot candle measurement is taken at an angle perpendicular to the beam of light (angle of incidence = 0).

(A) 10 feet

(B) 16.6 feet

(C) 17.3 feet

(D) 20 feet

PROBLEM 78 – CODES AND STANDARDS

The minimum size THWN copper conductors rated at 90 C installed in conduit required to serve a continuous duty 460-V, 25-hp (FLC = 30 A), three-phase synchronous motor and a continuous lighting load of 10 A. Assume a power factor of 1.0. Assume the lowest temperature rating of any connected termination, conductor, or device is 90 C.

(A) 10 AWG

(B) 8 AWG

(C) 6 AWG

(D) 4 AWG

PROBLEM 79 – CODES AND STANDARDS

An induction motor has the following nameplate values: 500 hp, 4,160 volts, 75 amps, 1,700 rpm, 60 hz, 3 Phase, 0.75 pf, code G, insulation class F, continuous duty. What is the maximum locked rotor current (amperes) for this motor?

(A) 756 A

(B) 621 A

(C) 578 A

(D) 437 A

$$Demand\ (kW, After) = 460V * \sqrt{3} * (52A + 18A) * 0.9 = 50.2kW$$

Each billing cycle occurs monthly, therefore, find the new monthly demand savings.

$$Monthly\ Demand\ Savings = (99.0kW - 50.2kW) * \$10/kW = \$488/month$$

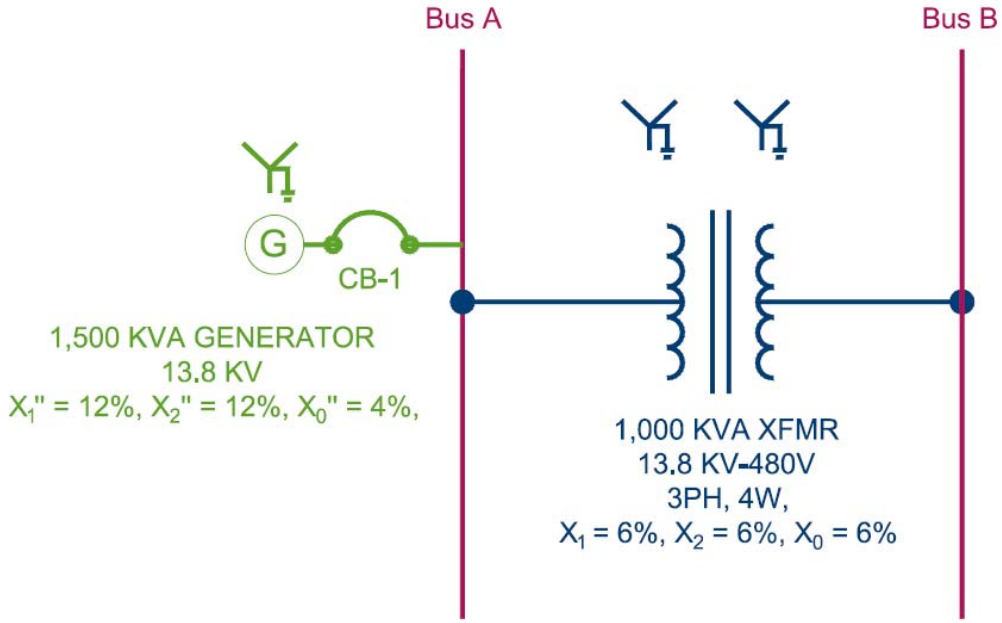
Then, find the yearly demand savings.

$$Yearly\ Demand\ Savings = \$488/month * 12month/year = \$5856/year$$

The answer is most nearly **(B) $5900**.

SOLUTION 15 – PROTECTION

What is the fault current through phase A, during a single phase (A) to ground fault? The percent values are shown for each individual equipment's base. Find the fault current at Bus B. The fault voltage is 1.0 pu and this is a 3 phase circuit.



(A) 1,850 A

(B) 5,275 A

(C) 9,150 A

(D) 9,850 A