Given a 200HP 3 phase synchronous motor rated at 460V 60Hz with 8 inductive poles with full load current of 200A with maximum power to rotor (torque angle = 0) calculate the following.

- What is the synchronous speed of the generator rotor (in RPM)?

$$n_s = 120\frac{f}{p} = \cancel{120}\ 30 * \frac{\cancel{60}\ 30Hz}{\cancel{8}\ \cancel{4}\ 1\ poles} \tag{1}$$
$$\underline{\overline{|n_s = 900rpm|}}$$

- What is the slip?

$$torque\theta = 0 \tag{2}$$
$$\therefore$$
$$s = 0$$

- What is the power factor?

$$200HP = 149.14kW \tag{3}$$
$$S = VI\sqrt{3} = 460V * 200A * \sqrt{3}$$
$$S = 166.28kVA$$
$$\underline{\overline{|pf = 0.89|}}$$

- What is the mechanical output in HP of this motor at full speed?

$$200HP \tag{4}$$

- What is the total impedance of this motor at full load?

$$|Z| = \frac{V}{I} = \frac{480V}{200A} \tag{5}$$
$$< Z = cos^{-1}(0.89)$$
$$Z = 2.4\Omega < 26.24^\circ$$

- What is the resistive impedance of this motor at full load?

$$R = |Z|cos(\theta) = 2.4\Omega * 0.89 \tag{6}$$
$$R = 2.15\Omega$$

- What is the reactive impedance of this motor at full load?

$$X = |Z|sin(\theta) = 2.4\Omega * sin(26.24^\circ) \tag{7}$$
$$\underline{\overline{|X = 1.06\Omega|}}$$

- What is the full load active power drawn by this motor?

$$200HP = 149.14kW \tag{8}$$

- What is the full load reactive power drawn by this motor?

$$Q = \sqrt{S^2 - P^2} = \sqrt{166.28kVA^2 - 149.14kW^2} \tag{10}$$
$$\underline{\overline{|Q = 47.49kVAR|}}$$

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Apply 3 phase power to the stator.

Define the following terms:

- Slip of a Synchronous Generator
  The difference in speed (in percent) between the synchronous speed (the frequency of the output signal) and the rotational speed (the speed of the rotor).
- Armature of a generator
  The rotating portion of the generator. When in a motor, this is the rotor.
- Rotating AC field generator vs Stationary AC Field Generator
  Rotating AC field generators have stationary magnetic fields, while stationary AC field generators have rotating magnetic fields.
- Permanent Magnet generator (explain benefits and whether its a stationary or rotating AC field generator)
  Permanent Magnet generators are stationary AC fields. Permanent Magnet generators are cheaper to build.
- Infinite bus
  The bus who's voltage and frequency remains constant even after variation in the load.