SPH3U 13.6 Power Plants and the Electrical Grid

1. Transmission efficiency

Power loss:	when current runs through a wire, some voltage is lost (based on the wire's resistance).
equation	$P = VI = (IR)I = I^2R$.
efficiency	lower current = less power lost.

A generator produces 300 MW (3×10^8 W) of power at a current of 30 kA and a voltage of 10 kV. That power travels through a transmission wire with a resistance of 0.1 Ω. How much power is lost (in MW and in % of the total)?

$P = I^2R = (30 \times 10^3)^2(0.1)$

$= 9 \times 10^7$ W

$= 90$ MW

$\frac{90}{300} \times 100\% = 30\%$

Now a step-up transformer is used to increase the voltage to 100 kV before sending it over the wire. This lowers the current to 3 kA ($V_P I_P = V_S I_S$). What is the new power loss?

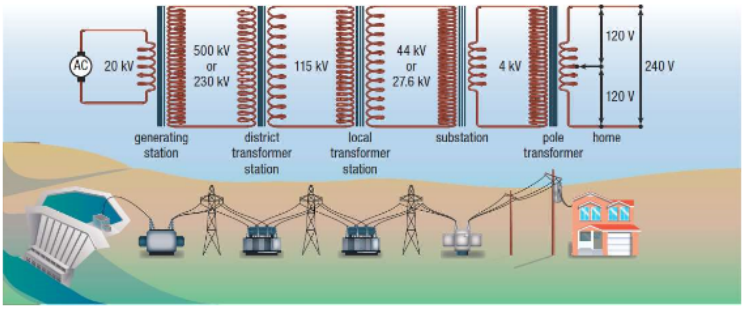
$P = I^2R = (3 \times 10^3)^2(0.1)$

$= 9 \times 10^5$ W

$= 0.9$ MW

$\frac{0.9}{300} \times 100\% = 0.3\%$.

2. The power grid



AC generators:	sometimes use a DC electromagnet inside the AC generator instead of a permanent magnet.

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