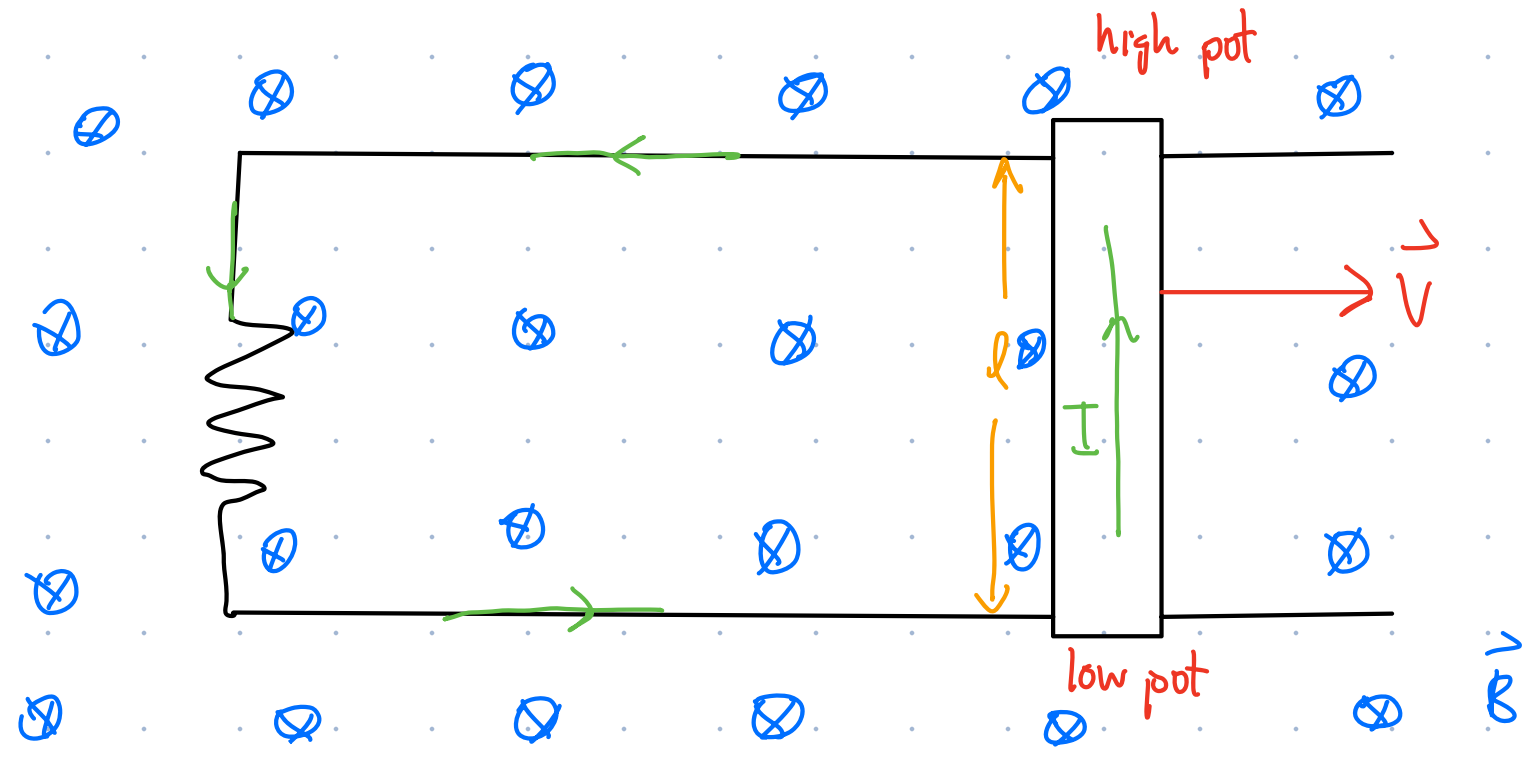
PHYS 121 April 4, 2025

- Next PrairieLearn HW due **Tues. Apr. 8**
- See course website for final exam details (including formula sheet)
- If participating in the hands-on bonus project, send me a link to your YouTube video by 23:59 on April 7.
- Complete the end-of-term survey by 23:59 on April 8 for 0.5 marks towards your final grade. A link to the survey has been provided in Canvas.



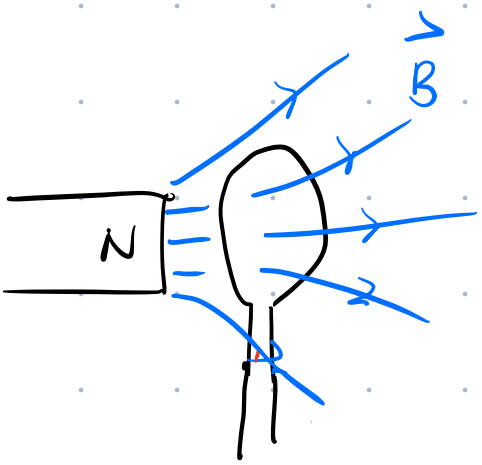
Last Time:

Faraday's Law:

$$\mathcal{E} = \left| \frac{d\Phi_B}{dt} \right|$$

$$\Phi_B = \int \vec{B} \cdot d\vec{a}$$

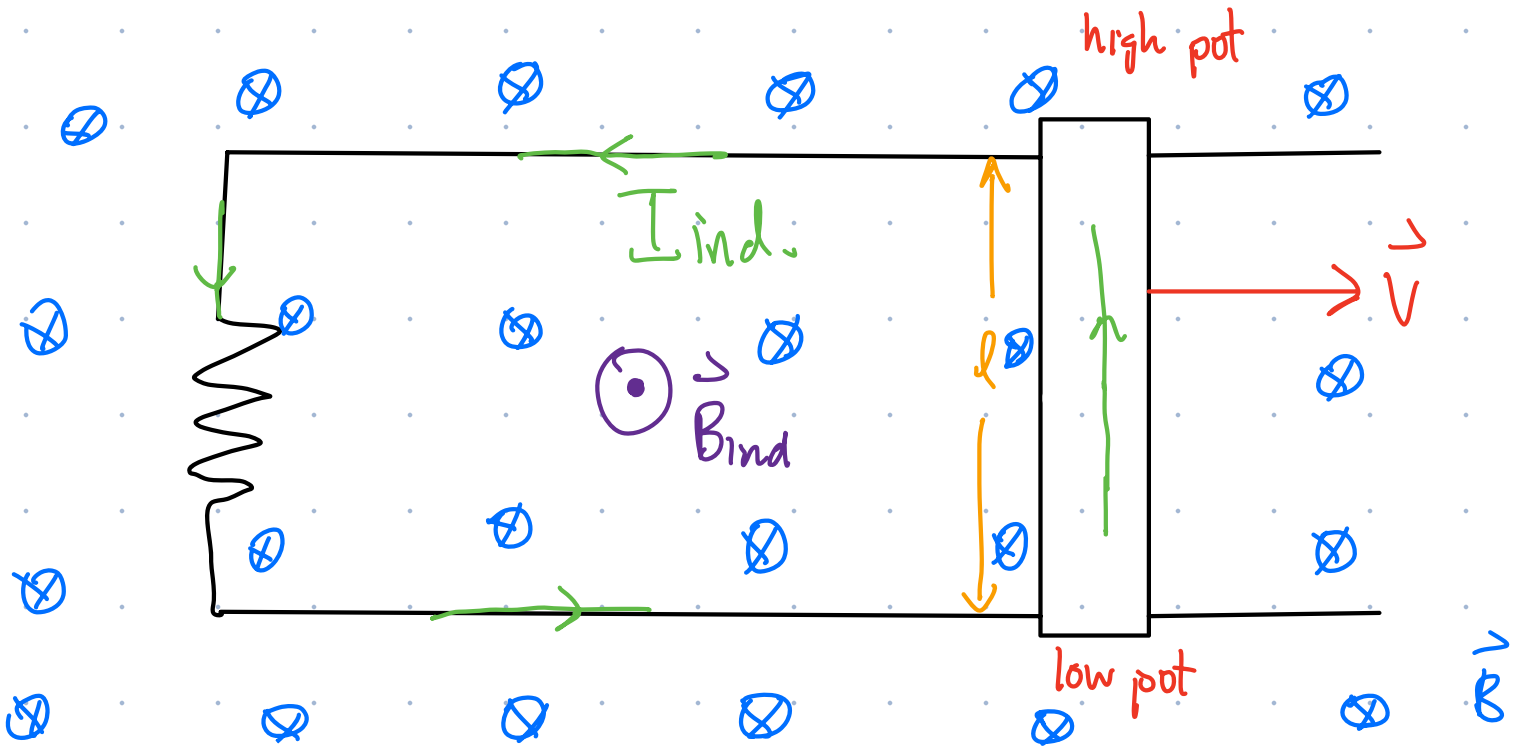
$$= BA\cos\theta \text{ for flat surfaces } \& \text{ uniform } \vec{B}.$$



Can get induce emf in three different ways.

- ✓ change the strength of $\vec{B}$ (magnetic braking)
- ✓ change the loop area A (eg. motional emf)
- ✓ change θ (angle between area & $\vec{B}$)

$\Rightarrow$ electric generators.



Consider the dirn of induced emf, current, and magnetic field.

CASE 1 Increase flux through the loop by pulling bar to right.

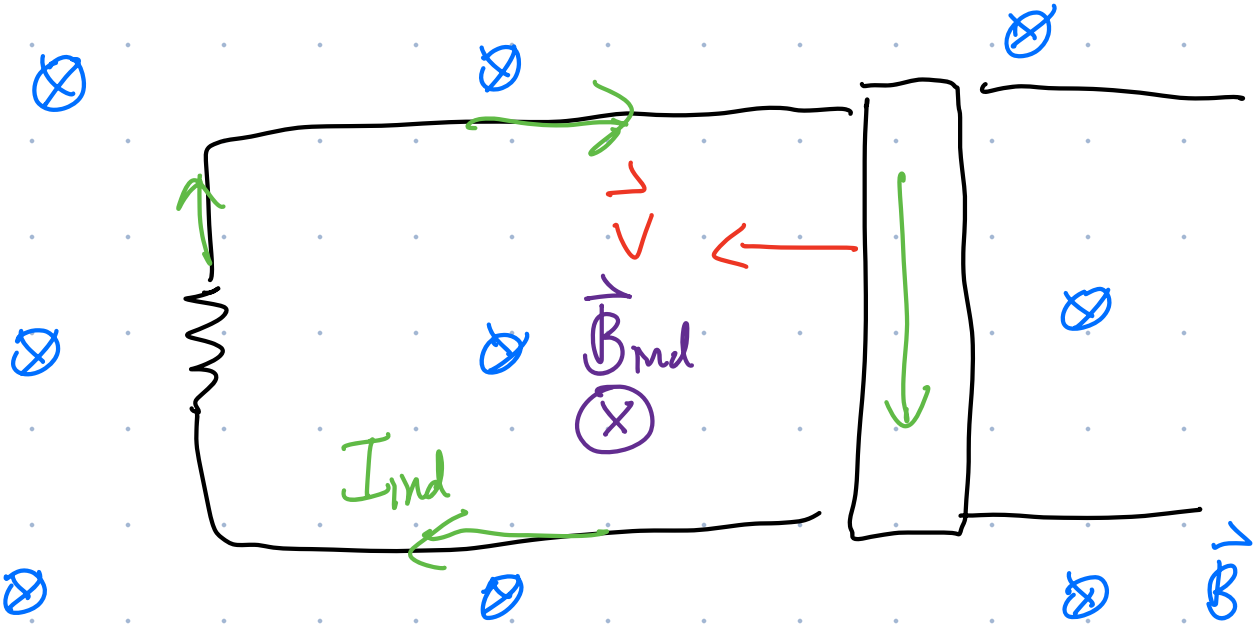
In this case, top of the bar becomes high pot & the btm low pot. (RHR).

Because pos. charges deflected to the top of the bar by the magnetic force, get a ccw current, I_{ind}.

This induced current, creates its own magnetic field $\vec{B}_{ind}$. By the RHR, B_{ind} is <u>out</u> of the screen.

When we <u>increase</u> Φ_B through a loop, the induced magnetic field opposes this change in flux by having a dir'n that is opposite to the dir'n of the original field.

CASE II - decrease Φ_B through loop.



In this case, by RHR pos. charge deflected towards btm of rod $\longrightarrow$ I_{ind} is in CW dir'n.

This CW current creates $\vec{B}_{ind}$ which, by the RHR, is into the screen (parallel to original $\vec{B}$).

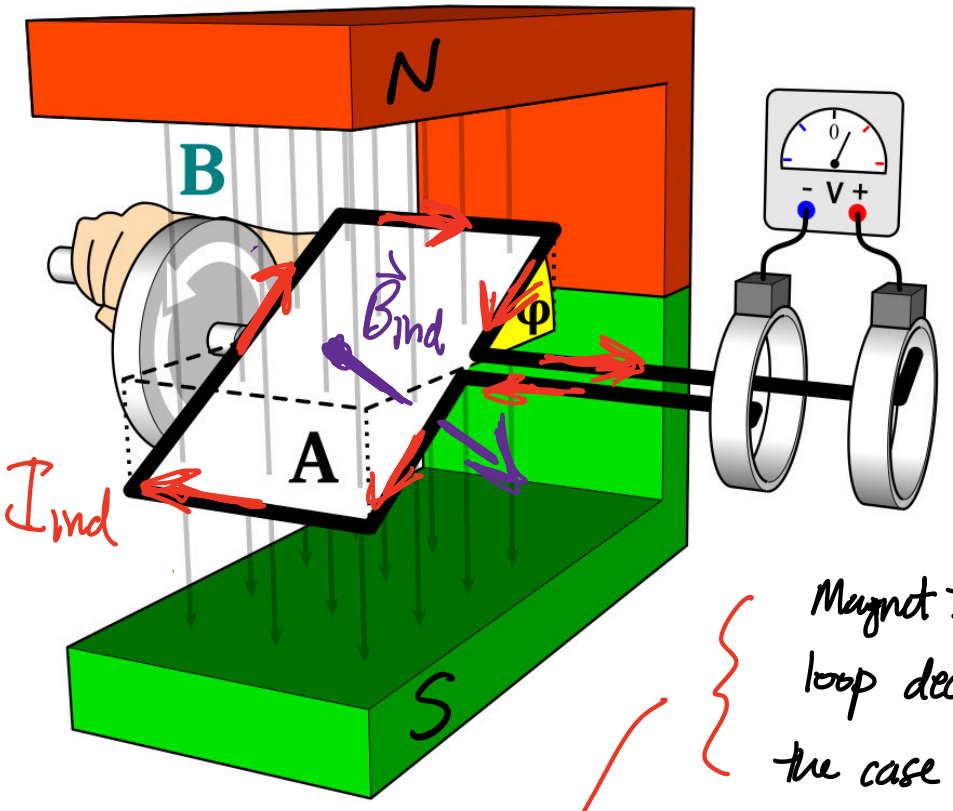
Again, $\vec{B}_{ind}$ acts so as to try to maintain the original flux through the loop.

Lenz's Law:

The induced magnetic field $\vec{B}_{ind}$ has a dir'n that tends to maintain the original magnetic flux.

- If Φ_B is increasing, $\vec{B}_{ind}$ is in opp. dir'n of $\vec{B}$
- If Φ_B is decreasing, $\vec{B}_{ind}$ is in same dir'n as $\vec{B}$.

Basic Electric generator - rotate a coil through a magnetic field.



Magnet flux through loop decreasing in the case drawn.

By Lenz's law,
→ B_{ind} parallel to original magnetic field.

By Faraday's Law, get an induced emf

$$\mathcal{E} = \left| \frac{d\Phi_B}{dt} \right|$$

By RHR, corresponding I_{ind} is CW

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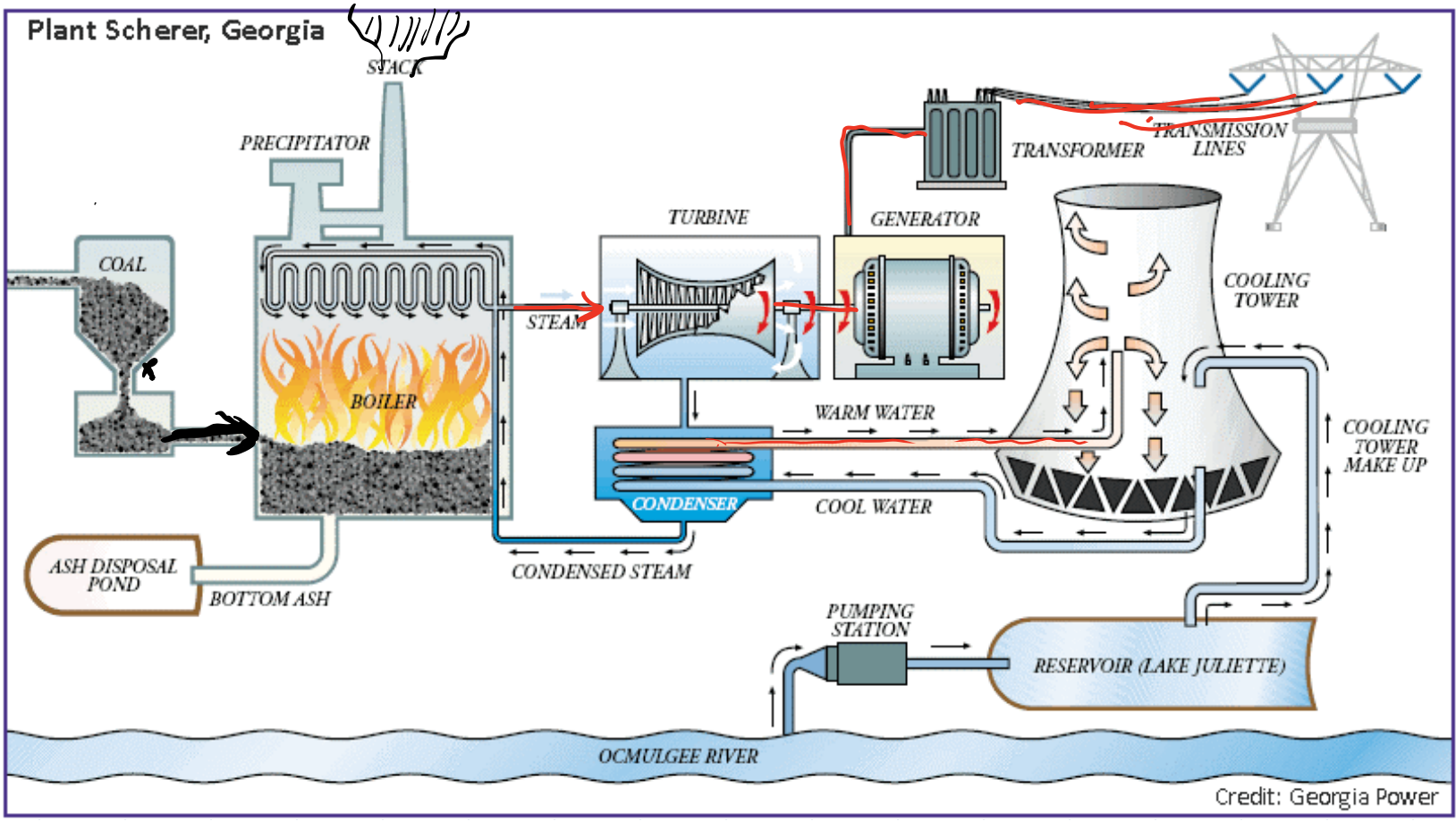
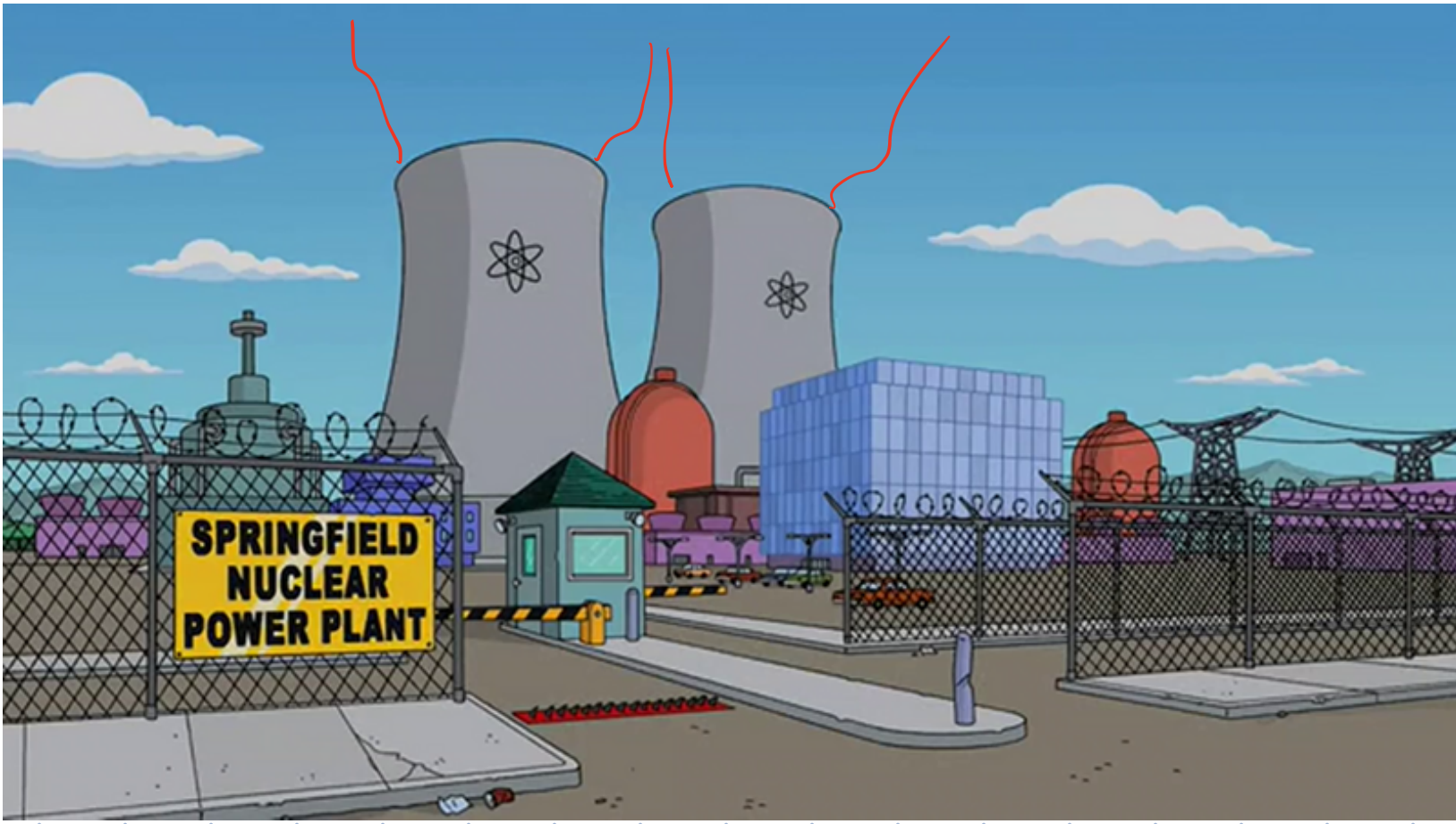
once loop passes vertical, Φ_B goes from zero to increases. When Φ_B starts increasing, B_{ind} & I_{ind} reverse dir'n → AC energy source (Alternating current)

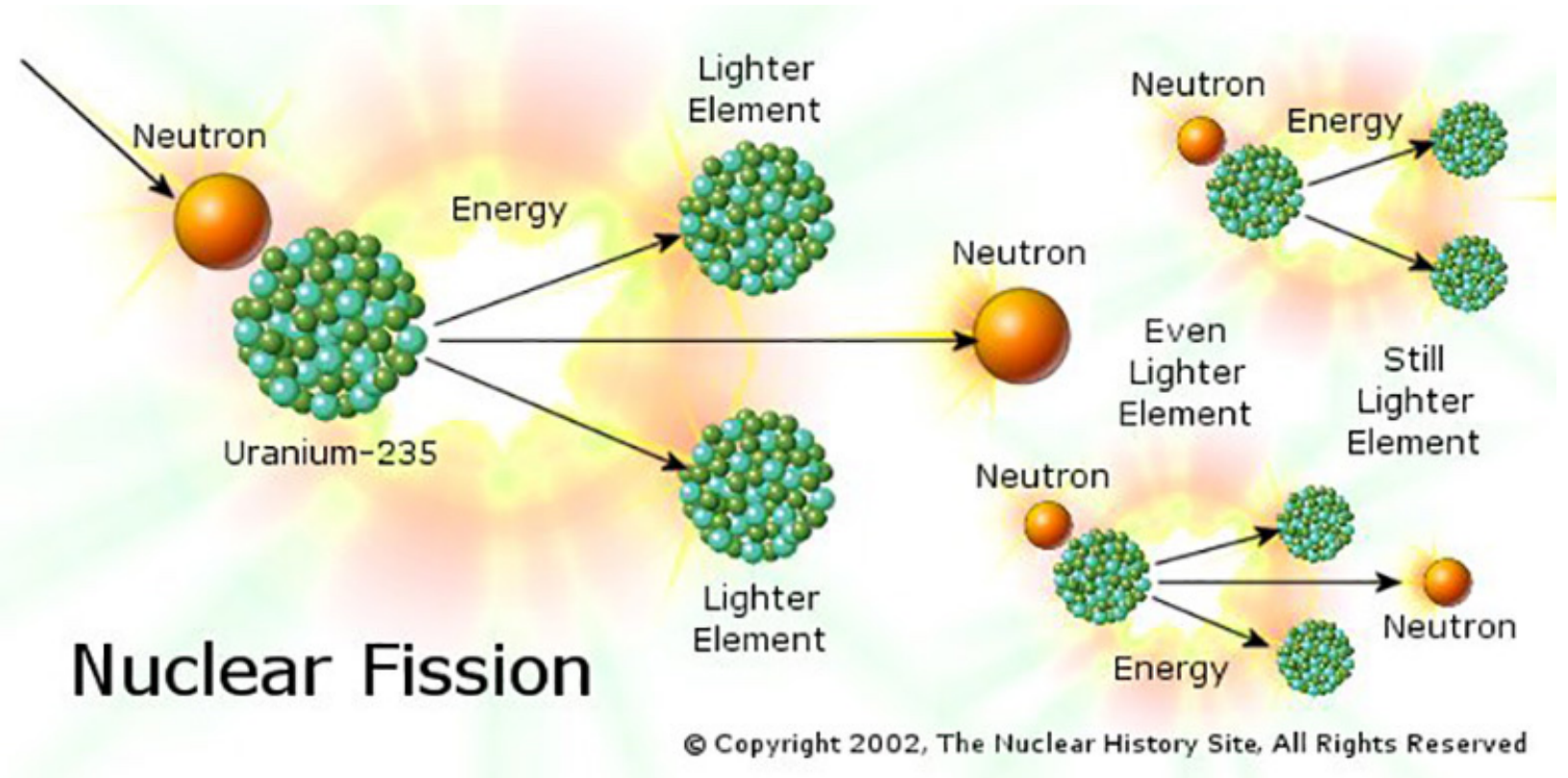
Coal Plant

Coal Plant Schematic

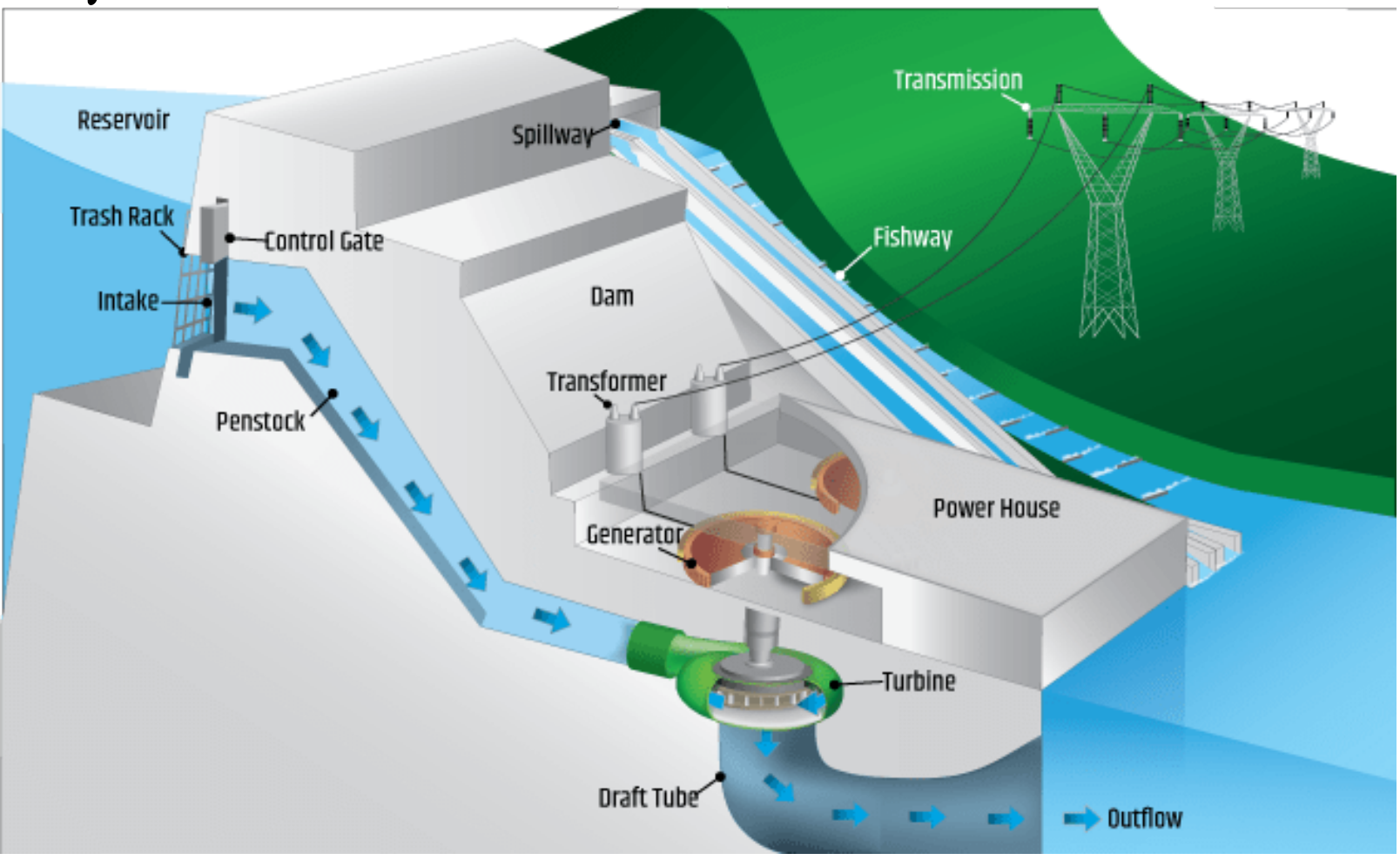


Nuclear Power Plant (Simpsons)





Hydro damn Schematic



Ruskin Dam. Between Maple Ridge & Mission