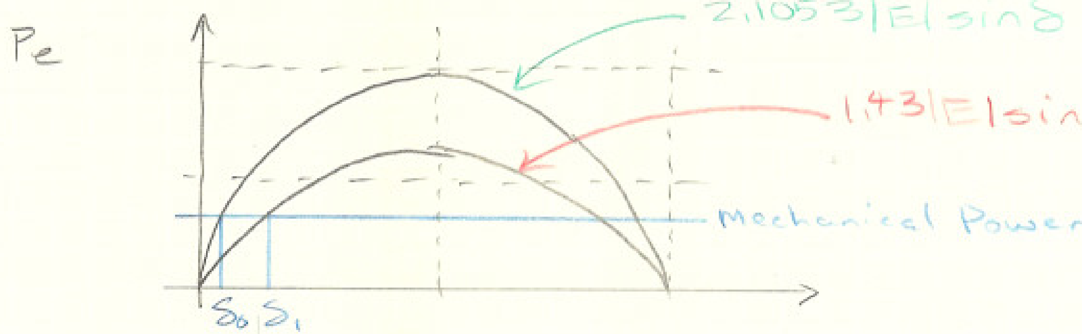
continued from last day...

P_e is the power reciever by the ∞ bus, changes in network configuration between sending end and recieving end, will change the value of X, hence the value of P_e.

For example, if one of the two parrelel lines in the above network is removed, then the new X is equal to...

$$X = 0.7 \text{ PU}$$

$$P_e = \frac{|E|(1)\sin\delta}{0.7} = 1.43|E|\sin\delta$$



The system delivers an apparent power of 1.1 p.u. at 0.85 PF lagging $\bar{c}$ too lines in service to an ∞ bus as shown above. Determine the source (excitation voltage) E and angle δ_0 under these conditions with the second line open, the new equilibrum angle δ_1 is reached. Find the electric power that can be transfered immediately following the cct opening as well as δ_1. Assume that the excitation voltage $\bar{E}$ remains unchanged.

<u>SOL:</u>

$$\text{Power delivered} = P_e = 1.1 * 0.85$$

Let $P_0 = P_e = 0.94$ p.u.

For the current $\bar{I}$ in the currcuit, we can write.

$$\bar{S}_0 = \bar{V}_\infty \bar{I}^*$$

$$\bar{I} = \frac{\bar{S}^*}{\bar{V}_\infty^*} = \frac{1.1(0.85 - j0.53)}{1.0\angle 0^\circ} = 1.1\angle -31.8^\circ$$

$$\bar{E} = |\bar{E}|\angle 0^\circ$$

$$\bar{E}\angle\delta = |\bar{V}|_\infty \angle 0^\circ + j\bar{I}X$$

$$jX = j0.15 + j0.1 + j0.45 \,//\, j0.45 = j0.475$$

then

$$|\bar{E}|\angle\delta = 1 + 0j + (1.1\angle -31.8^\circ)(0.475\angle 90^\circ)$$

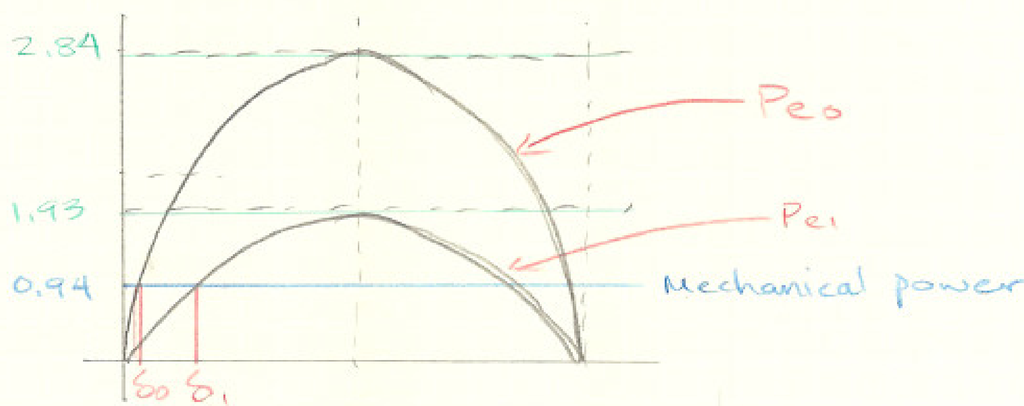
$$= 1.35\angle 19.20^\circ$$

with both lines in use, then the system is stable at δ_0 ...

$$\delta_0 = 19.20^\circ$$

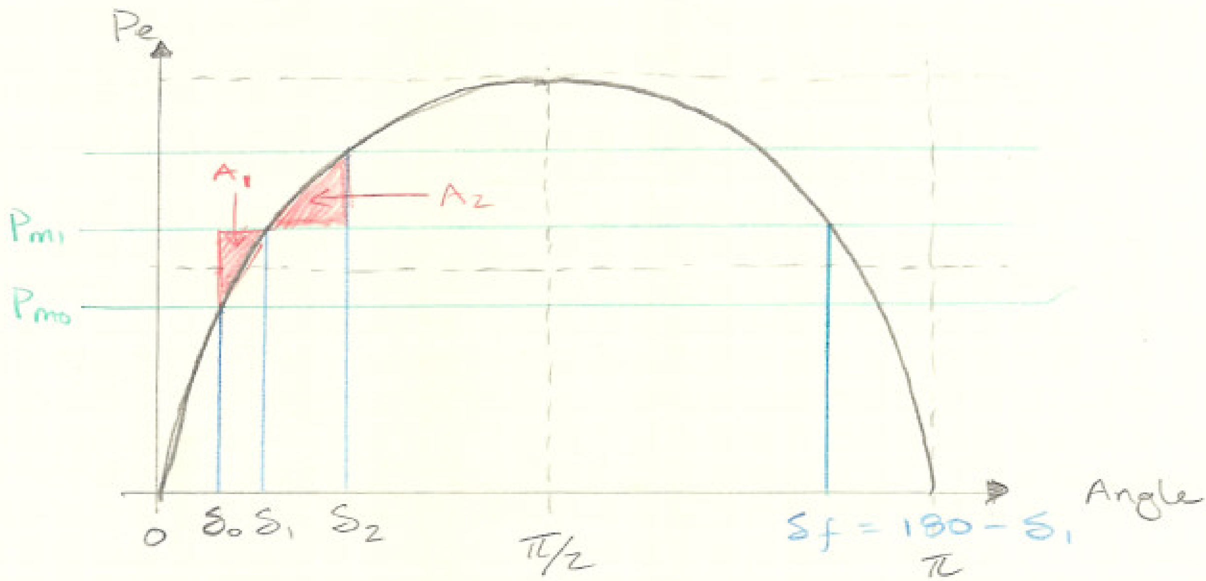
with one of the lines out of service, the new power $P_e = P_{e1}$ is:

$$P_{e1} = (1.43)(1.35)\sin\delta$$
$$= 1.93 \sin\delta$$



δ_1 can be found from $0.94 = 1.93 \sin \delta$.

EQUAL AREA METHOD



when $P_e = P_o$, then $P_e = P_{max} \sin \delta = P_o$, ie
$P_{m0} = P_e$

If shaft power is increased to $P_{m1} = P_1$, then $P_1 - P_o = P_1 - P_e = P_a$, where P_a is accelerating power, P_a will accelerated the rotor

P_a will accelerate the rotor and the additional energy will be stored in the inertia of the rotor, this will continue until δ reaches and passes δ_1

As δ becomes greater than P_1 and the rotor decelerates so that the additional electric energy needed is supplied by the stored energy. Then δ increases up to δ_2 and starts decreasing, oscilating around δ_1 until it reaches a new equilibrium state.

The excess energy stored in the inerta during the acceleration of the rotor is A_1, and is returned during the deceleration as A_2. For net energy to be zero then A_1 must equal A_2, hence the equal ~~area~~ method.