

ECE 526

PROTECTION OF
POWER SYSTEMS II

SESSION no. 30

Larger Scale Non-traditional

Generation - connected largely
at transmission level

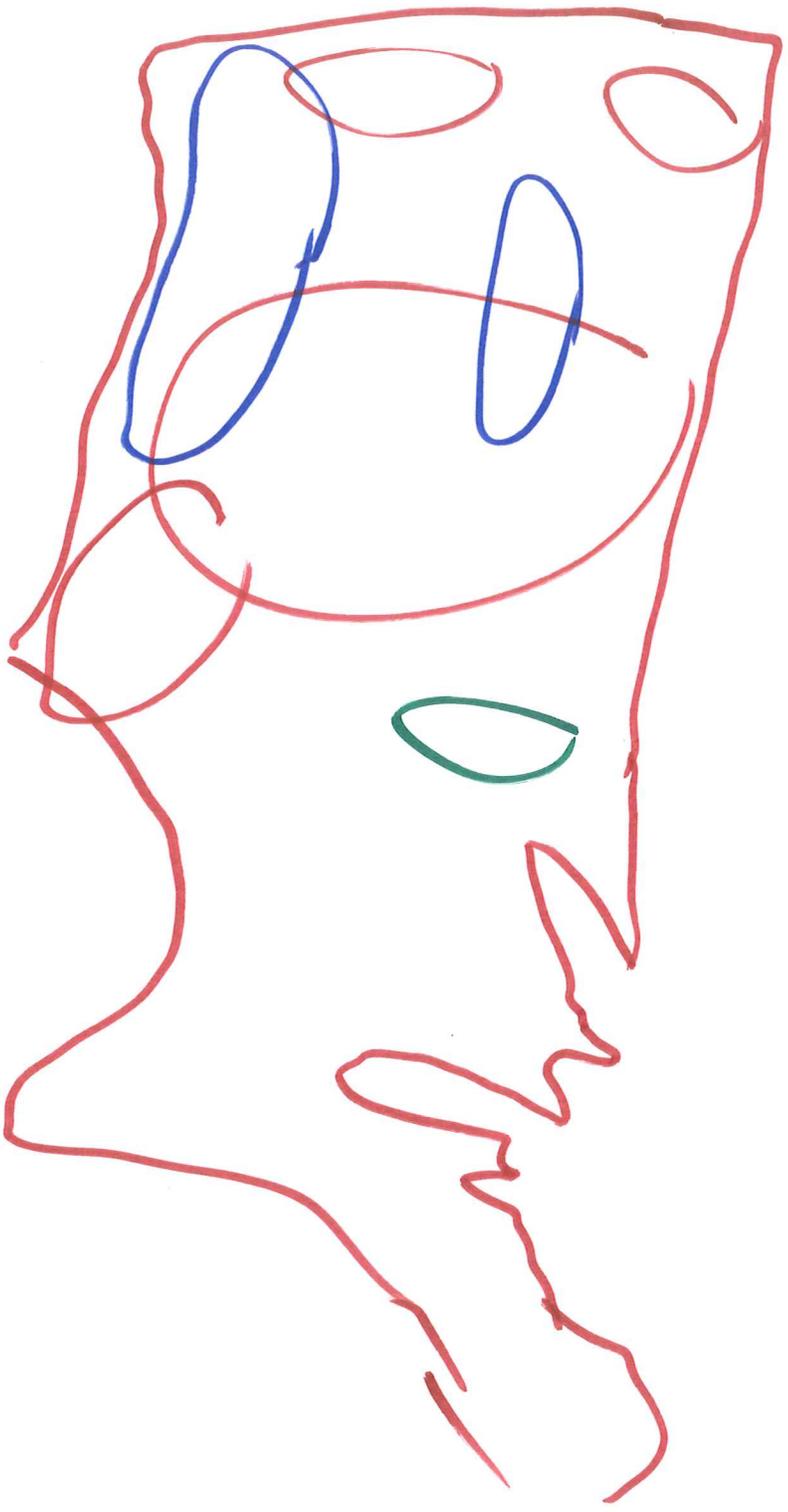
→ In many ways started with

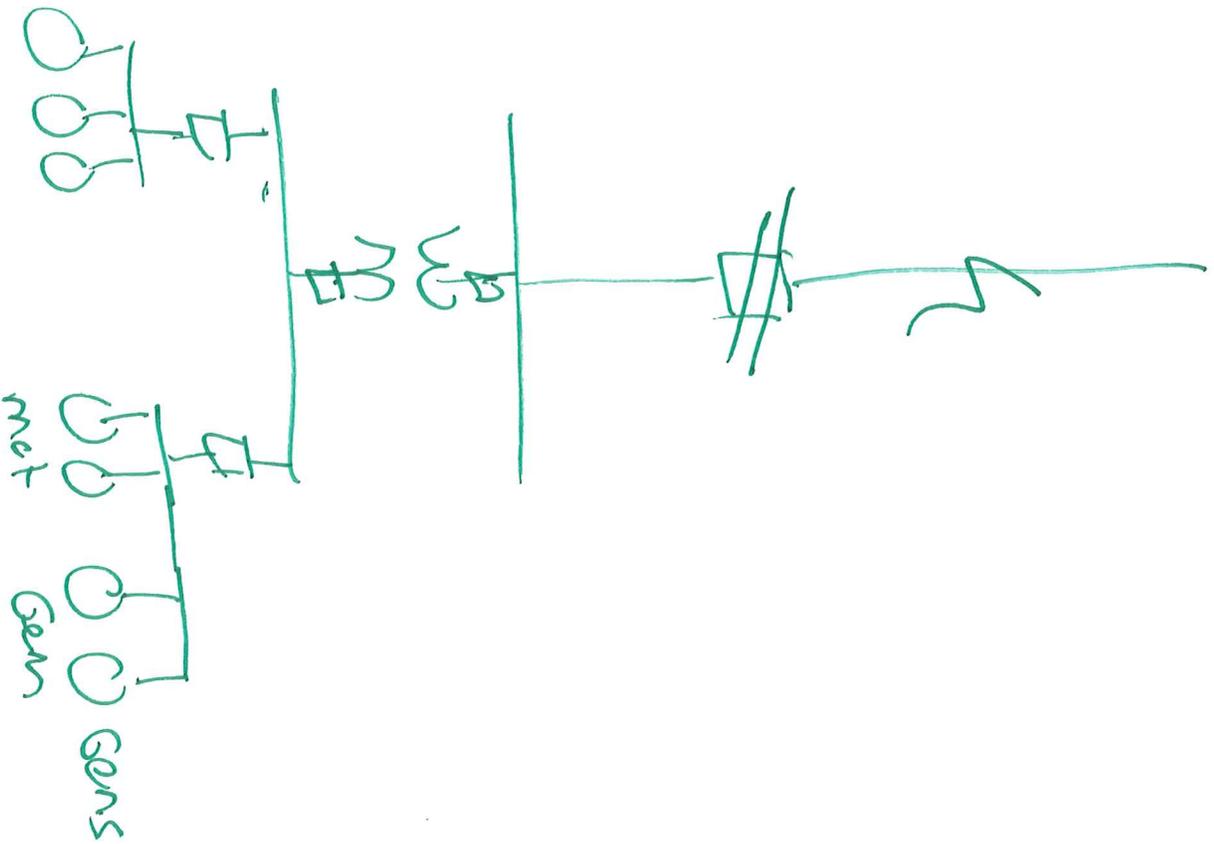
Federal rule making → PURPA

— Wind or PV

Connecting wind & PV at the
grid level

- modular - 1-5 MW units
- but many at one site





1304

Wind Plant



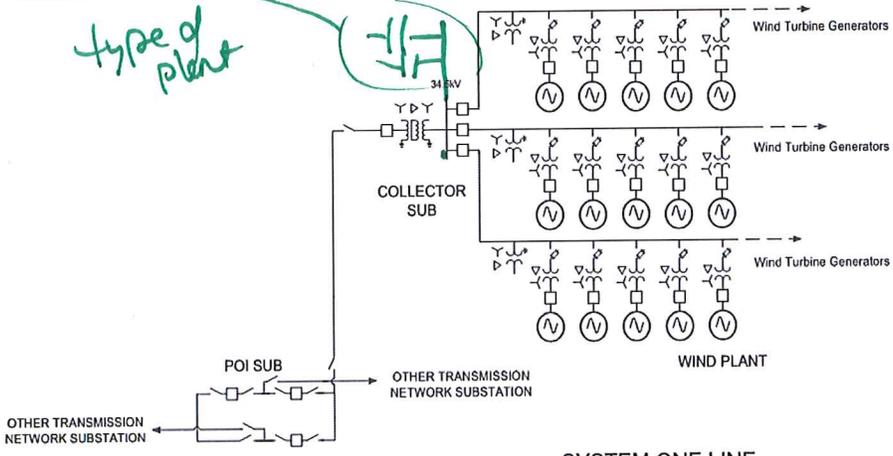
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Opportunities and Challenges

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depends on
type of plant

Wind Plant

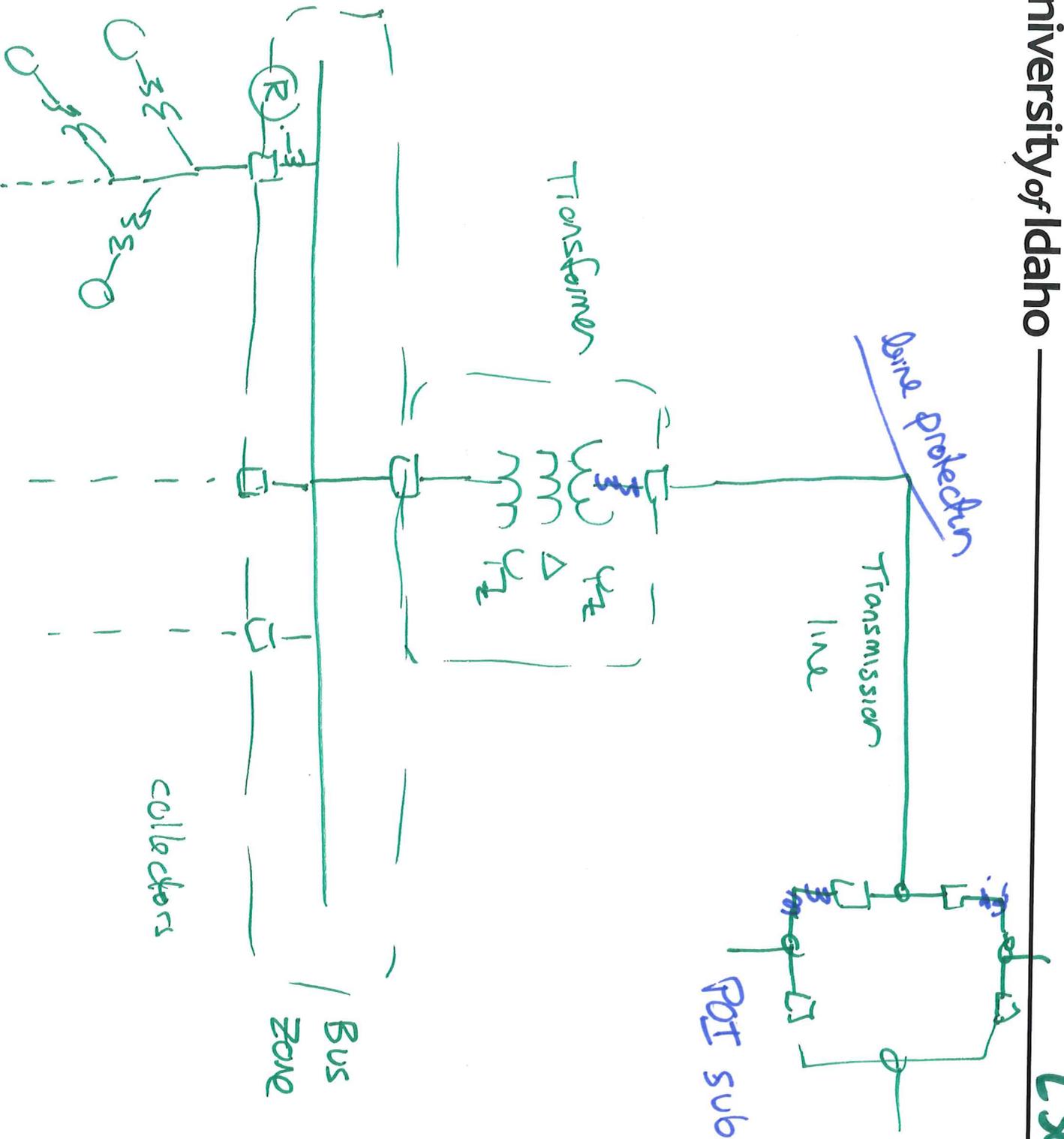


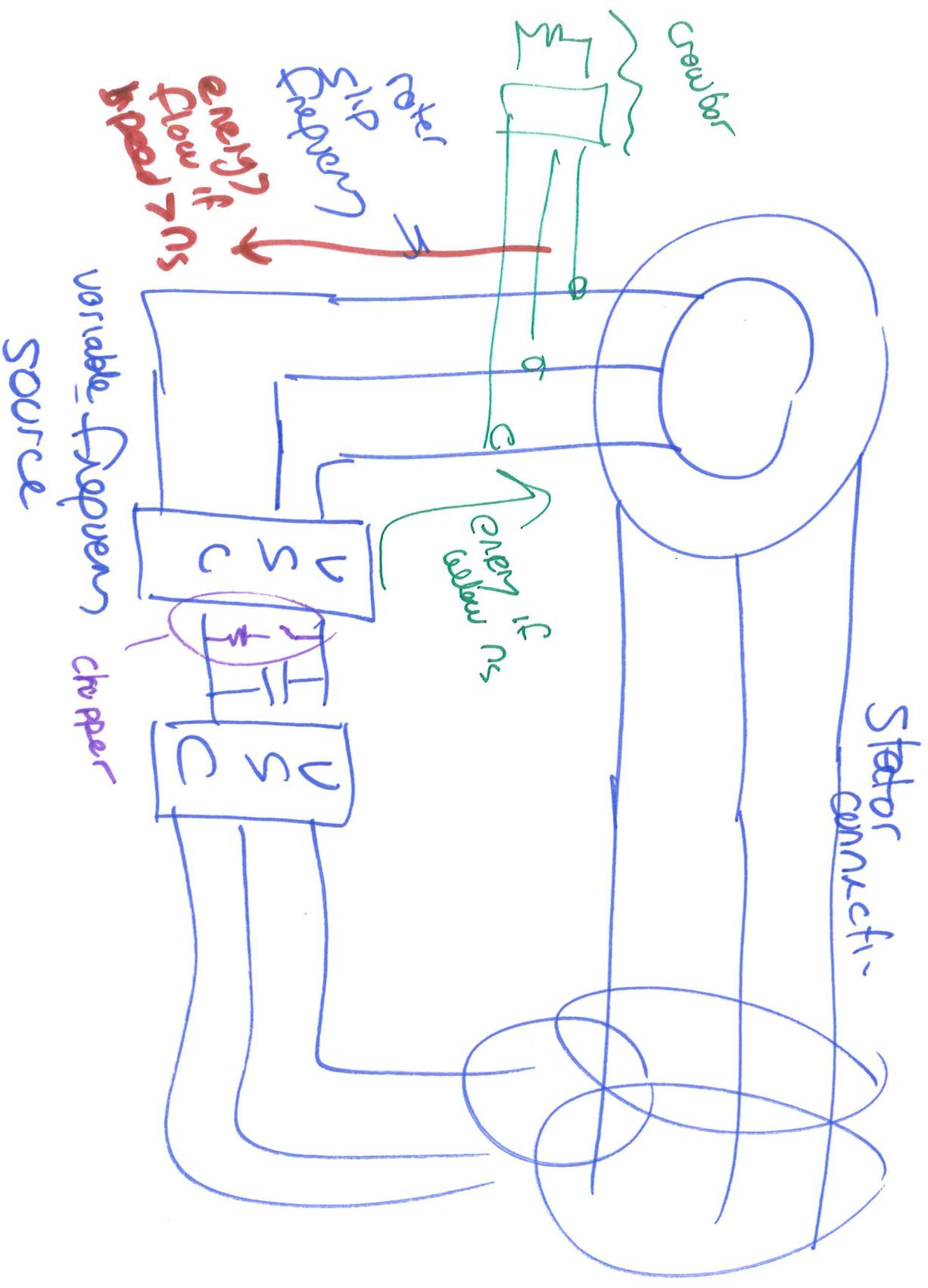
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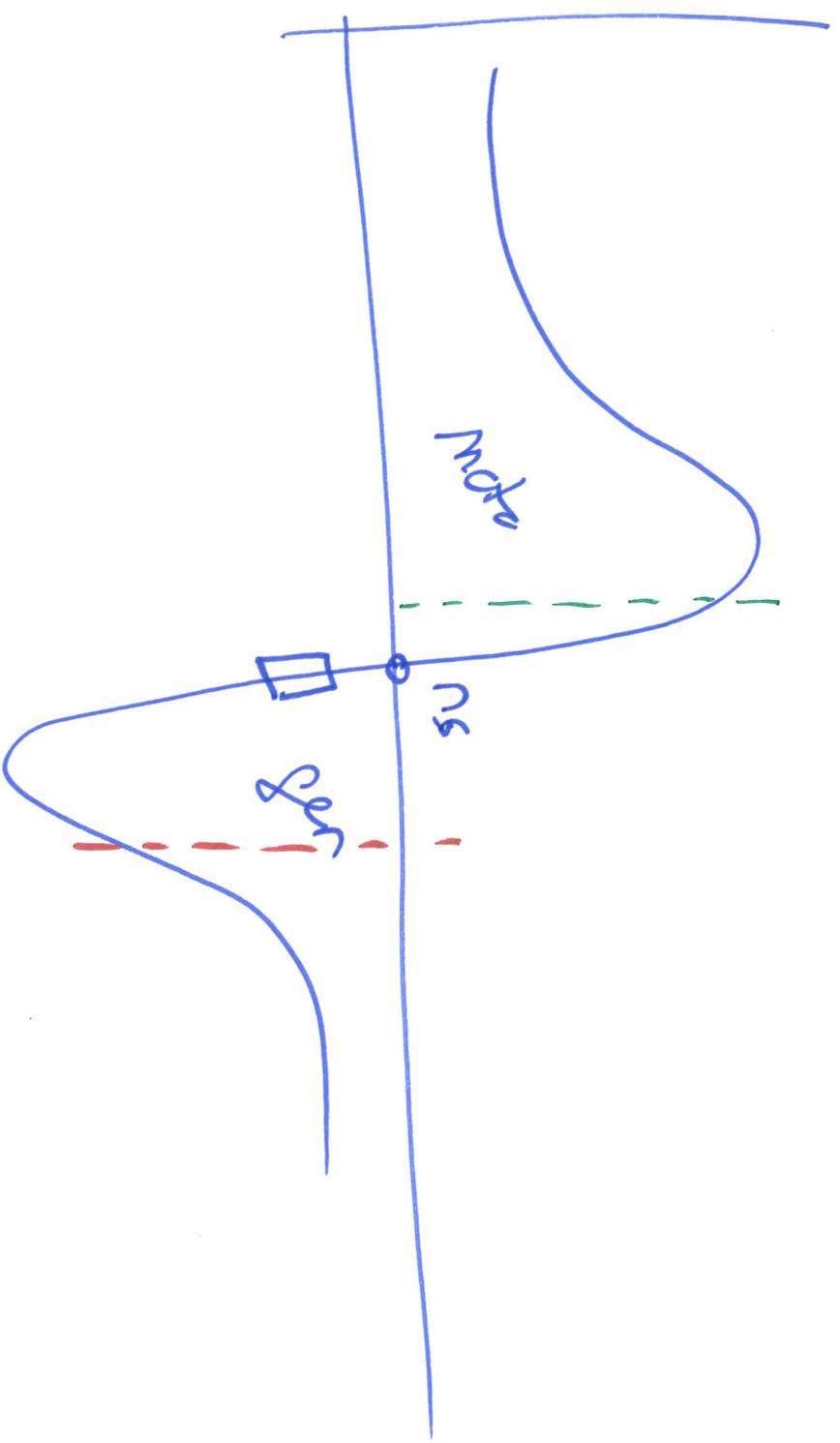
SYSTEM ONE LINE DIAGRAM

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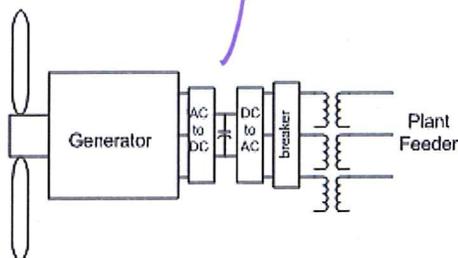




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PV has some grid side interface

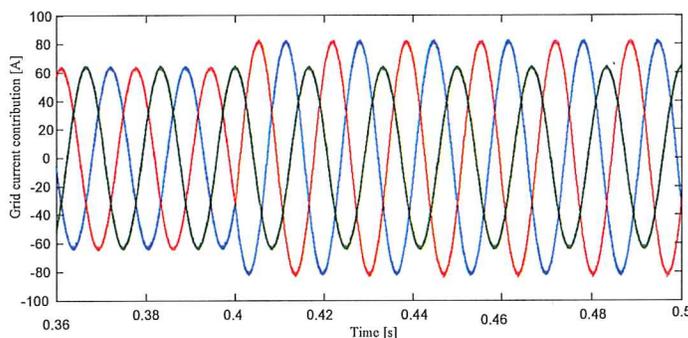
Type 4 Wind Turbine Generator



- Synchronous or induction generator
- Varies firing angle of inverters for real & reactive power control
- Fault current is limited and maintained by the by power electronics



Type 4 WTG Response to Fault



Single Phase to Ground Fault on the Terminals of the Generator



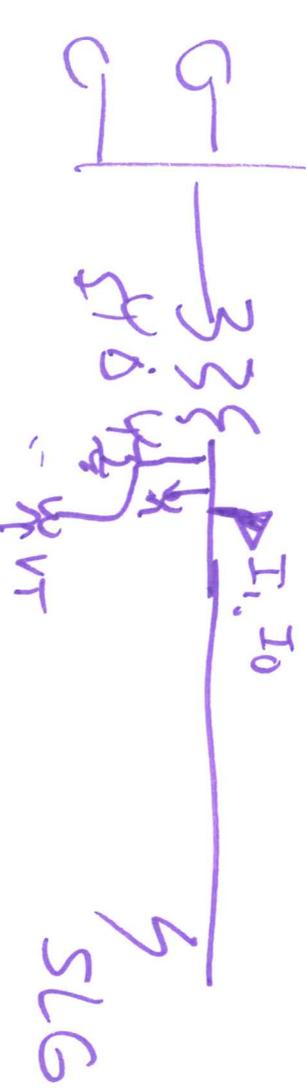
→ ~~can~~ PV, Type 4 WT

- limited overcurrent
- 1.1 - 1.2 pu potentially
- unity pf in most cases
- Pos sequence current

Transmission challenges..

- Distance elements - POTT

→ V, I - on lines side of substation xfm



Distance elements tend to do or mostly

- Directional supervision

$$\frac{Z_{\text{cell}}}{Z_{\text{bus}}}, Z_{\text{bus}}$$

angle between V_1 & I_1

Low voltage ride through requirement.

→ converter supplies reactive

power for faults with deeper

segs → I_1 loads V_1

- fault type selection logic can
have problems too

POTT - weak in feed

DCB - zone 2 sensitivity setting

Line cur different - minimum pickup

- depends on strength of other end

Capacitor Banks

- overcurrent for catastrophic fault,
- voltage imbalances
- Alarm

IEEE C37.99