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## **Grid Modernization using Simulated Communication Networks and Distribution Systems**

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# Grid Modernization using Simulated Communication Networks and Adapted Distribution Systems

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ECSE 398



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# Design Considerations

## Standards

- 60 Hz
- IEEE standard definition for Power Factor Calculation

## Technical Constraints:

- Equipment inefficiencies
- Near perfect power factor
- Wind Turbine
- Steady State Operation
- Case Grid Design



# Success Criteria

## Wind:

- DFIG nominal voltage value  $\pm 10\%$  ; frequency nominal value of  $\pm 2\%$
- 90% to 95% power factor

## Simulations:

- Simulation runtime is ~30 seconds

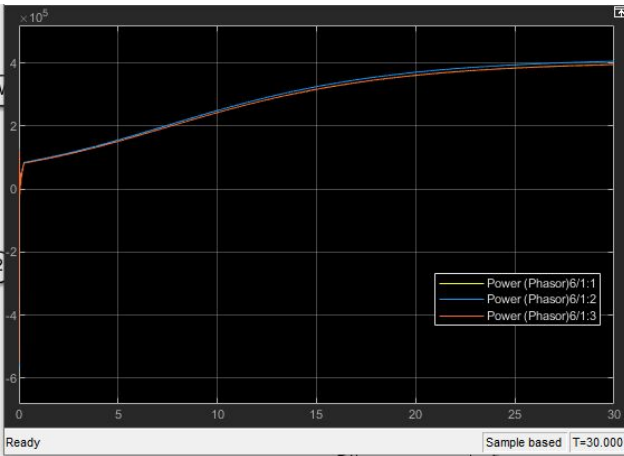
## Smart Metering:

- Follow IEEE definitions for PF calculations
- Smart meter reports voltage pu, voltage mag, phase angle current mag, real and reactive power, as well as power factor

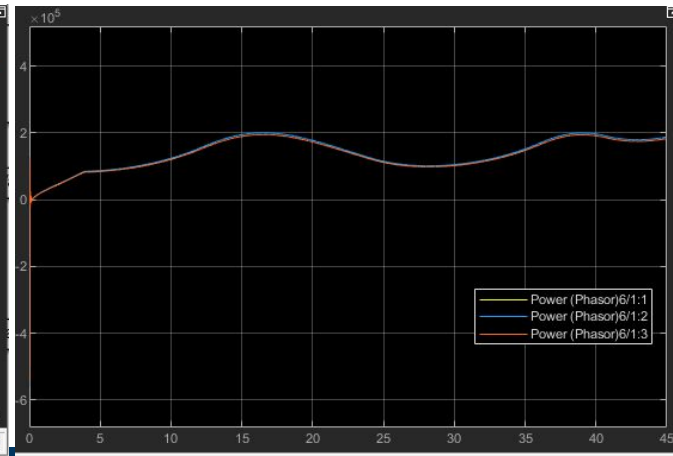


# Verification/Results

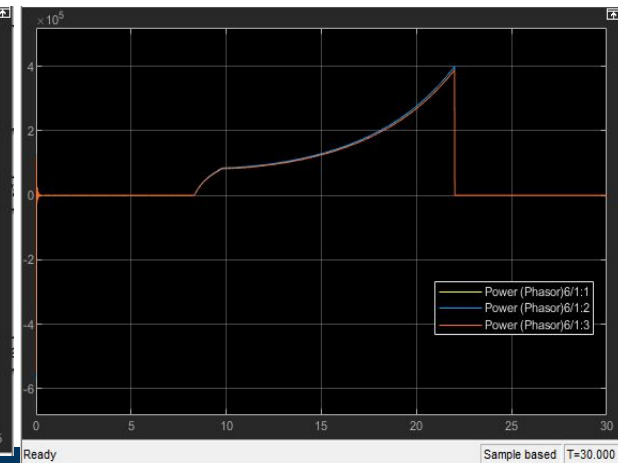
13 Node: Constant Rated Speed



13 Node: Constant Wind Variation

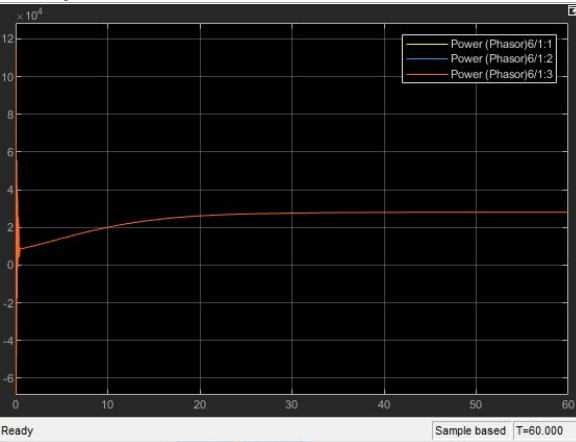


13 Node: Zero Wind to Cut-off

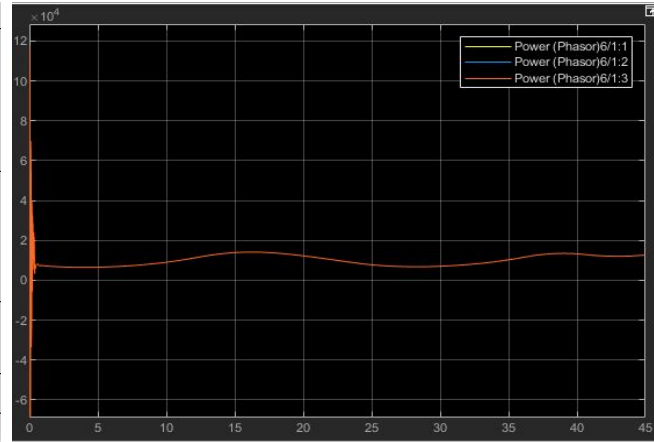


# Verification/Results

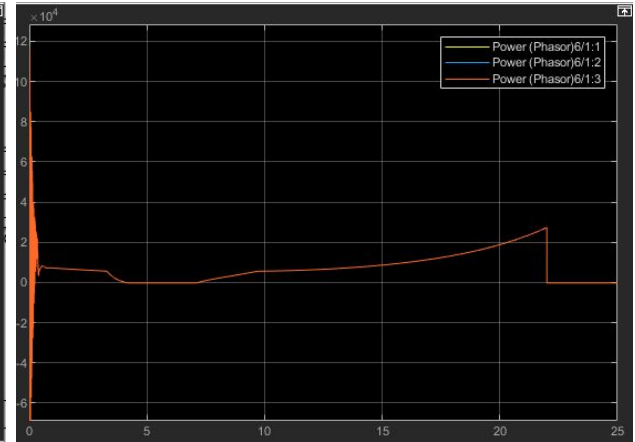
Case Grid: Constant Rated Speed



Case Grid: Constant Wind Variation

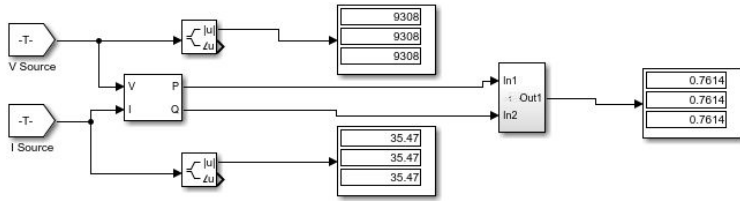


Case Grid: Zero Wind to Cut-off

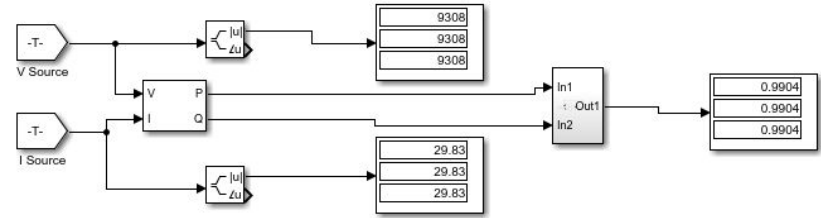


# Power Factor Comparison

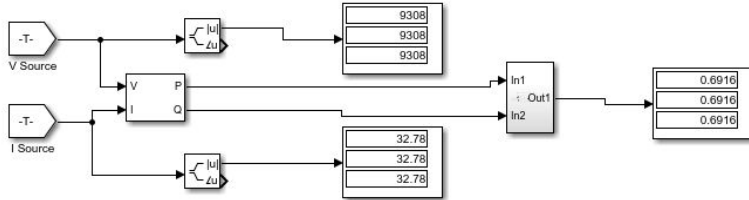
Neither



Only Capacitors



Only Wind Generation



Both





# Thank you!



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