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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 ±10% ; frequency nominal value of ±2%
- 90% to 95% power factor

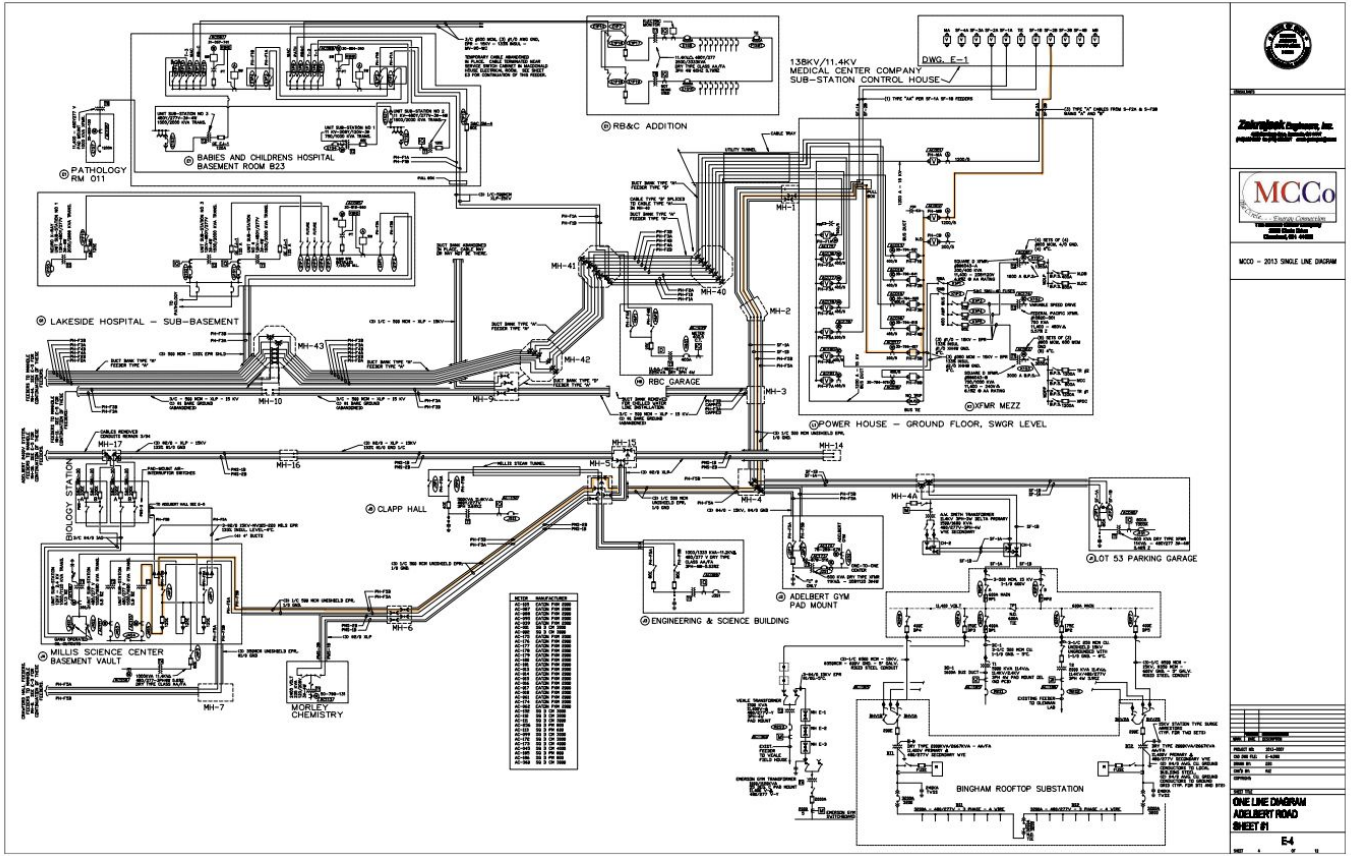
Simulations:

- 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

Simulation Demonstration



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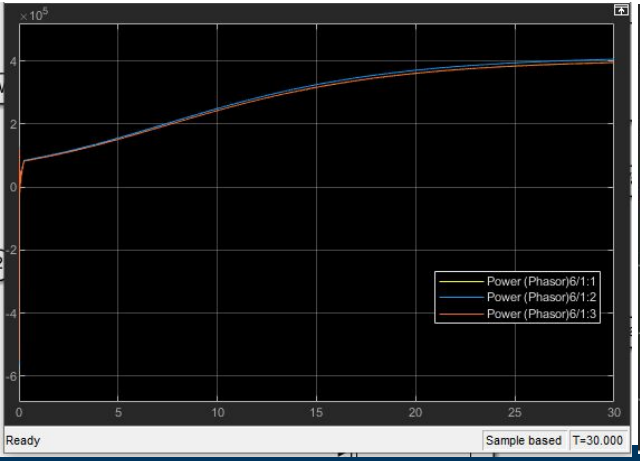
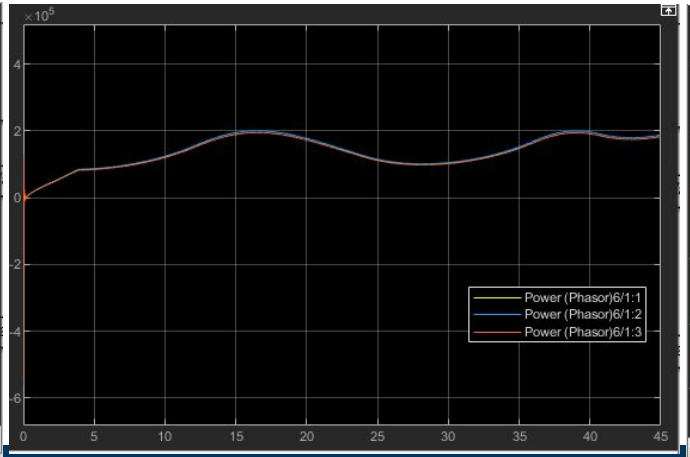
Verification/Results

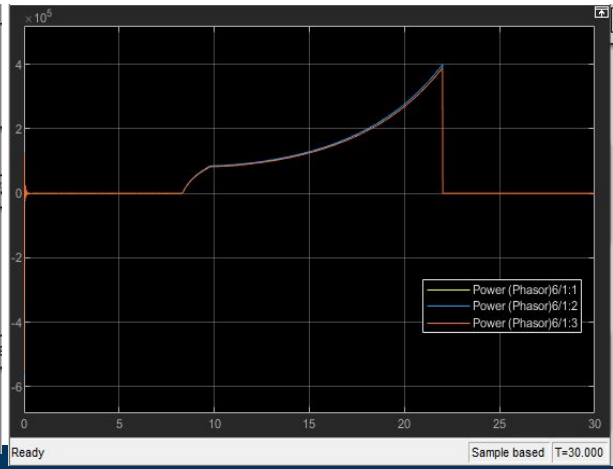
13 Node: Constant Rated Speed



13 Node: Constant Wind Variation

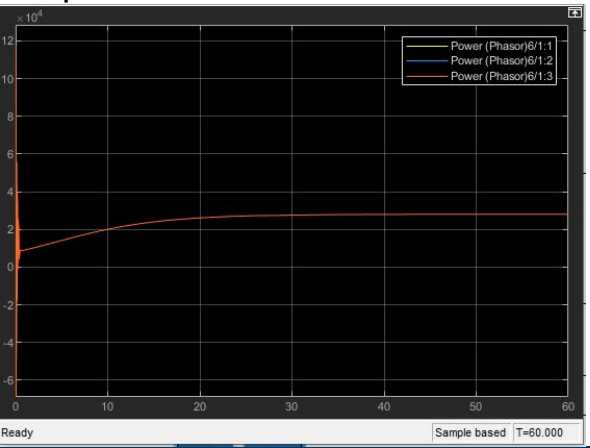


13 Node: Zero Wind to Cut-off

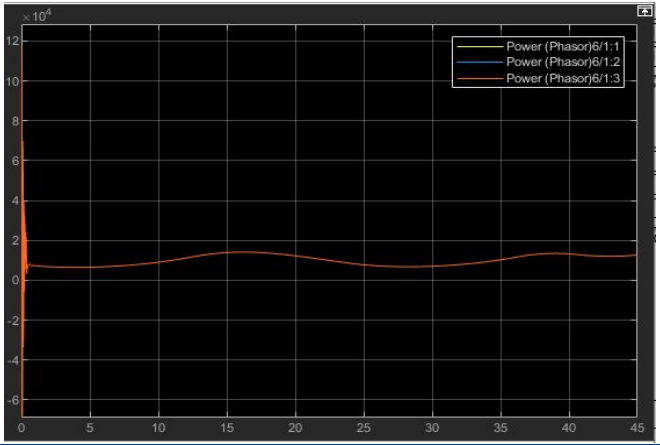


Verification/Results

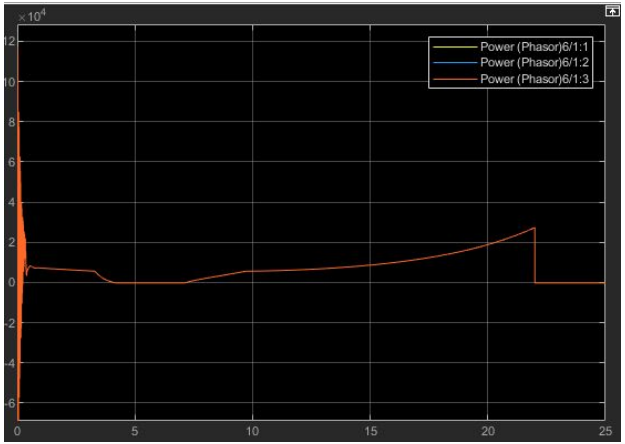
Case Grid: Constant Rated Speed



Case Grid: Constant Wind Variation

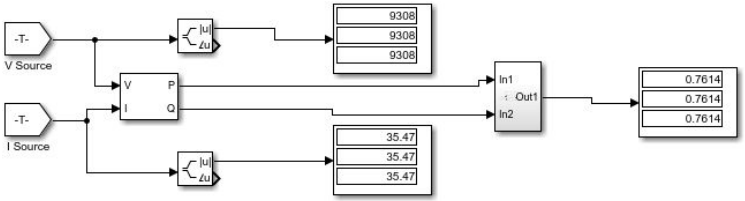


Case Grid: Zero Wind to Cut-off

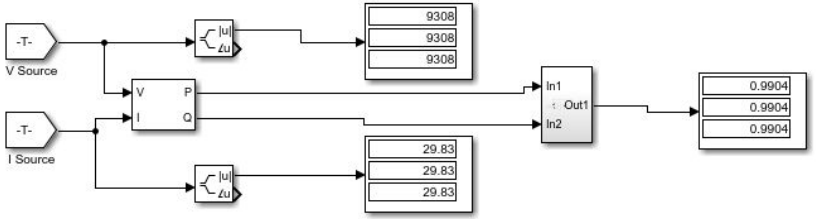


Power Factor Comparison

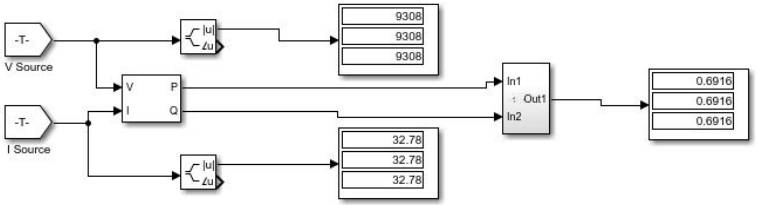
Neither



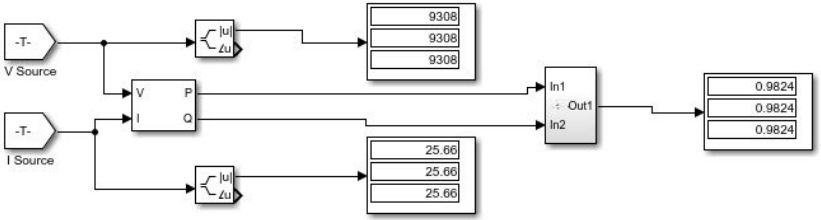
Only Capacitors



Only Wind Generation



Both



Thank you!