Toward Solving for System States Under Variable Wind Generation

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Introduction

Background and motivation:
Power grid operation is simulated under changing loading and generation. The grid will have large numbers of solar PV energy sources whose outputs will be assigned based on recorded data. MATLAB is used to simulate the operating states under these changing conditions. MATLAB time series analysis tools are then used to build tracking and prediction models for the system variables of interest.

Technical approach:
- Download wind and load data from: https://transmission.bpa.gov/business/operations/wind/
- Normalize it for 24 hours.
- Place a wind generator to Bus-2 and use the normalized wind generation data.
- Change load data using normalized load data.
- Run power flow for 24 hours and observe the swing generator compensation.

Conclusion:
- All generators are providing the same output except slack and wind generator.
- Slack bus is compensated for variation of wind generator and the losses.
- Total generation slightly different from total load because of losses per hour.
- Minimum voltage profile for 24 hours all below 0.95
Results

Figure 1: Active Power Dispatch per Generator
All buses are constant except slack (green) and wind generator (red).

Figure 2: Total Generation vs Total Load
Slight difference is due to the losses per hour.

Figure 3: Losses Per Hour
Total generation minus total load.

Figure 4: Voltage Profile per Hour. Voltage is below 0.95, meaning that corrective measures need to be apply to address the issue.
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