KTH Electrical Engineering

EG2040 Wind Power Systems
Assignment 3 – Grid Integration of Wind Power Systems

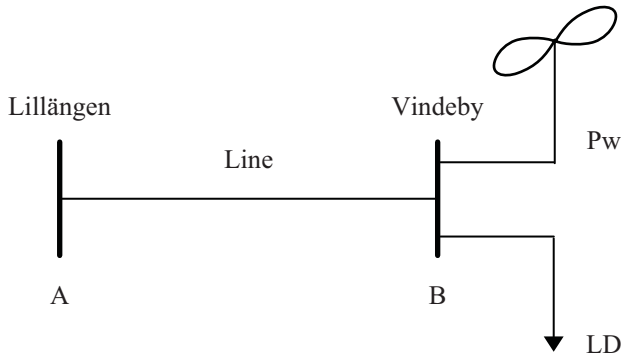
Deadline for full credits: See the course webpage.

The assignments should be completed individually and the report containing all solutions should be submitted in the blue box marked EG2040, outside the student room at Teknikringen 33. If Matlab is used for completing the assignment the code should be included with the report.

Solutions to the assignments should be well motivated and explained in detail. All equations used should be written clearly and all variables clarified. Figures and tables should be properly scaled and have captions. Write your name and student number on the front page of the assignment.

The teaching assistant will be available to answer questions during the scheduled course assistance hours.

In the figure below, consumers, LD, in Vindeby are fed with a 10 kV line from Lillängen.



Vindeby is a rather windy area and there is a large potential to install wind power plants. The problem is that the grid is rather weak, which means that there can be large voltage variations for the consumers in Vindeby if too much wind power is installed. The aim of this assignment is to estimate the amount of wind power that can be installed in Vindeby, without violating the voltage requirements.

System Data:

- Lillängen (A) is a weak grid. The short circuit capacity is 18–25 MVA (different for different periods)

and the feeding grid can be assumed to be purely inductive. There is no relevant voltage regulating equipment in the feeding grid.

- The line is a 10 kV transmission line, which can be modelled as a short line, i.e. line capacitance is neglected. The line is $10 + C$ km and the impedance of the line is $(0.1 + j0.1)$ Ω/km. The constant C is calculated as last 2 numbers in your personal number divided by 10. Don't forget to write your constant in the report.
- LD is the total load of the consumers at Vindeby. The load varies between 200 kW and 450 kW and the power factor can be assumed to be constant and equal to 0.8 capacitive.
- The voltage in Vindeby (B) is 10±1% kV (different for different situations) when there are no consumers and no wind power.
- The installed wind power P_w is assumed to be controlled in order to keep a constant power factor equal to 1.

Questions

1. The voltage in Vindeby should lie between $10 + 10\%$ kV and $10 - 10\%$ kV. How much wind power (MW) can be installed at Vindeby to meet these requirements?
2. If the wind farm has a constant power factor equal to 0.95 capacitive, how much wind power (MW) can be installed at Vindeby? Compare with the result from Question 1, and explain the difference.

For these calculations you can use the methods described in *Static Analysis of Power Systems* (examples 4.4 and 5.5). To solve the problem you can use Matlab. The code should be attached at the end of your report, and not sent as a separate file.