Cable Impact on Integration of Wind and Solar Power

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IN COOPERATION WITH:

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Problems and Aims

Future development of power systems

- Replacing conventional power sources with renewables
- Moving production from transmission to distribution level
- Cable penetration in grids increases

Challenges

- **Local grid:**
  - Overvoltages
  - Increased active power losses (when using reactive power support)
- **Overlaying grid:**
  - Reverse active power flows
  - Injection of reactive power at the point of common coupling (PCC) towards overlaying grid

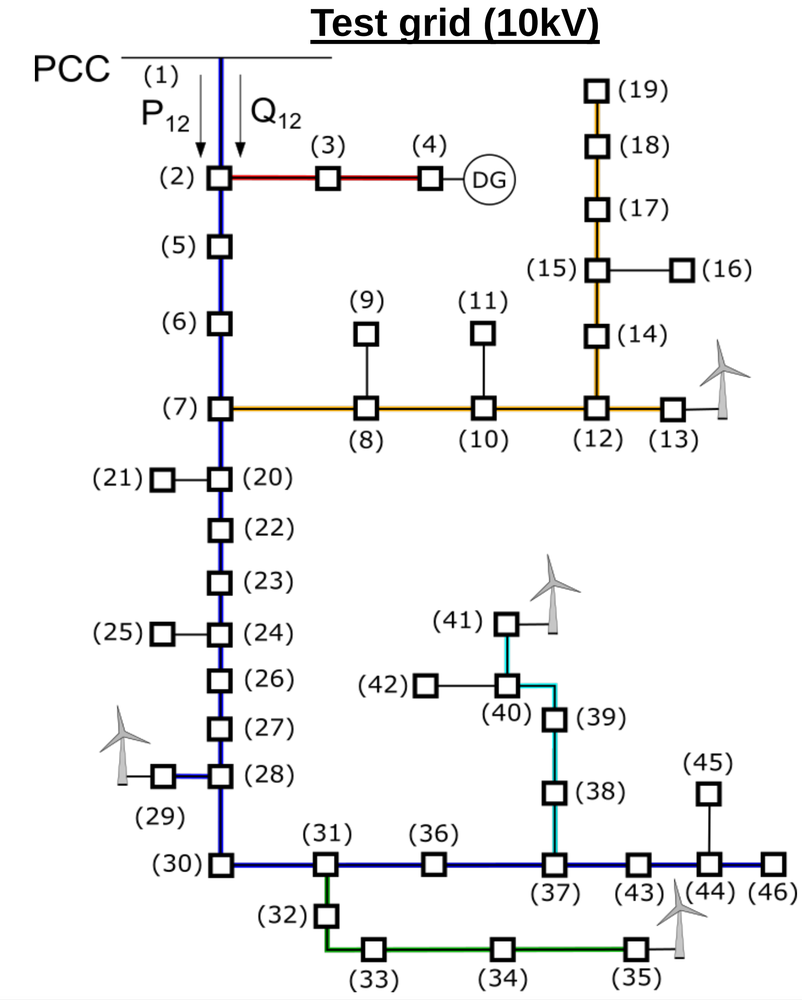
Test cases

Section *[1-2-5-6-7-20-22-23-24-26-27-28]* :

- **Case 1:** Overhead lines *(R/X= 0.5 – 1.2)*
- **Case 2:** Cables *(R/X = 1.5 – 6.4)*

Length of the lines and intersection stays the same in both test cases

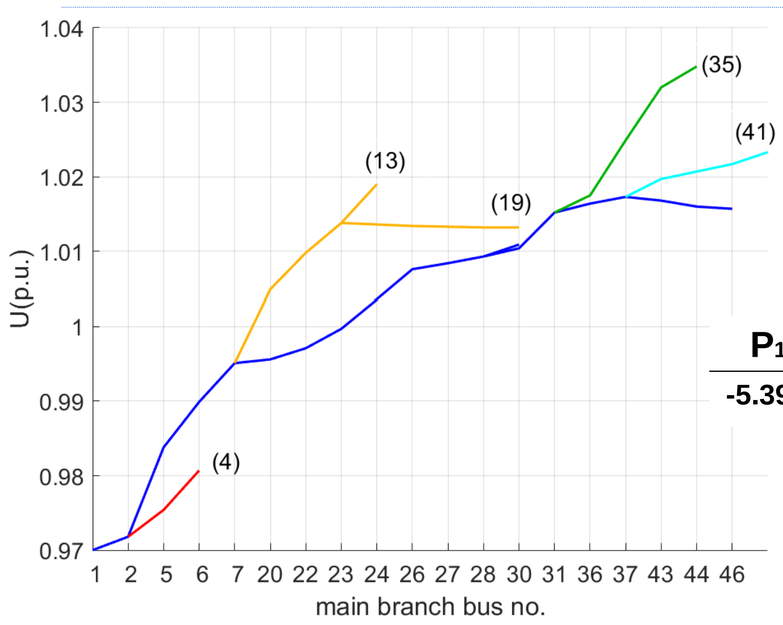
Test grid (10kV)



Voltage profiles

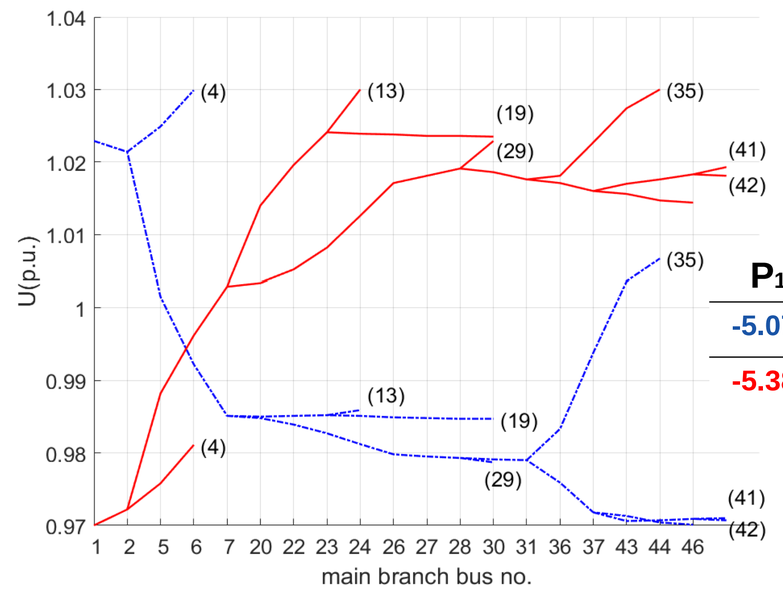
Overhead lines case

Without reactive support from DG



P_{12}	Q_{12}
-5.3953	0.6252

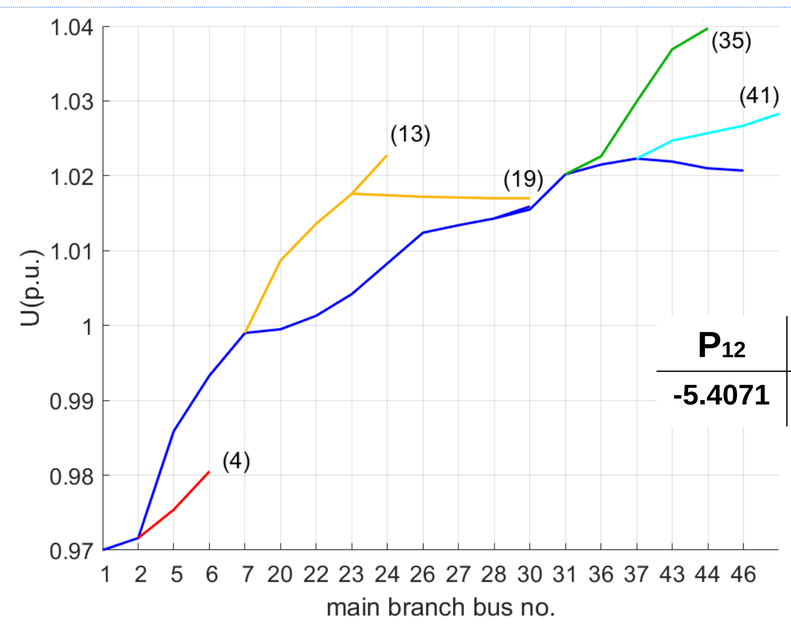
With reactive support from DG



P_{12}	Q_{12}
-5.0760	5.0950
-5.3824	0.0569

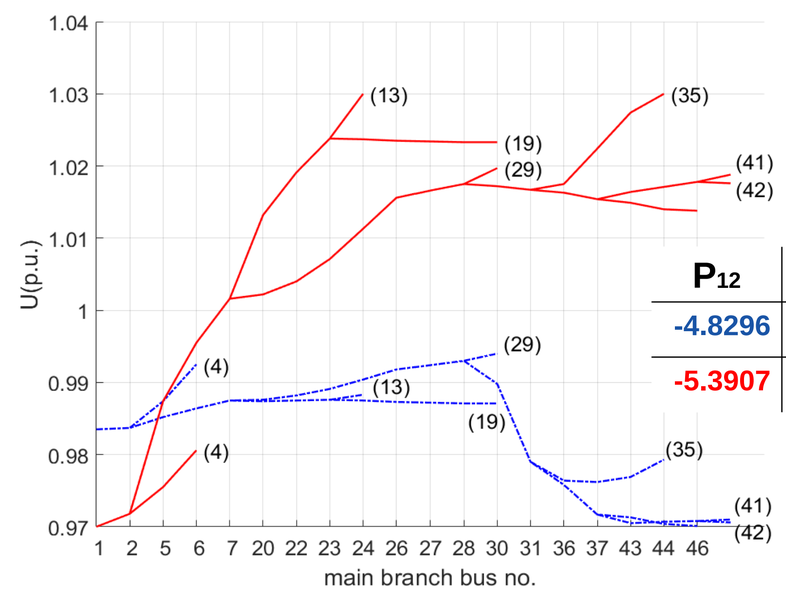
Cables case

Without reactive support from DG



P_{12}	Q_{12}
-5.4071	0.3290

With reactive support from DG



P_{12}	Q_{12}
-4.8296	6.2513
-5.3907	-0.4407

Conclusions

- Cables inject reactive power into the grid increasing the overall grid's voltage
- Reactive support from DG can be used to increase penetration of DG and/or tailor the voltage profile
- Cables provide reactive power decreasing the need of importing it from the overlaying grid in the times of high production of DG
- Cables' R/X ratios allow transfer of reactive power to longer distances
- Higher penetration of cables increases grid's overall capability to exchange reactive power with overlaying grid