

# Analysis of electrical power and energy systems

## Practical session 3

7 October 2020

### 1 The transmission line<sup>1</sup>

1. The parameters for a 500-kV transmission system with bundled conductors are as follows:  $Z_c = 258\Omega$  and  $R = 1.76 \times 10^{-2}\Omega/\text{km}$ . Calculate the value for the Surge Impedance Loading SIL and the percentage power loss in this transmission line if it is 300 km long and is loaded to its SIL.

Table 1: Approximate transmission line parameters with bundled conductors at 60 Hz.

Nominal voltage (kV)	$R$ ( $\Omega/\text{km}$ )	$\omega L$ ( $\Omega/\text{km}$ )	$\omega C$ ( $\mu\text{S}/\text{km}$ )
230	0.06	0.5	3.4
345	0.04	0.38	4.6
500	0.03	0.33	5.3
765	0.01	0.34	5.0

2. A 200 km long 345-kV line has the parameters given in Table 1. Neglect the resistance. Calculate the voltage profile along this line if it is loaded to
  - (a)  $1.5 \times SIL$
  - (b)  $0.75 \times SIL$

and the receiving end is held at the voltage of 1 per unit.

### 2 Solutions

Link to the python notebook shown during the session: Python Notebook TP3

1.  $SIL = 969 \text{ MW}$ , power loss = 2.05%

---

<sup>1</sup>Exercises 4.3 and 4.10 of Ned Mohan's book "Electric power systems, a first course"