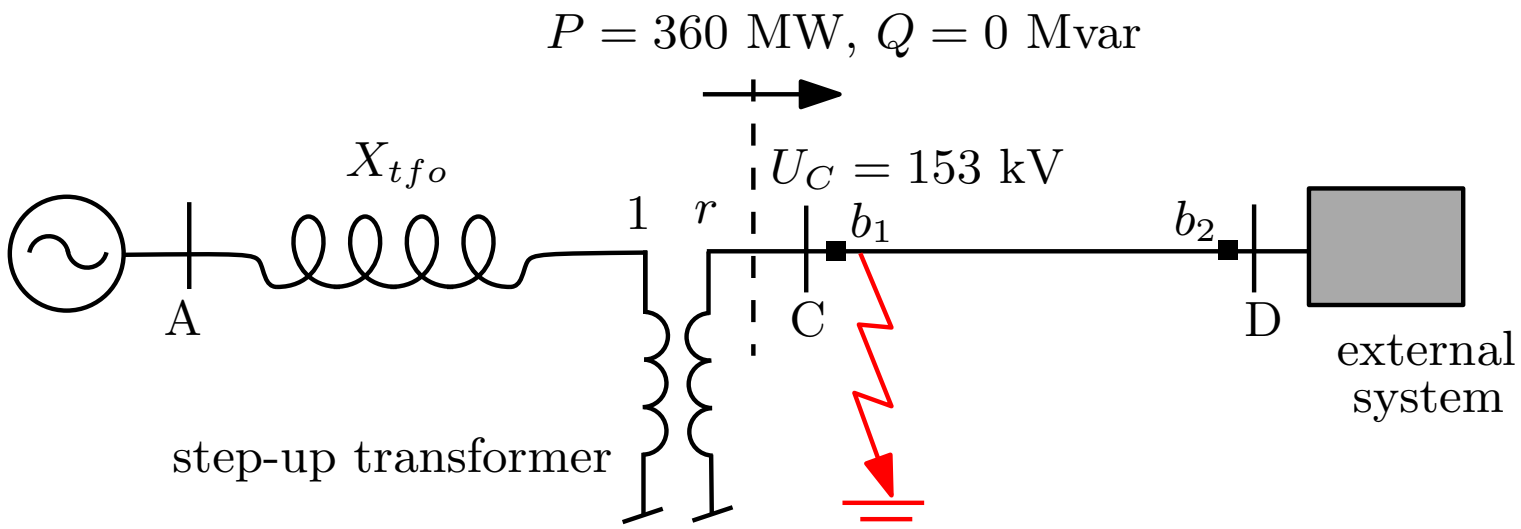
The system shown below has the following characteristics:

- transmission line C-D: 30 km, nominal voltage 150 kV, $r = 0.05\ \Omega/\text{km}$, $x = 0.32\ \Omega/\text{km}$, shunt susceptance neglected
- generator (bus A): nominal power 400 MVA, nominal voltage 15 kV, $X'' = 0.17$ pu[1]
- step-up transformer A-C: nominal power 400 MVA, leakage reactance $X_{tfo} = 0.16$ pu, ratio $r = 1.03$ pu/pu[2]
- external system (bus D) : short-circuit power 9 000 MVA.

The operating point is shown in the figure.



[1] on the (15 kV, 400 MVA) base
[2] on the (15 kV, 150kV, 400 MVA) bases

A three-phase short-circuit without resistance takes place on the line, at a negligible distance from the switching station of bus C.

Determine :

1. the currents in the circuit breakers b_1 and b_2
2. the short-circuit power at bus C
3. the same when the generator is not in operation
4. the voltage at buses A and D during the short-circuit.