ELEC-E8406 Electricity Distribution and Markets, Exercise 04 Reliability

1. Examine the following distribution network.

   a) Which customers experience an interruption and for how long when a fault occurs at point A? At point B? At point C?

   b) What is the total interruption cost caused by a single fault at point C if the CIC values for all customers are €1 / kW / fault and €10 / kWh, the manual switching time is 1h, the remote switching time is 0.15 h, the substation circuit breaker operating time is insignificant, the repair time is 10 h and the maximum demand (on which the CIC values are based) at each secondary substation is 1 MW?

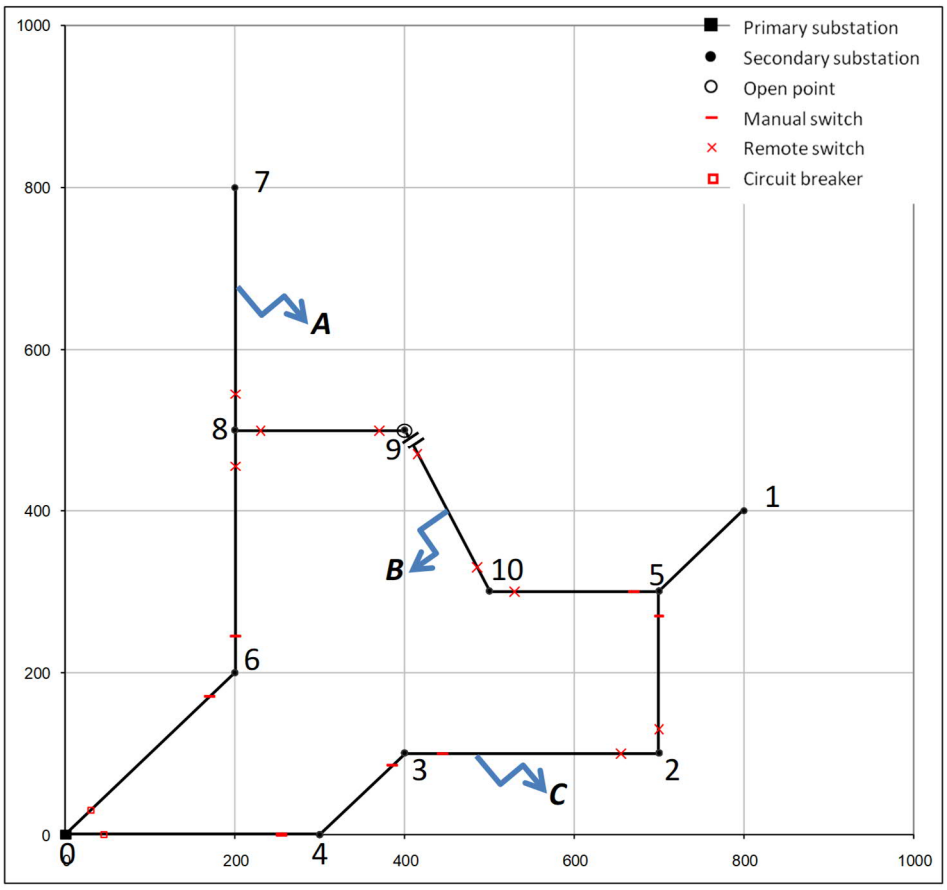
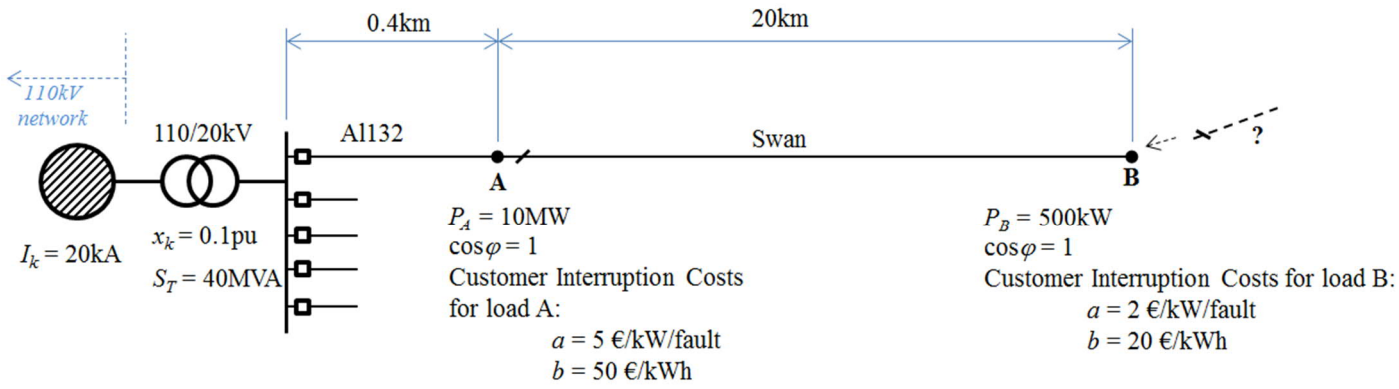


Fig. 1 20 kV network, 1 primary substation (node 0) and 10 secondary substations

2. A rural line connected to an industrial feeder



	Cross-section (mm^2)	Resistance (Ω/km)	Reactance (Ω/km)	Max load current (A)
Al132	54	0.219	0.348	495
Swan	25	1.358	0.416	155

Average fault rate for both line sections: 7 faults / 100km
Average repair time: 3 hours

The load growth is 3 %/year, the interest rate is 5 %/year and the review period is 20 years. The manual switches at A and on the proposed backup connection take 30 minutes to operate. It is assumed that faults only occur one at a time (not simultaneously).

Should a backup connection be provided to point B in Fig.1 if the connection including a manual switch costs 25 000 euros?

If you had 3500 € left in your budget, sufficient for another manual load breaking switch, where would you install it?

What else might you suggest?

What other benefit might the backup connection give (e.g., if it is connected to another primary substation)

What was overlooked (due to insufficient data) in this exercise?

This formula converts load related annual costs to present day value of life costs (for a lifetime of t years):

$\kappa = \gamma \dfrac{\gamma^t - 1}{\gamma - 1}$ where, for load related annual costs: $\gamma = \dfrac{(1 + r/100)}{(1 + p/100)}$,

r is load growth (%/year) and p is interest rate (%/year)