

ED&M Calculation Exercise Session 1: Power Flow (more correctly, summation!)

Q1. Figure 1 shows a section of MV (20 kV) demand-dominated distribution network. Which conductor size is needed to cope with the worst contingency (a fault in the line sections (0-1 and 0-13) closest to the primary substation)? The cables are buried in trefoil with screens bonded at both ends.

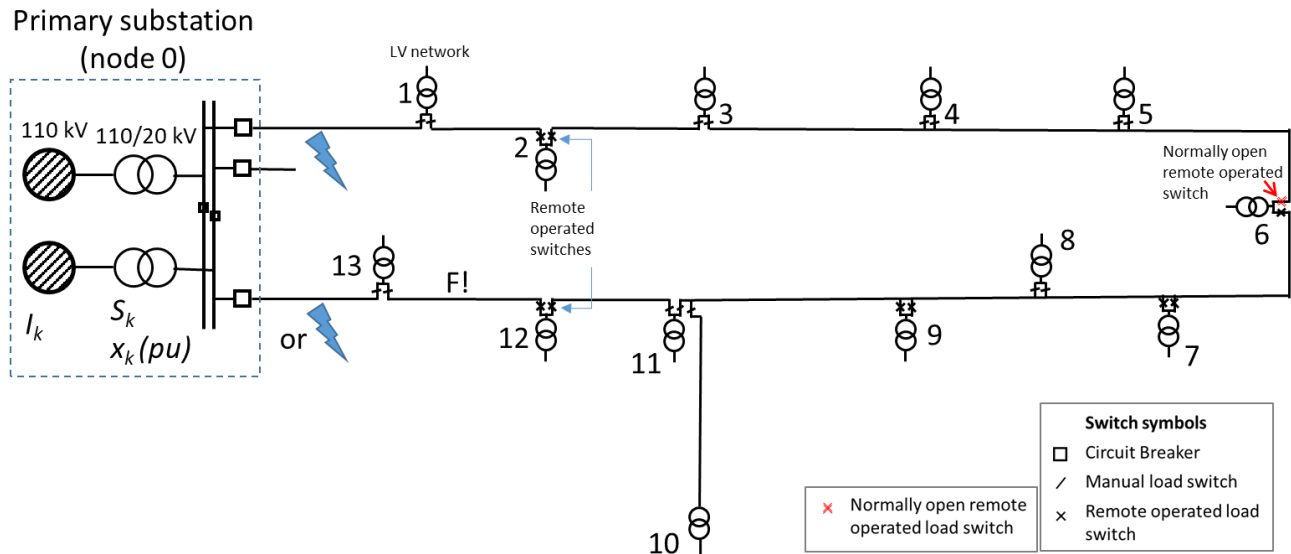


Figure 1 Topology of MV network section

Table 1 Maximum demands in year 1, but load growth $r = 2\%$ /annum for 20 years

Node	0	1	2	3	4	5	6	7	8	9	10	11	12	13
P_{max} (kW)	0	650	700	750	300	450	600	250	800	625	400	900	800	850
Q_{max} (kvar)	0	214	230	247	99	148	197	82	263	205	131	296	263	279

Table 2 Line data (Source: <http://media.drakakeila.ee/2015/05/AHXAMK-W-24kV.pdf>)

Electrical data

Number of cores x cross-section of conductor mm ²	Current rating at core temp. 65 °C in ground* A	Current rating at core temp. 65 °C in air* A	Current rating at core temp. 90 °C in air* A	Max. short-circuit current on the conductor during 1 s at initial temp. 65 °C kA	Max. short-circuit current on the conductor during 1 s at initial temp. 90 °C kA
3x50AL+35CU	155	160	195	5,2	4,7
3x70AL+35CU	200	190	235	7,2	6,6
3x95AL+35CU	235	230	280	9,9	8,9
3x120AL+35CU	265	265	325	12,4	11,3
3x150AL+35CU	300	300	370	15,6	14,2
3x185AL+35CU	330	345	425	19,2	17,5
3x240AL+35CU	385	400	490	25,0	22,7
3x300AL+70CU	435	460	565	31,2	28,3

*Trefoil with screen grounded in both ends. Nominal values unless otherwise specified.

Conditions

- The ratings are based on the following conditions
- maximum conductor temperature 90 °C
 - ground temperature 15 °C
 - air temperature 25 °C
 - thermal resistivity of soil 1,0 °K m/W
 - depth of burial 0,65 m
 - frequency 50 Hz

Q2. The question is whether to provide an MV (20 kV) connection to a proposed wind farm or to extend a radial 110 kV feeder and provide a new primary substation at the wind park.

a) What is the approximate peak rating of the wind park available with 2 MV feeders, each the largest conductor size from Table 2?

b) What is the approximate peak rating of a single (3-phase) 110 kV overhead line (bare conductor), the AAC 132 rated at 495 A

(Source:

https://fi.prysmiangroup.com/sites/default/files/business_markets/markets/downloads/datasheets/AAC.pdf

Do you have any comments about the relative merits of underground cables vs overhead lines feeding wind farms?