Annex C: Calculation of short-circuit current

Note:

- In the case of the I_k upstream and the length of the cable not being included in the table, it is necessary to consider:
  - the value right above I_k upstream;
  - the value right below for the cable length.

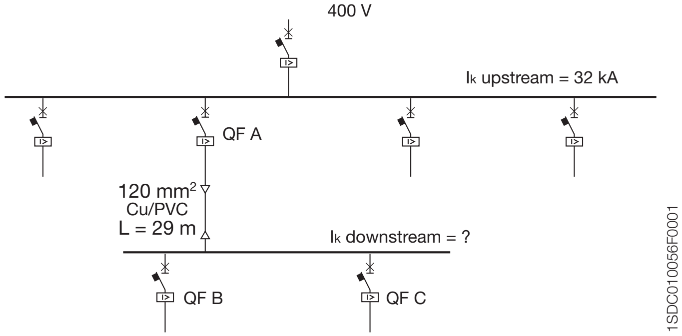
These approximations allow calculations which favour safety.

- In the case of cables in parallel not present in the table, the length must be divided by the number of cables in parallel.

Example

Data
Rated voltage = 400 V
Cable section = 120 mm²
Conductor = copper
Length = 29 m

Upstream short-circuit current = 32 kA



Procedure

In the row corresponding to the cable cross section 120 mm², it is possible to find the column for a length equal to 29 m or right below (in this case 24). In the column of upstream short-circuit current it is possible to identify the row with a value of 32 kA or right above (in this case 35). From the intersection of this last row with the previously identified column, the value of the downstream short-circuit current can be read as being equal to 26 kA.

Annex D: Calculation of the coefficient k for the cables (k^2S^2)

By using the formula (1), it is possible to determine the conductor minimum section S, in the hypothesis that the generic conductor is submitted to an adiabatic heating from a known initial temperature up to a specific final temperature (applicable if the fault is removed in less than 5 s):

$$S = \frac{\sqrt{I^2 t}}{k} \quad (1)$$

where:
- S is the cross section [mm²];
- I is the value (r.m.s) of prospective fault current for a fault of negligible impedance, which can flow through the protective device [A];
- t is the operating time of the protective device for automatic disconnection [s];

k can be evaluated using the tables 2÷7 or calculated according to the formula (2):

$$k = \sqrt{\frac{Q_c(B+20)}{\rho_{20}} \ln\left(1 + \frac{\theta_f - \theta_i}{B + \theta_i}\right)} \quad (2)$$

where:
- Q_c is the volumetric heat capacity of conductor material [J/°Cmm³] at 20 °C;
- B is the reciprocal of temperature coefficient of resistivity at 0 °C for the conductor [°C];
- ρ_{20} is the electrical resistivity of conductor material at 20 °C [Ωmm];
- θ_i initial temperature of conductor [°C];
- θ_f final temperature of conductor [°C].

Table 1 shows the values of the parameters described above.

Table 1: Value of parameters for different materials

Material	B [°C]	Q_c [J/°Cmm³]	ρ_{20} [Ωmm]	$\sqrt{\frac{Q_c(B+20)}{\rho_{20}}}$
Copper	234.5	$3.45 \cdot 10^{-3}$	$17.241 \cdot 10^{-6}$	226
Aluminium	228	$2.5 \cdot 10^{-3}$	$28.264 \cdot 10^{-6}$	148
Lead	230	$1.45 \cdot 10^{-3}$	$214 \cdot 10^{-6}$	41
Steel	202	$3.8 \cdot 10^{-3}$	$138 \cdot 10^{-6}$	78