Cos(ϕ) compensation

P	3000	Load Power [Watt]
U	230	Load rms Line-Neutral voltage
cos(ϕ)	0.75	Load cos(ϕ)
Rcable/meter	0.01	Cable resistance per meter[Ω per meter]
Lcable/meter	1.0E-5	Cable inductance per meter[H per meter]
Cable length	0	Cable length [meter]

Calculate

Calculate nominal power

Load parameters P and cos(ϕ) are defined for U without cable

Apparent power per phase S[VA] = P/cos(ϕ)=4000[VA]
Q[VAR] = sqrt(S^2-P^2)=sqrt(4000*4000-3000*3000)=2646[VAR]
Inom[A] = S/U=4000/230=17.391[A]

Calculate load resistance
From P and I the load resistance is calculated:
R_{load}[ohm]=P/I^2=3000/(17.391*17.391)=10[ohm]

Calculate load inductance
From reactive power, the load inductance is calculated
X_{load}=Q/I^2=2646/(17.391*17.391)=8.748[ohm]
L_{load}[mH]=X_{load}/(2 π f)=9/314.15927=27.8[mH]

Calculate cable resistance and inductance
R_{cable}[mΩ]=R_{cable}[per meter]* length [per phase]=10*0=0[mΩ]
L_{cable}[mH]=L_{cable}[per meter]* length [per phase]=0.01*0=0[mH]
X_{cable}[Ω]=L_{cable}*2 π f=0*314.15927=0[Ω]
Z_{cable}[Ω]=sqrt(R_{cable}^2+X_{cable}^2)=sqrt(0*0+0*0)=0[Ω]

Calculate total resistance and inductance seen from the source
R_{tot}[Ω]=R_{cable}+R_{load}=0+10=9.919[Ω]

L_{tot}[mH]=L_{cable}+L_{load}=0+0=27.844[mH]
X_{tot}[Ω]=L_{tot}*2 π f=27.844*314.15927=8.748[Ω]
Z_{tot}[Ω]=sqrt(R_{tot}^2+X_{tot}^2)=sqrt(9.919*10+8.748*9)=13.225[Ω]

Calculate new current
Inew=U/Z_{tot}= 230/13.225=17.39[A]

Calculate apparent power
S=U*I_{new}= 230*17.391=4000[VA]

Calculate Cable loss
R_{cable}*$Inew^2$= 0*17.391*17.391=0[Watt]

Calculate power delivered to the load
R_{load}*$Inew^2$= 10*17.391*17.391=3000[Watt]

Calculate Load voltage
U_{load}new=U-Zcable*Inew = 230-0*17.391=230[Volt]

Calculate new cos(ϕ)
Cos(ϕ) =(Pcable+Pload)/S = (0+3000)/4000=0.75

Calculate Reactive power for calculating the compensation capacitor
Q[VAR] = sqrt(S^2-$(Pcable+Plaod)^2$)=sqrt(4000*4000-3000*3000)=2646[VAR]

Calculate compensation capacitor
Xc = U^2/Q = 230*230/2646=20[Ω]
C = 1/(2π*f*Xc) = 1/(314.15927*20=159[μF]