

task_underseacable

Student Group

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Sure, here's the answer with the values and formulas in LaTeX notation:

Given:

- Distance between two coastal cities = $d = 400 \sim \{\text{km}\}$
- Depth of the cable below the ocean's surface = $h = 1000 \sim \{\text{m}\}$
- Resistance of the cable per unit length = $R = 0.1 \sim \{\text{Omega/km}\}$
- Voltage at the source end of the cable = $V_s = 500 \sim \{\text{kV}\}$
- Power factor of the cable = $\cos \phi = 0.8$
- Load at the destination end of the cable = $P = 800 \sim \{\text{MW}\}$

The total resistance of the cable is:

$$\begin{aligned} R_{\text{total}} &= R \times L = 0.1 \sim \{\text{Omega/km}\} \times 400 \sim \{\text{km}\} \\ &= 40 \sim \{\text{Omega}\} \end{aligned}$$

The current flowing through the cable is:

$$\begin{aligned} I &= \frac{V_s}{R_{\text{total}}} = \frac{500 \sim \{\text{kV}\}}{40.01 \sim \{\text{Omega}\}} \\ &= 12.5 \sim \{\text{kA}\} \end{aligned}$$

The real power being transmitted through the cable is:

$$\begin{aligned} P &= V_s \times I \times \cos \phi = 500 \sim \{\text{kV}\} \times 12.5 \sim \{\text{kA}\} \times 0.8 \\ &= 5,000 \sim \{\text{MW}\} \end{aligned}$$

The reactive power being transmitted through the cable is:

$$\begin{aligned} Q &= V_s \times I \times \sqrt{1 - \cos^2 \phi} = 500 \sim \{\text{kV}\} \times 12.5 \sim \{\text{kA}\} \\ &\times \sqrt{1 - 0.8^2} = 2,500 \sim \{\text{MVA}\} \end{aligned}$$

The total power that the cable can handle is:

$$\begin{aligned} S &= \sqrt{P^2 + Q^2} = \sqrt{(5,000 \sim \{\text{MW}\})^2 + (2,500 \sim \{\text{MVA}\})^2} \\ &= 5,590.17 \sim \{\text{MVA}\} \end{aligned}$$

Therefore, the maximum capacity of the cable is $S = 5,590.17 \sim \{\text{MW}\}$, which is greater than the required power of $P = 800 \sim \{\text{MW}\}$.

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