

task_underseacable

Student Group

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Table of Contents

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

Given:

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

The total resistance of the cable is:

$$R_{\text{total}} = R \times L = 0.1 \text{ } \Omega/\text{km} \times 400 \text{ km} = 40 \text{ } \Omega$$

The current flowing through the cable is:

$$I = \frac{V_s}{R_{\text{total}}} = \frac{500 \text{ kV}}{40.01 \text{ } \Omega} = 12.5 \text{ kA}$$

The real power being transmitted through the cable is:

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

The reactive power being transmitted through the cable is:

$$Q = V_s \times I \times \sqrt{1 - \cos^2 \phi} = 500 \text{ kV} \times 12.5 \text{ kA} \times \sqrt{1 - 0.8^2} = 2,500 \text{ MVar}$$

The total power that the cable can handle is:

$$S = \sqrt{P^2 + Q^2} = \sqrt{(5,000 \text{ MW})^2 + (2,500 \text{ MVar})^2} = 5,590.17 \text{ MVA}$$

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

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