2021A25 (MICROWAVE PATHS)

Level 1: To find the wavelength of the microwave, we need to divide the velocity of the microwave by the frequency of the microwave. Remember the velocity of a microwave is always the speed of light – 300,000,000 m/s.

$$Wavelength = Speed\ of\ Light\ /\ Frequency$$

We also have to convert GHz to Hz.

$$1\ GHz = 1{,}000{,}000{,}000\ Hz\ so\ 20\ GHz = 20{,}000{,}000{,}000\ Hz$$

$$Wavelength = 300{,}000{,}000\frac{m}{s}\ /\ 20{,}000{,}000{,}000\ Hz$$

$$Wavelength = 0.015\ meters = 15\ mm$$

This ~405-foot-tall wind turbine can obstruct microwave paths from even the tallest towers, which is why it is important for us to calculate a safe distance away from the microwave path to site our turbines.

Level 2: To safely site a wind turbine, like the one shown above, outside of the Second Fresnel Zone, we can look back at our equation for the radius of the Second Fresnel Zone:

$$Radius = \sqrt{\frac{n\lambda d_1 d_2}{d_1 + d_2}}$$

First, we have to convert d_1 and d_2 from km to m.

$$1\ km = 1{,}000\ m\ so\ d_1 = 10\ km = 10{,}000\ m\ and\ d_2 = 15\ km = 15{,}000\ m$$

We are given all the variables needed to solve the problem, so we just have to insert our numbers into the equation.

$$Radius = \sqrt{\frac{2 * 0.015\ m * 10{,}000\ m * 15{,}000\ m}{10{,}000\ m + 15{,}000\ m}}$$

$$Radius = \sqrt{180}\ m = 13.42\ m$$

The radius of the second Fresnel zone is 13.42 meters; therefore, the turbine must be sited at least 13.42 meters from the microwave path.