

Activity #3: Powering A City Vs. Powering A Submarine

Many cities and submarines rely on nuclear energy to provide the power needed for normal operations.

An SSBN (Ballistic/Nuclear Submarine) carries 160 people on board. In essence, a nuclear submarine is a moving miniature city that needs power for a variety of reasons including those involving in ensuring the crew's survival as well as constant propulsion, operation of equipment, light, and maintenance.

>The submarine generates 100 MW of power when at 100% power. However, normal submarine operations only use 10% of the total potential power.

- a) How many MWh are used by the submarines daily?
- b) Convert the MWh to kWh.
- c) How much energy (in Joules) are generated by the submarines daily?
- d) How does this amount of energy compare to a similarly sized city of 160 people? What accounts for the differences in these two numbers?

>Conversion Factor: $1 \text{ kg U-235} = 80 \text{ TJ}$

- e) What mass of U-235 is needed to power the submarines per day?
- f) How much U-235 is needed if submarines are typically patrolling for periods of 78 days?

>These submarines go on patrol for 77-78 days and then are docked for maintenance and service for 30 days before going on another patrol.

>The average SSBN holds 20 kilograms of U-235.

- g) How long can the nuclear submarine continue to run without needing a new fuel supply?

If you completed, Activity #2, you should've calculated how much energy is needed for the operation of a city that has about the same population as a submarine.

- a) How do the amounts of energy used to run a submarine and a city differ?
- b) Explain factors that could account for these differences in energy needs between the two systems.