Katie [redacted] & Kimmie [redacted]

Earthquake Destroys Nuclear Plant (Katie)

Flyer 1

An earthquake, according to the Bing Dictionary, is the "shaking of Earth's crust: a violent shaking of the Earth's crust that may cause destruction to buildings and results from the sudden release of tectonic stress along a fault line or from volcanic activity."

An earthquake hit off shore Japan on March 11, 2011, which caused a devastating tsunami. When the Fukushima Nuclear Power Plant was destroyed, radioactive materials such as Plutonium-239 and Caesium-137 were released into the air and soil. It will take while for the citizens to return to a safe environment.

What is more important: the energy or magnitude?

When building a power plant, the energy released by an earthquake has a higher value of concern. Why? Because energy is what is felt by people and what does the destruction, while magnitude is just a number to categorize the earthquake on the Richter Scale.

What is the Difference Between Energy and Magnitude?

When an earthquake occurs, the energy it produces is what people feel, and magnitude is how the earthquake is ranked on the Richter scale based off of that energy. The Fukushima Nuclear Power Plant was designed to stay standing against any 8.6 magnitude earthquake or lower. When a 9.0 earthquake hit, it was left in ruins and many harmful chemicals were released.

Change of Magnitude Formula:

$$\Delta M = \log(\frac{M_2}{M_1})$$

$$\Delta M = \log M_2 - \log M_1$$

M_2 represents the magnitude of the earthquake

M_1 represents the highest magnitude that the power plant was designed to withhold

Ratio of the Two Magnitudes:

$$\frac{M_2}{M_1} = 10^{\log_{10}\frac{M_2}{M_1}}$$

$$10^{\log M_2 - \log M_1}$$

$$10^{9-8.6}$$

$$10^{0.4} \approx 2.5$$

The earthquake's magnitude was 2.5 times stronger than the nuclear power plant could withhold.

Energy of the Earthquake:

$$\log E = 1.5M$$

$$10^{\log E} = 10^{1.5M}$$

$$E = (10^{1.5})^9$$

$$E = 3.16 * 10^{13}$$

Energy the Power Plant was Designed to Withhold:

$$\log E = 1.5M$$

$$10^{\log E} = 10^{1.5M}$$

$$E = (10^{1.5})^{8.6}$$

$$E = 7.9 * 10^{12}$$

Ratio of the Energies:

$$\frac{E_1}{E_2}$$

$$\frac{(10^{1.5})^9}{(10^{1.5})^{8.6}}$$

$$(10^{1.5})^{0.4} = 10^{0.6} = 3.981 \approx 4$$

The energy emitted by the earthquake was about 4 times stronger than the energy that the nuclear power plant was designed to stand against.

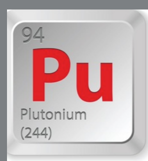
Kimmie [redacted] & Katie

Plutonium-239

Flyer 2

When the Fukushima Nuclear Power Plant erupted due to the dangerous earthquake and tsunami on March 11, 2011, 50 grams of Plutonium-239 were released into the area

What is Plutonium-239?



Who discovered Plutonium-239?

In 1941, Glenn T. Seaborg, along with coworkers Joseph W. Kennedy, Edwin M. McMillan, and Arthur C. Wahl, discovered Plutonium-239 at the University of California Berkeley.

What are the properties of Plutonium-239?

Atomic Number: 94
Number of Protons: 94
Number of Neutrons: 150
Half-Life: 24,100 years
Appearance: a solid, silver/white metal

What are Plutonium-239's uses?

Nuclear bombs, nuclear reactors, and power sources for space traveling equipment all need the energy of Plutonium-239.

After decaying, what is Plutonium-239's daughter element?

When decaying, Plutonium turns into the daughter elements uranium and neptunium.

What type of radiation emission is given off by Plutonium-239?

Alpha radiation is emitted by Plutonium, which does not cause problems when on the outside of the body. This type of radiation is very harmful internally because it can and cause complex problems, like increasing the risk of cancer.

How does Plutonium-239 affect the body?

When Plutonium-239 gets into the body, it had the possibility of increasing risk for cancer because it exposing internal organs and tissues to radiation over a period of time.

Exponential Decay Formula

$$N = N_0 e^{-\gamma\left(\frac{t}{t^{1}/_{2}}\right)}$$
$$N = \#\ of\ radioactive\ atoms$$
$$N_0 = initial\ number\ of\ atoms$$
$$\gamma = decay\ constant$$
$$t = timespan\ of\ decay$$
$$t\ ^{1}/_{2} = halflife\ of\ element$$

How much Plutonium-239 would be remaining after 10 years?

50 grams is the initial number of atoms released into the environment.

$$N = 50e^{-0.000029(\frac{10}{24,100})}$$
$$N = 50e^{-0.000029(4.1494*10^{-4})}$$
$$N = 50e^{-1.2*10^{-8}}$$
$$N = 50(0.999999988)$$
$$N = 49.9999994\ grams$$

As you can see, not a lot of the Plutonium-239 will have decayed within 10 years.

How many years would have to pass until there is a small enough amount of Plutonium left that will not affect the human body?

*3 micrograms, or 3/1,000,000 grams, is the human-safe amount of Plutonium.

$$50e^{-0.000029(^{t}/_{24100})} = 3*10^{-6}$$
$$\frac{50e^{-0.000029(^{t}/_{24100})} = 3*10^{-6}}{50}$$
$$e^{-0.000029(^{t}/_{24100})} = 6*10^{-8}$$
$$\ln e^{-0.000029(^{t}/_{24100})} = \ln 6*10^{-8}$$
$$-0.000029(^{t}/_{24100}) = -16.6289$$
$$\frac{-0.000029(^{t}/_{24100}) = -16.6289}{-0.000029}$$
$$(^{t}/_{24100}) = 573410.3448$$
$$*24100$$
$$t = 1.381918931*10^{10} years$$

It will take approximately 13,819,189,310 years for the area of the Fukushima Nuclear Power Plants to be harmless to humans from Plutonium-239.

Kimmie [redacted] &
Katie [redacted]

Nuclear Power Plant Concerns

Flyer 4

What Radioactive Material Should We Be More Concerned With: Plutonium-239 of Caesium-137?

When comparing the two radioactive elements, I have come to the conclusion that citizens living near Fukushima Nuclear Power Plant should be more concerned with Caesium – 137 due to the fact that a substantially larger amount of Caesium was released into the air then Plutonium. Over 3,000 grams of Caesium was released into the air, whereas a little over 50 grams of plutonium was released. Caesium also has a more potentially dangerous aspect of health risks to it then plutonium does, including severe burns, cancer risks, even death.

Should Nuclear Power Plants Continue to be Built?

After assessing my results, I have come to the conclusion that Nuclear Power Plant *should* continue to be run, however major changes in their building plans must be contradicted. They must be built to withstand an earthquake with a 9.5 magnitude, and it must be properly tested beforehand. The reason that I suggest taking the risk of the continued operation of these plants is due to the fact that the risk is extremely small. The chance of an earthquake hitting one of these plants with a magnitude of over 9.5 on the Richter scale is highly unlikely. In the meantime, imagine how much good could be accomplished in these plants. Fossil fuels and overall pollution would diminish greatly with many other benefits that outweigh the doubts.