Research on US nuclear levels after Fukushima could aid in future nuclear detection

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The amount of radiation released during the Fukushima nuclear disaster was so great that the level of atmospheric radioactive aerosols in Washington state was 10,000 to 100,000 times greater than normal levels in the week following the March 11 earthquake and tsunami that triggered the disaster.

Despite the increase, the levels were still well below the amount considered harmful to humans and they posed no health risks to residents at the time, according to researchers at The University of Texas at Austin.

The findings, published by a mechanical engineering professor at the Cockrell School of Engineering and researchers at Pacific Northwest National Laboratory (PNNL), provide important insight into the magnitude of the disaster. They also demonstrate huge advancements in the technology that's used for monitoring nuclear material and detecting covert nuclear operations around the world.

"I think the conclusion was that this was a really major event here," Cockrell School of Engineering Associate Professor Steven Biegalski said of the Fukushima disaster.

Biegalski was on a faculty research assignment at PNNL in Richland, Washington. Its here that, using technology that Biegalski helped

improve, he and a team of researchers were the first to detect radioactive materials from Fukushima in the U.S.

The material detected, Xenon 133, is of the same chemical family as helium and argon and is an inert gas, meaning it does not react with other chemicals. The gas is not harmful in small doses and is used medically to study the flow of blood through the brain and the flow of air through the lungs.

Tracy Tipping, a health physicist and laboratory manager at The University of Texas at Austin's Nuclear Engineering Teaching Laboratory, said the average person in the U.S. receives about 16.4 microsieverts of radiation dose per day from various sources of naturally occurring radiation, such as radioactive materials in the soil, cosmic radiation from outer space and naturally occurring radioactive materials within the body. In Washington, the increased levels from Fukushima meant the daily dose during that time could have been about 16.4017. A harmful amount that would cause obvious symptoms of exposure is anywhere from two to three million microsieverts at one time, he said.

"So, you can detect the increase but being detectable does not mean it's harmful," Tipping said.

Xenon 133 is a nuclear fission product that is closely monitored at nuclear stations around the world because it can be used to determine whether a country has conducted an illegal or covert nuclear test explosion. Such tests are banned under the Comprehensive Nuclear-Test-Ban Treaty (CTBT), which was adopted by the United Nations in 1996 and created a worldwide network of nuclear monitoring stations.

Similarly to how 911 emergency centers can pinpoint the location of a cell phone call by triangulating the signal between many different cell towers, nuclear stations within the network share information on Xenon

133 and other radioactive materials to determine where they originated. The network, established as part of CTBT, is crucial to detecting clandestine nuclear tests.

The detection of the radioactive gas in Washington is significant because it demonstrates technology advancements made by Biegalski, PNNL and others, to create a more sensitive monitoring system – one that's capable of detecting extremely small amounts of the gas.

"The culmination of international research collaborations resulted in this very sensitive monitoring technology. These advancements will not only be beneficial for nuclear monitoring, they are also very beneficial to the emergency response teams called to disasters like Fukushima," said Biegalski, an expert in nuclear forensics, nuclear modeling, and nuclear monitoring, who is currently developing complex algorithms that will be used to improve the capabilities even more.

As soon as he and PNNL researchers began detecting radioactive gases in Washington, they shared the data with federal officials in the U.S. and Japan so that it could be relayed to emergency responders on the ground at Fukushima.

"As the measurements came in sooner and at higher concentrations than we initially expected, we quickly came to the conclusion that there were some major core melts at those facilities," Biegalski said. "I remember being in the lab thinking, 'Wow, if this is all true we have a far more bigger accident than what we're hearing right now."

The thought was confirmed by data collected by he and PNNL researchers. Their study reports that more radioxenon was released from the Fukushima facilities than in the 1979 meltdown at the Three Mile Island Nuclear Generating Station in Pennsylvania and in the 1986 Chernobyl nuclear disaster in the Ukraine.

Biegalski said the reason for the large release in Fukushima, when compared to the others, is that there were three nuclear reactors at the Japan facilities rather than just one.

The study was published in the *Journal of Environmental Radioactivity*.

Provided by University of Texas at Austin