Nuclear Radiation Detection – Fukushima Incident

Last Updated: Tuesday, March 22nd

Q: What specifically are you finding?

A: On Wednesday, March 16, Pacific Northwest National Laboratory (PNNL) in Richland, Wash., initially detected a small amount of the radioactive isotope xenon-133, whose origin was determined from atmospheric models to be consistent with a release from the Fukushima reactors in northern Japan. The levels of xenon-133 that PNNL detected were extremely low and pose no health hazard. More recently the levels measured were a bit higher but again significantly below levels that would impact public health. On Friday, sensors at PNNL also showed the presence of iodine isotopes, but at even lower levels than the xenon isotopes. PNNL sensors have also detected small quantities of cesium, tellurium and lanthanum.

Q: Where and when did you detect it?

A: It was first detected in Richland, Washington at Pacific Northwest National Laboratory. PNNL is collecting data continuously; however our initial data was collected and measured on March 16.

Q: How do you know what you're detecting is coming from the incident in Japan?

A: The detection is consistent with isotopes detected locally in Japan, and the measurements are consistent with calculations of where we expect the location of a plume. We have ruled out any possible local sources such as the nuclear power plant at Energy Northwest.

Q: What levels are they – do they pose any health problems?

A: The initial levels measured were approximately 0.1 disintegrations per second per cubic meter of air. The dose rate from this amount of radioactivity poses no threat to public health and is a tiny fraction of what a person receives from natural background sources, such as the sun, each day. Later measurements were slightly higher but again significantly below levels that would impact public health.

Q: What is the long term fate of the radio xenon?

A: The radio-xenon we measured will continue to migrate across the world and in doing so will become even more dilute. It will also decay away into stable elements.

Q: How do these devices work?

A: These systems work two ways: one by filtering a large amount of air through filters and using nuclear detectors to count gamma rays from the debris, and the other by collecting trace radioactive gases in specially designed beds of adsorbents and then using a specialized nuclear detector for the analysis. They carefully separate the xenon from the bulk atmosphere by exploiting the differences between the physical properties of xenon and the main constituents of air (e.g., oxygen, nitrogen, and argon.) After collection, ultra-trace nuclear detection is performed exploiting distinctive properties of xenon decay to make very sensitive measurements of this isotope.

Q: What do the detectors measure and why does this come from the reactors?

A: With our systems, we measure the gamma rays emitted from the radiological debris that is emitted from the reactors. This type of debris is generated during the process of fission in a nuclear reactor and is carried by dust particles or exists as a gas. Specifically, we measure the gamma rays emitted from short-lived radioactive xenon isotopes. Our initial detections were of xenon-133, but current detections show presence of iodine isotopes, but at even lower levels than the xenon isotopes.

Q: Why does PNNL have this capability?

A: For several decades, PNNL has been conducting research and development on methods to detect very low levels of nuclear releases. This work includes the development of the world's most sensitive sensors to detect airborne radiological debris for treaty verification and monitoring purposes. We drew upon these capabilities to detect the trace debris in the plume from Japan.

Q: In addition to Richland, Washington, where are these monitors located?

A: PNNL-developed technology has been incorporated into the international monitoring system used for treaty verification at approximately 30 locations around the world. These monitoring systems are operated by the Comprehensive Test Ban Treaty Organization. Domestic locations include Sacramento, California; Oahu, Hawaii; Ashland, Kansas; Alaska, as well as Wake and Midway Islands. Systems at these locations are operated by the Department of Defense.

Q: What is volatile and non-volatile?

A: Volatility refers to whether radiological debris is in solid or gaseous form. Non-volatile debris is in solid form and moves in the air only as small particles released by an energetic event (such as an explosion or a fire). Volatile debris is in gaseous form and is easily released when in contact with air.