Major source of radon exposure overlooked at former Ohio uranium-processing plant

October 23 2008

Q-11 silos

(PhysOrg.com) -- University of Cincinnati (UC) scientists say that a recent scientific study of a now-closed uranium processing plant near Cincinnati has identified a second, potentially more significant source of radon exposure for former workers.

That source—six silos filled with uranium ore in the production area—resulted in relatively high levels of radon exposure to 12 percent of the workers. More than half (56 percent) of the workers were exposed to low levels of radon while working at the site.

"Our findings have scientific and political ramifications," explains Susan Pinney, PhD, corresponding author of the study and associate professor of environmental health at UC. "Now we know workers in the plant's production area prior to 1959 may be at increased risk for developing

lung cancer and other exposure-related health problems."

Third-shift plant workers were most affected, during some years being exposed to three times more harmful radon gas than workers on other shifts, according to the UC study. Researchers say the elevated exposure was the result of decreased air movement and less dispersion of radon gas during the night.

Pinney and Richard Hornung, PhD, recently reported their findings in the September issue of the *Journal of Exposure Science and Environmental Epidemiology*. This is the first time on-site radon exposure at the plant has been quantified in workers.

A previous study identified two silos, known by the code name "K-65," as the only source of radon exposure. The silos were located on the west side of the U.S. Department of Energy Uranium Processing Plant in Fernald.

"Our original intention was to develop and validate radon exposure estimates for the K-65 silos," explains Hornung. "But when we studied radon tracks on film placed on window glass in the Fernald plant, we found evidence of a second, previously unidentified radon source."

UC researchers traced the radon to six silos, known by the code name "Q-11," centrally located near a major production area. The silos were originally used to store high grade uranium ore and later held byproducts from the ore chemical separation process known as raffinate.

"The initial site review conducted by the federal government overlooked the Q-11 silos as a source of radon emissions," says Hornung, a professor of environmental health at UC and director of the biostatistics and data core at Cincinnati Children's Hospital Medical Center. "This second source of radon dominates the total radon exposure from both sources

during the period of 1952 to 1958 for workers near the Q-11 silos. Our study revealed that a small number of Fernald workers' cumulative radon exposures were in the range of underground uranium miners."

"When the plant was in operation, employees wore badges to measure gamma radiation exposure—but not alpha radiation sources like radon," he adds.

According to company records, 7,143 people worked at the uranium processing plant between 1952 and the plant's closing in 1989.

Uranium is a heavy metal that is essential for operation of electricity-producing nuclear reactors around the world. The metal can be removed from ore through a chemical separation process that leaves a soupy mixture of liquid and chemical byproducts known as "raffinate." That raffinate was stored in the K-65 silos.

"Uranium raffinate has high levels of radium and radon decay products," explains Pinney, "and for more than 30 years the K-65 silos emitted radon gas into the plant's atmosphere. The gas is odorless and colorless, so the workers never knew they were breathing it."

According to the National Academy of Sciences, radon is the second leading cause of lung cancer in the United States. The substance, which can be dispersed in the form of gas through air or water, genetically alters cells in the lung's lining and can greatly increase a person's risk for lung cancer.

Pinney's team conducted a four-year study, based on questionnaire information about actual work location and the time of work shifts, to determine how much radon workers from different areas of the plant were exposed to.

Fernald personnel records did not include work locations, so to accurately evaluate radon exposure levels the UC researchers developed a complex worker-location coding system to place employees at specific sites across the plant. They also used a specialized plastic film to measure radon exposure at the various plant locations. By studying the number of tracks left on the film by radon decay products, they found the second radon source.

"Radon gas disperses widely," explains Pinney, "and since the level of radon exposure is based on your proximity to a specific source, we had to know approximately where each worker stood or sat during their shift to figure out what level of radon they were being exposed to."

Pinney's team divided the 1,000-acre Fernald facility into numerous work locations within areas of the facility: the "production area," which included all production plants and outlying buildings; "controlled production areas" other non-production areas where workers were also required to undergo decontamination measures; and "uncontrolled areas," which included common destinations such as the cafeteria, administrative offices, laundry and laboratories. Employees were further differentiated into 41 categories based on what years and shifts they worked in the plant.

Using information from individual worker's job history files, the team was able to assign workers to locations across the plant, for each calendar year. Worker locations were verified using data from more than 2,100 detailed questionnaires completed by employees enrolled in the plant's medical monitoring program.

"Although we can't determine the exact number," says Hornung, "our research suggests that over 2,500 people may have been exposed to levels of radon gas that were higher than previously thought during their daily work, coming from a combination of the Q-11 silo and K-65

sources."

Researchers say the radon emitting materials in the K-65 and Q-11 silos were removed in the process of cleaning up the site, so there is no longer any source of radon gas related to the site.

Provided by University of Cincinnati