

Pandora's

BOX

Richard Whitman, Radiation Safety Officer at US Customs and Border Protection reveals how a chance discovery in the 1980s uncovered a 30-year-old radiological accident

IN early July one year in the 1980s, after delivering a newly calibrated radiation meter to a laboratory at a US military research and development base, I left with the expired meter. While approaching our department's delivery truck, the meter, which had been left on, alerted to the presence of radiation. At first it seemed as though the meter was damaged, but depending on which direction I faced, the alert would move higher or lower. Moving towards the higher reading took me through the parking lot gate to the front of a small building.

This building, perhaps five meters on a side, had a single door with a window. The base was built in 1943-4 and this building was added in 1947. Because it was directly in front of steam utility lines used to deliver heat across the base, it seemed to be a part of the steam line system. The readings near the front door were quite high – in the order of several millirad per hour. At this point it seemed more likely that the meter was defective than the possibility of finding contamination. Still thinking this was a steam line valve control station, I pulled back vines covering the window and discovered a faded yellow "Caution Radioactive

Materials" sign mounted to the inside of the window.

Still wary of using an expired meter, I returned to the Health Physics building,



Radiological incidents need not always come from terrorists

picked up several other radiation meters, graph paper and some chalk sticks. Within an hour, I found radiation on all four sides of the building, as high as one metre up the cinder block walls. I also noted two other hot spots – along a sidewalk and off into a low spot in the ground about five meters from the door of the building and another, perhaps ten meters away in the concrete. From there I returned to the office and looked at the drawings, thinking of what could have caused these readings. Could this have been an innocent inclusion of some radioactive material in the sand that had been used to make the concrete sidewalk and the mortar for the block walls of the building? Or was this an old experiment that had gone badly?

The next day, some others and I returned and resurveyed using still different instruments. The radiation definitely was real. A locksmith gave us access, and we were take readings, samples and make observations inside the building. This was an unusual building, with a large and solid rectangular concrete table directly in front of the door. It appeared to have been cast in place. To the right, the side wall of the building

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was about one meter away and along the length of the table in this space were ten pipes leading into the ground, all steel, all about 15 centimeters in diameter and each at least three meters or more in depth. The floor was covered by linoleum tile, which were curled and no longer affixed to the floor.

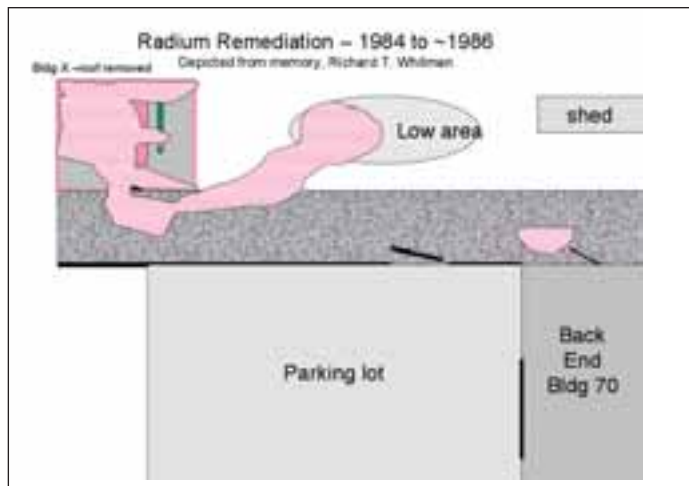
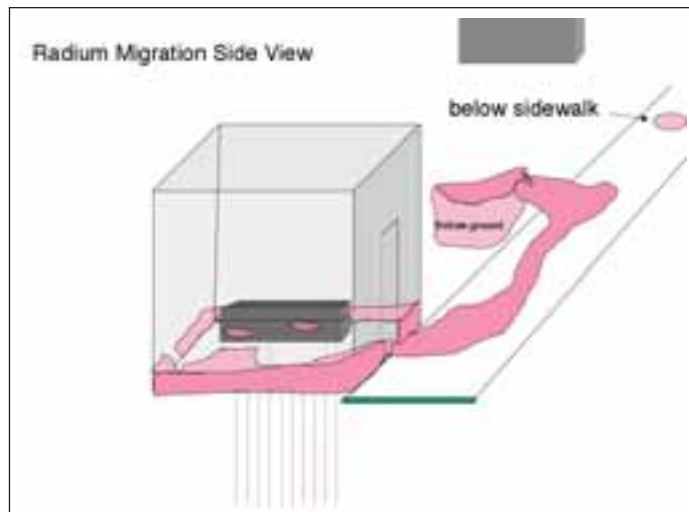
Since the roof of the building was flat, it appeared that the roof had leaked over time, perhaps from winter snow, and water had pooled on the floor for some time, until either evaporating or until more water was added, which explained why the highest readings were at the threshold of the door and why it would travel down the walkway and down in to the low ground where the sidewalk had tilted over time. Some of the tiles had presumably floated off and a second layer of tile was beneath the first layer.

Radium in the samples

That day, we also took some samples from the sidewalk, the low spot, the walls, and near one corner of the concrete table. All were analysed on an alpha, beta, gamma counter overnight and showed the presence of radioactivity in the alpha and gamma fields. The next day, when viewing a sample from the table on a sodium iodide well counter, the obvious energy fingerprint of Radium-226 was found. The same isotope showed up on every sample. Radium 226, with a high toxicity and a half life of more than 1,600 years, is not ever what a health physicist wants to find.

So, now we had an idea of what was there. But this led to more questions:

Since it was not just in the mortar for the blocks and the sidewalk, had this been released on purpose? How and when did it get there? Who put it there? How much was there? And was the Radium-226 inside and outside the building connected to the other spot further away?



Military bases are supposed to be good at record keeping, but the office that owned the buildings had no one signed for this building for at least the previous 20 years or more. The blueprints for the building had several details that seemed different to what we observed. Entries on the blueprints indicated that this was a project for apprentices, and there was no information as to whether the building had been built true to specifications and changed at a later date or changed while it was being built. The second set of floor tiles indicated a later alteration.

Within the next few days, during a meeting with a research staff librarian, I learned that the base had only recently upgraded the library, making it possible to do Boolean queries on the titles, authors and abstracts of works from 1944 onward. The librarian helped create a search using the word Radium-226 in five year increments beginning in 1945. The search

was of the classified material, because in the 1950s nearly anything with the word radiation in it would have been classified. The results yielded two work groups (of not more than six scientists in each) of interest. One group developed theoretical proposals for dosimetry referencing Radium-226, while a second group developed what became known as the AN/PDR-27, the classic US military beta/gamma meter. This group had the highest probability to be the group connected to the Radium-226 contamination. A few others were eliminated because their work had been in the more recent past, or their worksites were well known.

The personnel department had no records on anyone in the group of interest; most likely all had been retired more than ten years earlier, and from other details it appeared likely they had retired perhaps 20 or more years earlier. This is the point in time during which the US government and personnel lists began to limit

what information would be released to third parties. As the Radiation Safety Officer, workers would have been on film badge dosimetry, yet my records contained nothing earlier than 1976 even though these are considered a 'forever' record. The clinic had no records on former employees either.

The accident, late December 1953

Fortunately, an elderly employee on base knew how to reach someone who had been involved in the work at the Radium site. The current employee I knew took a message to this former employee saying that I needed information on how much and what isotopes other than Radium-226 were being used. We arranged for him to telephone me late in the work day under

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the condition that I not ask his name. During the call he related the following. Two glass ampules of 25 milligrams each of Radium-226 were being “tossed” between employees in December of 1953. Both ampules were broken. The employees mopped up the residue with rags and buried them in wooden box within forms for a sidewalk being poured right after the start of the 1954. In January, they dug up the wood box, had the sidewalk dug to 50 centimetres instead of 12 centimetres and then had extra concrete poured over the concrete table. Once dried, a new floor was installed, the sign hung on the door and the lead scientist’s name removed from the records in the laboratory Public Works records. He led me to believe that all involved then retired.

At this point, and with this information, another mystery was solved. In doing an inventory check months earlier I had noted a wooden rack with eight ampules of Radium-226 and had commented to another staffer that it seemed odd to have a rack for ten with only two ampules. She assured me that in her years on the base, it had always been that way; indeed she had no records of anyone every using Radium-226.

And so, the impression that the roof leak and water containing Radium-226 eventually washed out over the door threshold, which had a depth of a few millimetres, down the sidewalk and into the swale. The water leaking in from the roof also explained how the Radium-226 had migrated in time into the block wall through a Brownian Movement process; as

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Data on legacy items/incidents is not always going to be in a format that is easily accessible

calcium and Radium are chemically exchangeable, the water was a carrier. We also learned why there was another spot 20 meters away. The storm roof gutters had failed over the intervening years, water had migrated under the concrete walkway and the same kind of Radium for calcium migration had allowed the Radium-226 to migrate within the sidewalk.

Based on our interviews, surveys and other records, a demolition plan was funded by the command. In all, and after nearly seven man-years of effort and many residue samples, we removed 38,500 pounds of building block, 12,800 pounds of table, 22,000 pounds of concrete walkway and 750 cubic feet of soil. Total cost for all, was about \$1.8 million.

Implications for CBRNe readings and first responders

First impressions are just that. Use precautions; tracking a long-lived and strong isotope like Radium-226 out of a suspect site into a public area will not help anyone. When investigating a potential

CBRNe site, compare it to working on or near a painted floor and be careful where you step.

Use the right tools. Although Radium-226 is the classic alpha, it also emits a very high energy gamma. Although alphas can only travel a short distance, well under 20 centimetres in most cases, the gammas are a lot easier to find. Field tests should be backed up by laboratory confirmation. Record, map and photograph everything. Digital cameras make this easy to do. A high end camera (8 mega pixels) can be used with a single 1 Gigabyte “SD” type recording chip to store 666 photos.

Radium and some other isotopes also present an inhalation hazard (as Radon) in confined areas. Although this case was not confined, we sampled for it anyway. Shoe covers, gloves and coveralls are a must. Tools should be marked, left on site and used no where else until cleared by the radiation safety staff. Continue to sample even after a site is considered cleared. Radium in particular can sometimes “reappear” through additional migration.

This story is based on actual events and has been altered slightly for compression.