Interview with

Low Enriched Uranium Oxide Experiments Done in the 70s for NRC (1972 – late 70's).

-Came from either Mound or National Lead, Ohio (not sure)
-They shipped it back there after they conducted the experiments, and they also made the briquettes.
-It came in 55-gallon drums in oxide form.
(-this didn't have anything to do with tritium or that '73 accident.)
He showed Reflectors on pg. 123 of his book.

Low enriched uranium history and can preparation on pgs. 288, 289

RF photography department is where he got the pictures

Numbers he came up with (not sure what they are referring to:
"Here's some numbers I came up with..."
0.77
15.12

"Moist uranium oxide weight"
"Each of the briquettes at 5-something and you did 20 of them"
Aluminum cans, plastic bags.

"The oxide came from national lead" - Steph
An excess of 2000 kg of uranium oxide had been shipped to building 886 from a company called national lead of Ohio, later the Fernauld plant. The material was uranium oxide, which had been [calsigned?] at a high temperatures - a very dry uranium oxide. The vast majority of the material was U-308 although a careful analysis by x-ray defraction revealed a small component of the oxygen:uranium ratio of about 2.3 whereas this could have been oxide in the form u-409, instead of u-308..Uraniums are very complicated and complex and take many forms."

"Nobody knew or cared about this. We needed to know the weight of these cans so we would weigh them once a year...and some of these cans were gaining weight – how do you gain weight? Now the fear was that even though we had sealed those holes by putting tape over them – an impervious tape where air couldn't pass through, so there was no evaporation of the water. So most of the cans stayed right fixed at their weight of let's say 128.2 grams or something like that per can. But some of the cans were gaining weight. One possibility was that they were absorbing moisture. So we did an experiment where we put some of the cans and left them for a couple of months in a can with a pot of water so they would absorb the humidity which would be hot. But they didn't change weight. Then we put one can in that had a steady flow of oxygen gas through it, and here's what was happening:
The U-308 was taking in a little additional oxygen, and converting to the more stable form of u-309. U-309 (U-03 and U-203) which are the more stable forms of uranium."

The sealing wasn't perfect in these cans, possibly suggesting exposure to the cans' contents. Though Rothe didn't explicitly state this.

These cans got shipped back at the very end when they were finished conducting experiments.

Plutonium never delivered to 881 according to Rothe. He doesn't remember/know about Jack Weaver's claim.

"Were talking about uranyl nitrate high concentration 100, 200, 300, 400g/L. Highly-enriched, 93.2% **(U2-35). This was weapons grade uranium."**

"A mile slab is essentially the same as an infinite slab. It's just as critical. A mile is a pretty good approximation to infinity."

"An infinite slab at 450 g/L would attain criticality at 12.64 centimeters. Now, you can't have infinite slabs for storage of solution. You need to have bigger volumes, so in this big diameter tank you would attain criticality at if not 12.65, maybe 12.67 because it's not infinite. But it's very sensitive. When I measured that 12.65 parameter, if I added another tablespoonful to a big 5 foot square slab, it would have been out of control."

"When I'm doing the experiments, I have neutron measuring devices. There's 2 or 3 ion chambers, 3 or 4 BF3 counters (Boron tri-fluoride proportional counters), a gamma counters... What I'm doing is watching the radiation grow, so each time I add a little solution, the neutron population increases. At some point when I'm just slightly above delayed critical, when the neutron population increases exponentially."

"I liked to keep my neutron e-folding time to .8 times what it was. I liked to keep the e-folding time to one minute."

Suppose at 12.62, the e-folding time is 10 minutes so then I add a cupful...

"A flat slab is not a practical way to store this solution, and a big tank is just like a slab. So if you fill that if you fill the tank with these glass rasching rings, there is enough boron there in the glass, because that's what they are, they're borosilicate glass, they absorb neutrons, such that those neutrons that are absorbed, they don't exist anymore, therefore they can't cause a fission. So that's called a nuclear poison because it absorbs neutrons. And we learned a long time ago that, if you fill a tank with these glass rings, which only takes a third of the tank's volume, that leaves two thirds of a tank to put liquid in. And it still absorbs neutrons. **This keeps it way sub-critical....The neutrons were coming out of containment – sure absolutely. And they were, no matter if you stored them in a slab or you store it in a plastic bottle, a 4-liter bottle. [Time: 9:45]**

Steph: So how would you have been measured for those neutrons?

Oh because I wear the radiation badge – the TLD as well as the full size dosimeter."

What radionuclides were you exposed to?

Where would you been exposed to polonium?

"Oh an ordinary uranium solution will just sit there and radioactively decay and will gradually build up dozens of daughter products, one of those on the way to becoming lead would be polonium.

S: "And that's U2-35 at 93% will decay and polonium will be one of the decay products."

:"Yeah yeah. So will U2-35 and U2-38 at any concentration."

Stephanie: "Now those decay products are separate? So 238 is the depleted?
So if we have U2-38 on the cold side of a building, and people are machining it, they're around it all the time, aren't they being exposed to polonium? And any of the daughter products?"

:"Probably not much. Yes, in theory, some. I do not know how much. Somebody does, I just don't know."

Stephanie: "So there's the decay products for uranium and there's the..."

:"Fission bi-products [13.40] And here I have to give you a little hand waiving picture. Here"s a "blob" of uranium. Metal liquid powder I don't care. No no, its not a blub of uranium, it's one nucleus of uranium. And a neutron goes flying into it. Can I draw you a picture? This is a neutron that's moving at slow energy that means its thermal. It hits this nucleus of U-235. This is just one neutron and one atom. What I'm telling you now is called the liquid drop model. Like if you hit a bowl full of jello with a spoon. In this model, this nucleus will squeeze together and then expand and squeeze together tighter and expand further and at some point in time it rips itself apart into different blobs....**These are the fission fragments. Those are the four f rare earth, strontium, yittrium, dysprosium, iodine. Cesium is one of those."**

Stephanie: "DOE stated 'We did not create the rare earth [metals]'. "

:"They didn't take into account that in experiments, he created a lot more...In another bldg. like 881 that handled uranium for years, and anywhere else that uranium was handled, they wouldn't have enough fissions going on. But I'm the one who took it up to levels that caused fission fragments that caused the radiation monitors to say "this is hot, don't go into this room for a day or two."

Stephanie: "And what room"

:"Room 103 – the mixing and storage room. The radiation monitor would go into any room where the solution was."

Stephanie: "Where did the solution go when it had fragments in it?"

**:"This picture shows the passage of 10 to the minus x seconds, a very short time. And typically 6 of these oscillations and your left with nucleus x and y and those are the fission fragments, plus neutrons. This means that it's possible that one of these can cause another (chain reaction). You can lose this one to leakage; this one to boron, this one can hit a reflector and bounce back so it at least has a chance again. That's what causes these rare earth fission fragments.......
What you need to know is that you are exposed to radiation that is not found elsewhere in the plant site, because of the fact that I went to high power experiments."**

Stephanie: "Was anybody exposed to it, and then not monitored for it?"

"Yes, absolutely."

"It was never so hot that I had to wait more than a weekend for decay."

Stephanie: "Doesn't it have a 23 year half life (strontium)?"

"Yeah but we don't care about that. The fast decay products are more dangerous because they decay before you even get to them. You can't monitor for the effects of them. There may be dozens of fragments that have a decay life of minutes to hours. The fission fragments are highly radioactive, not only 4 f, but most of them are."

Stephanie: "So I read about you putting some solution in a 4 liter bottle. So when you were doing that, you were exposed to those fission fragments and not being monitored for them, right?"

[at 24:15]" If I had done that minutes after an experiment yes, but days after, probably not. Days after the experiment, the radiation is down to the normal ambient levels. X and y are all the fragments, and as they decay away, their radioactivity changes and they are born neutron rich so they give off neutrons and gammas."

Stephanie: "Why would you have a zero on your neutron count?"

"I don't know why they wrote that – I don't see those reports. I think the strongest argument you can make is that I – and anyone in building 886 – was never monitored for highly active uranyl nitrate solution [at 26:10]. And you don't even have to ask how much. They just said "well the uranyl nitrate solution is this, and it's ok to be that. Its ok to be near it forever. What they didn't realize is that since I went to relatively high power levels, (never high as a watt, even though reactors go to megawatts). I just wanted to know what conditions would attain criticality. The same conditions were required to get to a watt as a megawatt."

doesn't ever remember getting a fecal exam.

Stephanie: "Can they go back and tell you how much your exposure to uranyl nitrate was?"

"I don't think so – how would they? The thing is that I never got a lung count or any kind of medical test within a day or two of having done the experiment. They'd make an appointment for urine or something like that, but if I hadn't done an experiment like that the same day or the day before, I wouldn't have been exposed and they would never know. Whoever is talking about what they did monitor for doesn't take into account that the solution I used was different than normal uranyl nitrate solution – it was much more radioactive because of the fission fragments in it."

Stephanie: "Where did the solution go or travel."

"We had 9 tanks in room 101, where the experiments were done. There's a pip that leads into room 103 where there were tanks, 1 – 8. These tanks were all connected by pipes. Room 102 was where the thick wall was – 18 inches. Room 101 had a 4 foot thick wall on 4 sides. And the one separating 101 from 102 and 103 was 5 feet thick and the ceiling was 2 feet thick. To do the experiment, I wasn't in these rooms I was outside. If I was in the room when the experiments were done, I would have died every 15 minutes. (of a criticality accident). That would be the life expectancy with that kind of a radiation dose."

But this was room 112- the control room. From this point right here I would push a button that would push a solution to this tank through the pipes (made of 304l stainless steel). There were lots of leaks in the pipes. I would keep adding solution as the neutron flux grows steeper. [at 32:00] Fragments were being created all along. And the faster this is going up the faster they would be created. Then I would drain the solution away so it would drain back to storage. Looking for how to get at critical levels – where the neutron flux isn't changing" [33:50]. [34.20 to review].

Stephanie: "You never used Pu in those experiments?"

"Plutonium, yeah [34:30] we used uranium 235 solution metal, powder, and Pu 239 'old lot.' After the experiment's done, the inventory of radionuclides is built up however power level I went to, however long I stayed there (which would be up to 9 hours). I had to watch the whole thing, in fact there had to be 2 of us whenever we did an experiment where we were adding reactivity. They would always be at least 30 minutes – enough time to build up a lot of fission fragments. And after, I'm still sitting in there, then we go shut off the manual valves. All the solutions drained back. So I have to go back into room 103. And this is the time that the radiation monitor would say "don't dwell in here. The tank is too hot" He'd measure it with his victorine 440. Typically he'd measure the tanks because that's what I would be near and more to worry about. Then he'd say "stay away from this room". I'd turn off valves in 101 and 103."

Stephanie: "So there were no criticality alarms in 101 because there was criticality happening."

[37:38] "Oh yes there was, but we shut it off (the criticality alarm) during an experiment because we were going to take it to critical (oral history). The big difference was that many of our experiments wouldn't even trip the gamma alarm. We realized the gamma alarms, the criticality alarms in the rest of the plant, would be set at a threshold considerably higher than we – cause we didn't want gamma radiation, we weren't interested in that – but what they don't understand, and I'm not sure how big it was. But you at least have the truth, that the solution that they thought I handled was not the solution that I did handle.[38.30] The solution I did handle was much more dangerous. They thought I was handling just ordinary uranyl nitrate, like if you made it from a centrifuge at Oak Ridge. Normal Uranyl nitrate, which would be made up of highly enriched uranium – but it wouldn't have any fission fragments in it. It came to me as weapons grade uranyl nitrate."

(Every where it's going, it's exposing people – where did it come from, how did it travel?)

"They thought I was working with the regular stuff. This normal uranyl nitrate would only build up enough fission fragments for the normal/occasional neutron (an almost negligible amount), but when I did experiments I was intentionally trying to increase that number a lot…to determine the conditions under which it would happen at the plant. They weren't monitoring for the type of uranyl nitrate that had fission fragments.

Even the pipes in the tanks, though they contained the solution, I didn't have to see the solution to get radiated. In fact that's why he told me "don't dwell in here" because it was coming through the stainless steel tank. It's just gamma radiation, that goes through anything."

Stephanie: "So after the experiments, now you've got this fission fragmented uranyl nitrate that has to be shipped off and torn apart."

:: "The last experiment was done (to criticality – check book) they didn't start tearing things apart and removing the solution until the early 2000s. So it would have years to radioactively decay. And by the time they started having access to the solution, I don't think anyone was subject to radiation."

Stephanie: "Who else had access to room 103?"

, other experimenters, guards, radiation monitors. Occasionally crit engineers.... In 1964, the doors to room103 or the one that ran into it, any one could walk in there. No problem.

Pu cylinder problem – January 93. That was the stuff in room 102. That was metal.

Pu would be in this container inside an aluminum can with a rolled steel lid, and this lid would be put on and sealed and that's the way we handled this. And in room 102, there would be, oh a hundred and some big water-filled tanks with lead lining. The water moderated the neutrons, the lead absorbed the gamma rays. Oh and this is very important: the Plutonium we had was very old, and the old Pu builds up high Amarecium which is extremely gamma radiant. So every time I handled this material, we also had to wear aprons and wrist and forehead TLDs. They'd just scotch tape it on my forehead. That way they could determine how much gamma radiation my brain got. The point is that we had such different (Pu) it was 20 years old.
And bldg. 771they had line 2 was the amarecium line where they would essentially pass the Pu through and extract the amarecium so then they have pure Pu you could handle without as much gamma."

Stephanie: "So if amarecium is being put into drums, it's going right through the metal and hitting everybody with gamma?"

: "Sure."

Stephanie: "Ron burning off labels off drums in 991 that said amarecium. A TLD and dosimeter, you won't get your dose because when you get gamma, they won't know if they measure a few days later."

"Sure. The gamma dose you get while you're wearing it. We always put our radiation badge inside our lead apron. Those devices were trying to measure what we got. Now those aprons didn't cover our wrists, hands or forehead. We knew the Pu was very gamma active. We would screw a rod into a hole in it and handle it at the end of a rod.

Pu cylinders incident possibly happened in room 101. They were doing an experiment with Pu the night before. He left it in an enclosed room overnight without water. With no water, the metal got hot and that thermal cycling eventually broke the seal in the cylinders. They found out this only through that experiment. Open top tank with yellow dust alerted him to the broken Pu cylinders. He never wore a mask. Also, if the Tyvek was stretched, it wouldn't protect as well from chemicals."

In 886, you are on the right track for getting down to where people were exposed.

The build up of Amaricium was the reason for line 2. The old weapons had to be brought back, disassembled at line 2. He thinks there may have been tritium in some of those shelves.

"Anybody on the plant site who worked with the returned weaponry would be exposed to radiation that was not considered by people who said you were exposed to plutonium. Because of the amarecium. I don't think they distinguished between Pu and Amarecium.

We got our Pu from Lawrence Livermoore. We got them in the 70s when they were already old and kept them for longer. It wasn't ordered from Lawrence Livermoore, it was taken from them (maybe political reason). They got 375 kg of that old Pu metal when it came in. They knew it was more radioactive."

In 886, there had been a problem with Pu from Lawrence L. They got rid of Pu in 1983 by giving it back to the productions crew. It stayed on the plant site, returned to the weapons stream, but not entirely sure where it went.

Possible the people handling it in Jan 83 were getting gamma radiation.

Waste from area – a cement filled drain. Waste water would go into a drum for disposal. "They would "decontaminate me with paper towels and wipes" and that would go into a drum and they'd say "you're decontaminated enough to go up to medical."

I would clean up after the leaks from the pipes. Protected by whatever the radiation monitor told us to wear. But never supplied air. Occasionally wore a full face. Leaks, wore a half mask. Never got immediately monitored after these incidents.

They were only monitored for alpha but not gamma during these. Victorine 440.

The RCT was not documenting gamma exposure [1:08]

consent to NIOSH interview [1.11.00]

“Bldg 875 was our filter building I think”

RFPs are RF plant reports. He wrote a number of these.

document.