Nevada Test Site Oral History Project
University of Nevada, Las Vegas

Interview with Robert Friedrichs

June 18, 2004
Las Vegas, Nevada

Interview Conducted By
Mary Palevsky

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Produced by:

The Nevada Test Site Oral History Project
Departments of History and Sociology
University of Nevada, Las Vegas, 89154-5020

Director and Editor
Mary Palevsky

Principal Investigators
Robert Futrell, Dept. of Sociology
Andrew Kirk, Dept. of History

The material in the *Nevada Test Site Oral History Project* archive is based upon work supported by the U.S. Dept. of Energy under award number DEFG52-03NV99203 and the U.S. Dept. of Education under award number P116Z040093.

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Table of Contents

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[00:00:00] Begin Track 2, Disk 1.

Robert Friedrichs: In 1963 I was working at one of the industrial plants in Henderson, working a rotation shift. Decided I needed to get out of that because physically and mentally it was very detrimental. And so I had two offers for a job and one was with TWA working graveyard at the airport, and the other one was to go out to the test site, and that was Monday through Friday, days, and essentially the same pay. So I grabbed that one. It made more sense to me to have free weekends and not wonder if I was going to see the sun go up or go down or what have you. And when I was first interviewed for the job there were three people that actually performed the interview. One individual named Garn Iverson, and another person that was in that interview group was Jay Brady, who became the senior health physicist for REECo [Reynolds Electrical and Engineering Company], but had been involved in security in the very early 1950s and then went over to the radiation safety side of the house after that. The third person was an individual named Omer Mullen, and he was a chemist, and Omer retired from REECo many, many years later and the last thing I heard he lived in southern Utah with his wife. It was interesting because the person I worked for was not in that group.

Mary Palevsky: *Is Anita Mullen his wife?*

Yes. The person I actually worked for was a gentleman named Lester Hartzell, a little gray-haired, or white-haired, gentleman who was a chemist from the old school. He had been educated at the Montana School of Mines and had worked in South America in the mines and before he went to the test site he worked for the manganese plant that used to be on the road to Lake Mead

from Henderson. You can still see some of the remains of that facility but not very much left. And when that plant closed down he got the job out at the test site, so he's the individual I really dealt with on a day-to-day basis. The very first day I reported for work I overslept. And so instead of showing up at eight o'clock, he was very patient and waited, by nine o'clock he'd sent one of the other people over to find if I was all right, because I was staying in a trailer out there, a four-man trailer. And I went in very embarrassed and he just politely said, Don't ever let it happen again, and so I got started.

But I did radiochemistry and various types of chemistry with some rather crude instrumentation. We didn't have the multi-channel analyzers, we did not have the sophisticated stuff that came on later, but we had a Baird atomic unit that chunked away and we had some other units that were really very crude by today's standards. In fact one of the counter units had the tubes that were wafers that had the numbers on the wafer going from zero to nine in depth, and so as the counts would change these numbers would flicker and change but they would **[00:05:00]** become further away and closer like an eye depth perception test, very, very interesting stuff. I started out doing, oh, strontium analyses, gross alpha, gross beta, gamma, plutonium, some uranium analyses, and those were ion exchange techniques for the uranium and plutonium. We did tritium using the vibrating reed instrument, where you would actually take the moisture created—or change it into a gas, capture it in a big metal sphere, and then through electrical current determine if you had what you were looking for inside. The fact that tritium was used in nuclear weapons at that time was classified, so we analyzed for it but we never used the term, so everything that we did was logged as "activity." Before we used that word they used the term "mint," and so when you look at the old laboratory records you will see analyses for

"mint," and then during my period "activity," and that's just part of the secret code you needed to learn.

I started out as a junior laboratory technician, doing the chemistry analyses, wet chemistry primarily, and did some work in the dosimetry laboratory, but we were in Building 155 which was a cinderblock building, one story. We were in one end and the Public Health Service was in the other end of the building. They were building the new Building 655 which had the medical facility and the radiation safety people in it when it was completed. So in order to save money they decided they were going to pull the lab furniture out of 155 and install it in the new building, and it was not that great to begin with but it was a way to cut the cost down. So they brought in a trailer and set it next to Building 155, and it had counters and hoods, what have you, in it, and so I would work in a trailer for several months while they were gutting out the laboratory and then reinstalling the equipment. Unfortunately the trailer was only six feet tall, the walk space, and being six-six I had to pretend I was Quasimodo the whole time I used that. So that was really quite awkward but we managed to continue to function. And then when we moved to Building 650, I mean that was grand. Even though it was old furniture it was really nice, large rooms, large laboratories, and worked there doing radiochemistry. But it became apparent very quickly that the building wasn't large enough, plus the state-of-the-art technology was changing so rapidly. Instead of doing everything with chemistry and one small room for counting, we now needed to have a very large counting room, prep rooms, *et cetera*. And so they built the addition on that had all of that type of capability. And there they went into very large multi-channel analyzers, very sophisticated low background systems for the pigs that you would put the samples in, have the detectors inside, so all lead-shielded or heavy steel shielded. The steel pigs that were used had to be pre-World War II steel because they use isotopes in the steel-

making process today, and so anything postwar you have a higher background, so you in turn **[00:10:00]** have a greater noise level and you can't detect as low as you would like to. And so several of ours were made out of battleship gun barrels. And they still had the grooving in it that would make the shell rotate as it came out. That was a unique application, to say the least.

Yes. Now are any of these artifacts still around?

No. They got rid of the gun barrel pigs years ago, and I would imagine they probably just surplused them. We also had a whole body counter that was added to the building several years later, and that was all steel and that steel came from a battleship.

Now how did that work?

And it was like two-inch thick steel that they welded the whole thing together, and very, very heavy steel door going in. Small openings where the cables would run out from the detectors and go to the instruments, and the technician would actually sit outside and monitor, then work the data.

So someone would walk into this thing and—I mean how did it work?

Actually they'd change clothes. They'd put on paper coveralls and little paper booties and they'd go in and they'd lie down on a table and they'd just lie still, and then they would be counted for twenty, thirty minutes to be able to get the kind of numbers that were needed to really determine if they had any uptake or not, internal depositions. And so just the fact that in order to have that type of a background they had to get battleship steel to build this entire box, which is still out there today.

Interesting. It's sitting in a building there now? Is it still in use?

It's attached to the back of Building 650. It is not used today but I mean it's still physically there. But those were just some of the kinds of things that evolved. We also over time started doing a

lot of work for specific individuals in the national labs. It wasn't just our routine sampling network stuff. We would begin getting in samples that had been taken for specific reasons and they would need the data turned around very quickly in order to know if they could have the crew go in the next day and work, or if the dose was such that some of them could not work on that job.

So would it be a soil sample or a plant sample or—?

They were frequently urinalyses, and if there were incidents we would get wound swabs and nasal swabs, and the routine program we did air sampling, we did vegetation sampling, water sampling, not a lot of soil, but we'd do the other three, *a lot* of the other three.

So if someone was trying to see if it was safe to go in, you would do—

Normally we'd do a combined filter for the air sampling. It would have a pre-filter that would be paper that would catch all of the particulate, and then we'd have a charcoal cartridge behind that in the head of the air sampler that would capture the gases, and so you could count those and determine what gamma emitters you had. And you could analyze the filter paper one for other radiations besides gamma, but with the gamma spectrums it's quick and easy to do the analyses and prompt fission products primarily to know if you had any kind of seepage from the shots and what isotopes would be coming out.

Now we're talking about underground at this point, so seepage up.

[00:15:00] Yes, I need to clarify that the last shot that was really atmospheric was in 1962, and I went out there in 1963, so I didn't see *on* the test site. I did not see any of the atmospheric shots, but certainly saw underground shots on a regular basis. And I can remember standing on the balcony at CP-2 [Control Point] and looking out on Yucca Flat and see the ground movement and the dust and whole thing from an underground shot. You knew when they were going to be

ended, watched that, and then you'd go back in and do whatever you were there for. So that's the kind of samples we normally did.

And then you were saying that it reached a point where then you're doing that for safety and for just general knowledge of what's going on—?

Safety.

And then you've got the lab people asking you to do it on their specific—?

They would have a requirement where they would need fast turnaround. They would have special interest in a specific type isotope and so we would get samples and we'd be very focused in getting that information and getting it back to them, working swing shift and then calling out and providing the information. Not to say anything negative about our management, but what we would normally do is call the person that evening and tell them, but clarify that that was not the official result. And then our management would get the counting data the following day and call out and formally report the results. And it was always fun to see if they came up with the same answer. And the folks that we did that for were kind enough never to tell our bosses that we'd already told them. But it helped them do their plan for the next day.

And we did a lot of samples that were water, a lot of air samples, and in particular for shots you'd have an array. You'd have up to thirty-two air samplers for a single shot, and on days where you had more than one shot you got this large volume of samples and you had to pull the filter out, bag it for counting, label and everything. Then you had to puncture the charcoal cartridge out of the cone head that it was in, bag it, get it numbered and everything, and into counting, and not cross-contaminate samples. So it was just a fairly fast operation. And the water samples we'd put 500 mils [milligrams] in a bottle for gamma counting. We'd take just a few mils and put it in a cocktail for tritium analyses. We might take the remainder for plutonium

analyses and that would go into a different laboratory. So you had all of these kinds of things going on. And the vegetation, you'd have to dry that out first before you would then crush it down and ash it and then deal with the ash. They originally would bring the vegetation in in paper bags, and we'd slit an H-pattern in the side of the bag and open it up and just put the whole thing in the drying oven, until one day the drying oven caught on fire. And we'd been getting away with that for, oh, probably two years before it finally kindled. And so from that point on then we'd make an aluminum tray and put the vegetation in the tray and dry it that way. But again those are things you learn as you go along. But I'll never forget looking in the room, seeing it's full of smoke, and walking in. The drying oven doors are open and the smoke's just rolling out because of the fire. First thing we did was slam the door shut and then cram a wire shelf under the handles on the door to hold it shut, and then go out and hit the fire alarm because we didn't want it to get out of control. We wanted to at least try to cut off the oxygen and keep it **[00:20:00]** contained. So the fire department came over and put out the fire and then chastised us for our stupidity and then they went away.

But those were interesting experiences. They really were. The biological, you know, we'd have wound swabs, if somebody had a puncture, of the wound and they were concerned that there might've been plutonium that they were exposed to through that pathway, and that is a definite pathway of concern with plutonium because of its long half-life and being an alpha emitter. So anybody who had a puncture wound, that was routinely checked. And nasal swabs if they happened to get into a dust cloud and weren't wearing the respirator, you'd want to confirm if they had any inhalation because there again that's another pathway of concern where you would not want the plutonium in the lungs because of the potential damage to the tissue.

Ingestion is another pathway but most people aren't stupid enough to eat radioactive materials. And those are really the three primary pathways for plutonium.

What would happen if you got a reading that was too high or either from the samples or from an actual sample from a person?

Well, you would count it and then that would determine how that person was treated medically. In one case we had a bioassay where it turned up positive and so they brought the person in, gave them great quantities of beer so they would produce a large amount of urine that we could then analyze. And they literally kept him at the bowling alley until I had finished the analyses and confirmed with the follow-up sample that he had not gotten a plutonium exposure of that magnitude, that indeed the sample had been contaminated in the field.

Oh, I see.

Shortly after I went out there I did bioassays from one individual who always had positive bioassays for plutonium, and at that point we would actually take product out of the ion exchange columns. We would then put it in solution and electroplate the plutonium onto a very small platinum disk, and then we would take that disk, put it on a glass slide with photo emulsion on it, leave it for seven days, then go in, pull off the disks and then develop the slide and then look at it under a microscope and count the alpha tracks, and it was just black. So we then went to a matter of hours instead of days in order to be able to count the tracks and determine the internal deposition and exposure the person had. But he had gotten a snootful several years before and being plutonium it doesn't go anywhere very fast and so we could just rely on every time he had one come in we were going to see. No question about it.

But those are some of the types of samples we did. Then as I got more proficient over time I started actually working for Los Alamos when they did the nuclear rocket engine tests.

And I would work at what the laboratory referred to as the "Mouse House," and that was their counting laboratory and offices, and we would analyze various samples that would come in from the field. And it was fun because it would be two hours after the run before the samples would physically get there, and so if we knew what time the run was going to be we could actually go over and watch it, and then go back to the lab and be there and ready to go when the samples came in. So I got to see some of the reactor runs that way.

[00:25:00] *So this is the reactor that they're trying to make so it could be for the nuclear rocket.*

Yes.

And they're doing tests on the—

Nuclear engine for deep space probes.

For deep space, right.

Yes. We also did a lot of samples from Plowshare shots when that program was very active, because obviously you have this enormous mass of earth that's thrown out— you've got radioactive material in that—you have radioactive material released to the air, and some that's in the debris pile that on the bottom, and so we would analyze those samples also. But I didn't physically go out and watch those shots when they occurred.

Then we were providing support to Sandia laboratory and I'd been working in the lab and they set up a special group where there were literally three of us in the group—

And so you're still working for the contractor, for REECo, and first Los Alamos and then Sandia says, We want you to do this specific work for us?

Actually there was a group of us that would go do the Los Alamos stuff. Then I was put in this special group where there were two chemists and myself, and we would do special samples, one-of-a-kind analyses, one-of-a-kind-type samples. One of the things I was assigned was the

responsibility to set up a series of analyses for used motor oil, to determine when it should be changed out instead of just changing it on some fixed frequency, and so I found the appropriate lab procedures. We had infrared light analyses that we did. We did some gas chromatograph analyses. We did a couple of rather unusual ones that I found. We could actually determine the PH by mixing two indicators in a very careful ratio, and you would take a filter paper and you would saturate it in this solution, and then you would put it down on a piece of clear glass. You'd take a swizzle stick and put it in the oil and then drop one drop of oil onto the filter, and as the oil would diffuse out there was a halo ring that went before the oil, and that actually would have the color that would tell you the PH. And the two we used covered the entire spectrum. And so we could just do that very quickly, very cheaply, and know the PH. Then another concern is water in the oil, and we'd use what I refer to as the crackle test. If it is over a certain parts per million water in the oil, if you put a drop of oil on a hot plate that's hot it would sit there and crackle and bounce all over. If you took oil that was below that, drop it on, it'd sit there and just fume off.

Yes, that's like a cook knows if there's water in the oil. That's interesting. So you're checking the motor oil for its usability, not—

Well, for the compressors and for the heavy equipment, because they didn't want to just automatically change out the oil on some fixed frequency.

Right. I see.

They also were having some problems that they wanted to know when it was occurring in some of the equipment. They were losing rubber gaskets in some of the systems, and we were able to determine that an engine additive that had been used was literally deteriorating the seals.

So you're doing an analysis of this material but in this case it's not about radioactivity; it's about the composition of that material.

[00:30:00] Although some of the problems we were given, the obvious issue was radioactive, a unique-type isotope, what have you. But in the case of the motor oil, that was strictly to know the quality of the oil.

Yes. Interesting.

And so that was fun, to get into that. We also caught engines that were beginning to deteriorate; you'd have heavy metals. We had an atomic absorption unit that we used for part of that analysis, and you'd shoot a wavelength through the flame where you were running the sample through, and this wavelength then would be recorded for very specific elements. And if you wanted to look for a different element you had to open the side of the box and crank it around to the next tube and run that. And so we found that we had some very large pieces of equipment where the engines were starting to deteriorate, and so instead of running them until they failed they were able to go in, repair them, and minimize the cost *significantly*.

That's interesting.

So those were some of the fun kinds of things I did in that group.

Yes. Yes.

[00:31:30] End Track 2, Disk 1.

[00:00:00] Begin Track 3, Disk 1.

But as a result of working in that group, learning the gas chromatograph in an updated way and far more technically oriented than when I worked a gas chromatograph at one of the plants in Henderson, I was asked to support Sandia Laboratories on one of their shots where they wanted to do gas chromatograph analyses of the air in the tunnels and different places in the tunnels after a nuclear shot but before people were allowed to go in. And so I worked on that Diamond Sculls shot in T-tunnel which was enormous. I mean it was just incredible, the size of the line-of-sight

pipe and everything. And so I was out there weeks in advance. We were running transit times from the different valves that we would open to know if we opened a valve and pulled a sample how long it would be before it got to the trailer and went through the machine. And then on the shot itself they delayed that several times and so I was going back and forth with the scientific advisor for REECo and we decided that we were going to do a little something interesting when the shot went. And so the day of the shot they had the electrician go into the portal and hook up the power. That was the first thing. Then *we* went in and I ran the gas samples. *Then* they allowed the monitors to come in and the others to come in and actually begin access into the tunnels. So we're the second and third person to go up to the portal. And we had the results, we called them out, they knew they could send the next folks on in. So a fairly significant number of people were coming up the road, and as they pulled in the scientific advisor and I were sitting on the steps of the trailer, eating watermelon. We'd done our work; now we were relaxing.

That's funny. When you say the line-of-sight pipes were huge in that thing, I mean what are we talking about in scale here?

I think it was thirty-five feet in diameter. It was big. You look at photographs of that shot and the end of the line-of-sight pipe is just enormous. That was in the 07 drift and it's all closed off now. You can't see it. But for years afterwards they had like a wire mesh door on that drift so people could look in and see it. It was just really impressive.

So they're testing a certain kind of design in there, or a certain kind of application, or a certain kind of something in there.

Actually in the line-of-sight pipe they draw a vacuum to simulate space. And also to make sure you don't have a bunch of air molecules for the radiation to have to fight its way through to get to the experiments that are on the very end of the line-of-sight pipe. And so you get better data

that way. It's very difficult to draw vacuums on large areas, and so they have to do some very sophisticated stuff. But that, to my knowledge, was the largest one they ever did.

OK, so let me see if I'm understanding the technology correctly. You have the line-of-sight pipe and it's a vacuum in there and you're trying to get measurements of things that are coming off the tests, is that correct?

Yes.

But when you have it so large, you're not only trying to take measurements, you're saying you're actually trying to simulate space. In other words, every line-of-sight pipe is not trying to simulate space.

No, but several of the shots, they actually put missile warheads, satellites, et cetera in to see what the effects would be if there was a detonation nearby.

[00:05:00] *In space.*

In space, and to harden the warheads from the enemy shooting off missiles, trying to in any way make them ineffective.

So this is in the tunnel itself, these warheads are sitting.

Right. All underground.

Right. That explains a comment someone made to me several weeks ago that said, `I spent so many years in tunnels pretending that we were in space,` or something to this effect. That's what he was talking about.

Yes. In fact one of the participation certificates, and I think it's Huron King, when you look at it you can see the large white vessel that was on the surface, and that was a vertical shot, but they ran a line-of-sight pipe up to the surface and into this large container, and they have a cutaway and inside of that they have a satellite hanging there.

OK, so yes, if I get to see that. All right, so that explains that part of it. So a "vertical shot," that means that the device is placed in a certain way that's in a hole rather rather than in a tunnel, is that what it is?

Right. A thousand-plus feet underground, and then they run the pipe up to the surface in that case. Normally they wouldn't have a line-of-sight pipe; they would have the cables coming up and there would be all the gas seals and all of that. But in the case of that specific event, and it wasn't the only one like that they did out there. They actually ran a line-of-sight pipe all the way right up.

Wow. Well, I interrupted you but I needed to get clear that I'm understanding what you're saying.

They had line-of-sight pipes that were so large, they put full-size equipment in to determine the effect of radiation flux on the electrical systems, *et cetera*. So a lot of that.

Amazing. It's just amazing to think of the technological sophistication that has to go into things like this.

As a result of the work that I did for Sandia they invited me to go down to the laboratory and have a tour of the Sandia Laboratories. And so when I did that it was quite an eye-opener. That's where I really saw very complex science going on. [I] realized that I needed to do something with my life. Sitting out there being a technician was not going to make it.

Interesting. About what era would you say this is?

Oh, probably 1971, that general time period. So I came back and in 1973 I actually started at UNLV [University of Nevada-Las Vegas]. We had gone through the Baneberry incident out there where we had the venting that shut the test site down for several months.

Were you there for that?

I was in Mercury and we could see the cloud, we knew there had been a major problem, and so we started gearing up, getting additional supplies out of the warehouse and everything and getting everything set up, knowing we were going to have work. And in fact we started just before eight o'clock. I got off the next morning at I believe it was six, went home, got some rest, **[00:10:00]** went back in, and we started working twelve-hour shifts. And we counted tens of thousands of samples by the time we were all done. They would go through and they would swipe all of the equipment, all of the housing, everything in the forward areas to make sure everything was decaying out properly, and at the appropriate point then allow the general workforce back in. We had monitors there all the time collecting those samples. But that first day though we had a busload of people that were brought in who had been contaminated. They'd been decontaminated initially out at the control point, still had readings, and so they brought them down to Mercury where we ran them through the showers again, took bioassay samples, did thyroid counting, et cetera, on those folks, and then went ahead and took them into town and dropped them off. But it was rather interesting because that happened in the middle of the winter and these guys are running around in again the paper coveralls and the paper booties and we're dropping them off in front of their houses because it's so cold they can't go any distance. And then just the tremendous volume of samples that followed.

So you saw the cloud in the distance. I mean just a sense of what the atmosphere was like when people started coming in. Are they afraid? Are they talking about what had happened? Are they worried? Are they—?

Actually when the bus got there, they'd already gone through the decontamination process at the control point and the hot water heater had just been overwhelmed and so many of these people had been taking cold showers, in December—

At the test site.

Right, and they were in coveralls. They came in. We were taking them off the bus one person at a time and working them through the process. Well, some of them made contact with friends out the window of the bus, what have you, and the next thing we know they're getting drunker and drunker as they come in. So they were taking care of any tritium exposure they might have had on their own. And one of the people was rather obnoxious. And we had Nye County sheriff and their personal possessions were being bagged and sealed and everything, and they were checked to make sure they weren't contaminated so they could take the plastic bag with their wallets and that with them. And we'd run them through a shower and they were very grateful because the hot water heater we had in Building 650 was adequate and so they got nice steaming hot showers and loved that. But as I say, the later it got the drunker they were coming off the bus. And at one point they'd taken the personal effects from this one gentleman and had it bagged and he was starting to hassle the technician about, `You better not take that. I know you're the one that got that.` And the technician looked at him and said, `You're so damn drunk, you're not going to remember me tomorrow, so shut up or you'll never see it again.`

So explain again, because this is another thing you hear. I've heard about the beer and the tritium, and so you drink a lot of beer, and you made reference to it before, but that's just to—

Well, you've got two processes that go on, OK. You've got the radiological half-life, but then you have a biological half-life, and that's how fast the body deals with that material. So obviously if you drink a lot of water you flush your kidneys and everything and so you're getting rid of the impurities faster. So that's how that works.

That's what I thought you were saying. So in this case it was beer.

Yes.

OK. But there's no particular quality of beer that helps you flush your body out better, or does it?

No. You could do water, iced tea, anything, any fluid will do it.

Yes, because that's another legend I heard in passing, this reference to beer, is that beer itself contains some particular magic thing, and that's not true. It's just that it's a liquid.

Right. And it's a good excuse.

[00:15:00] *Yes, and it's a good excuse to get drunk, especially after something like that. So people weren't talking about what had happened or what they'd seen or what it had been like at that point.*

Not really.

OK. Maybe enough time hadn't passed.

Because there were a lot of things that happened that morning and people being shuffled around during the evacuation and all, and I don't think anybody really clearly understood who had been where or when, the whole thing. So they saw this rather large dirty-looking cloud that went up and then sheared a second direction, which is something that's documented as having happened out there before with the Smoky shot where the cloud literally sheared, separated, and you had two different areas where you had fallout occurring. But I think most people just were so uncomfortable because of the temperature and the whole thing with the showers and all, they just wanted to get it over and go home and they'd worry about it another day. There was no mass hysteria or any of that at all. They were good. They were patient. And they knew we were trying to get the information that would allow the appropriate follow-up. So we didn't have a problem with that at all.

But that was quite an experience, to go through that, and we got kudos afterwards because I think we had done something like thirty thousand samples by the time it was all over, and the error rate was really low. Really low. Just handling that kind of volume, getting the wrong number on the wrong sample.

Oh, the error rate.

Yes. So that was quite a remarkable thing that we were able to crank through like that. But we had good people. I don't know if I mentioned the technician that I first worked with in Building 155, speaking of the unique personalities. Danny Stewart was his name, and he taught me the hands-on way of doing the procedures. Before I'd reported for work they gave me the procedures manual and said, `Go home, read this, understand it when you come back.` And so I knew the paper version but actually working with various pieces of equipment and that, they had me work with one of the other technicians. And Danny left, moved away, and a couple of years later the FBI showed up. Realize now we're talking going into the mid-1960s.

Yes, we're back in time a little bit.

And Danny had filed for conscientious objector status, and they couldn't understand how someone could work in the nuclear weapons program and then file for conscientious objector. They thought he was trying to be a draft dodger, and we explained, `No, we don't think of ourselves as weaponeers. We're the people who are trying to make sure things are done safely, the people are protected.` So we've got a different philosophy than the designers, the testers. Not that their philosophy's bad but our focus is significantly different. It's just that there's a nuclear weapon that has a commonality there. And so it was very conceivable that a person could be a conscientious objector. Didn't think anything of that.

Right. What's implied in what you're saying is if he had been a weapons designer or—

You'd have to *really* explain how he had had a life conversion, where someone working in the laboratory—doing the analyses, determining the exposures, or how to properly **[00:20:00]** control to reduce exposures to people—that's a whole different mindset and it's not a contradictory mindset to someone not wanting to go to war. Now, did he really believe that? I don't know, because in the length of time I worked with him he never talked about his philosophy on war, so I don't know if it was a heartfelt thing or if he was trying to dodge the draft and not go to Vietnam. But I could understand that relationship. We had several young males that worked in the laboratory. In fact we really only had two females that worked in the laboratory for the first several years, and they both worked in the dosimetry portion, but the chemistry side of the house and then later on the counting side, that was almost exclusively male for years and years and years. And so when I first went on board there were seven of us, and I mentioned Lester Hartzell with his white hair, and the other supervisory people referred to us as Snow White and the Seven Dwarfs, and Lester was the shortest one of all. But interesting people, very interesting people. One who passed away just a year-and-a-half to two years ago, Larry Hatcher, worked in the laboratory forever and ever, and when he first went to work out there we made good money, remarkable money, and then he went into the service and he had occasion where the entire unit was called out because somebody had had their footlocker broken into and their money stolen. And they're going through everyone's wallets and that to determine what was going on, and they got to Larry and he had a fair amount of cash in his wallet and so they were going to accuse him right then and there of having been the one that stole the money. And Larry suggested they look at his check stub, that was also still in his wallet, from his last check prior to going into the service, and when they saw how much he had made they decided he wasn't the guilty party after all.

That's a good story. But what you're saying is interesting sort of culturally because one thing we're trying to understand is what life was really like and what people's day-to-day life was really like. So you're conceiving of yourselves in that work even then when someone comes to you and says, `How could this guy work here and then be conscientious objector`*, you have that conception of yourself* then*. It's not something you're looking back at retrospectively. You're saying,* `Well, we're not weaponeers.`

That was *my* mindset from day one. I never thought in any other way. I felt like I was doing a patriotic duty but I felt it was clearly a safety, help your co-workers, that was my focus, and wanting to do it and do it well. Other people had other reasons but I think all of us in the lab felt like we wanted to make sure it was a safe environment for people to work in, and if they did get an exposure we had the most accurate answers to what that exposure was. And that never changed over the years for me. I never got jaded. I never switched in what my focus was. I felt very proud to have been associated with the program. But I never perceived myself to be one of **[00:25:00]** one of the weapons scientists. I just never did.

We had some other interesting personalities too. One individual we called Kiwi, Henry Kayuha. And Kiwi came west. He had had some college and then he and friend decided they were going to go find their fortune and so they jumped in the car and started heading west. And he worked various odd jobs as they came west, one of which was—when they talked to him about his skills, *et cetera*, he indicated he had had a general first aid card, so they made him a medic. And he drove the ambulance and it was on a construction project. And the most serious incident they ever had was an individual who had been in a Porta-Potty, and one of the other co-workers had been upset because he felt he had contracted a certain problem from the Porta-Potty, and so he went over and doused it with gasoline and set it on fire. Well, the guy who was inside,

yes—so that was the height of Kiwi's medic experience, and then he quit and moved on to another job farther west. He worked in the forward areas for years, and if you talk about crazy stories, it's the field monitors that have the crazy stories. We were very tame in the laboratory. But he worked out at the site as a monitor and then in the laboratory, and he decided he was going to go back for his master's degree and a law degree. Well, he was going to go back and get his master's, first of all, in industrial hygiene, and so we took up a collection. Well, it started out, he sent his wife and family back to West Virginia and he was going to work through the summer and save money to help with the tuition and all when he got back there. And so at the end of the summer he was ready to leave and he didn't have any money; he had spent it all. So we took up a collection and he had a couple of hundred dollars, and so we said goodbye, a party on Friday and everything. And Monday he called from Kingman and he had run out of money. So he eventually got back and got his master's and came back to work at the site and worked for a couple more years, and then he decided he wanted to go to law school. He had been sitting in a bar and struck up a conversation with this guy who was a professor in San Diego at the law school, and so that convinced him he was going to go to law school. And so we had the going-away party again, and he had asked the management if he could come back to REECo when he got his law degree, because they had a law department, a couple of attorneys on staff. He was told, number one, they weren't going to pay for his law degree; they didn't pay for advanced degrees, doctoral degrees. And second, they weren't going to guarantee him a position. And so at the going-away party they got up and they gave their speeches and then it was his opportunity to give his final remarks and he said, I just want to tell you, you refused to pay for my degree, you refused to give me a job, so I've made the decision, I'm going to study labor law and when I come back I'm going to go to work for the union. I thought it was a class way to walk out the door.

That is indeed.

And he went to San Diego, and it was a year-and-a-half later, I think, there was an article in some publication where the school had sold their law library, and why I don't know, and we figured Kiwi had to be behind that somehow and he was working a deal. He never finished law school, and the last time I heard anything about him he was working at China Lake [Naval Weapons Center] **[00:30:00]** as an industrial hygienist, years and years ago now. But he was one of the more colorful individuals.

Absolutely.

On Baneberry we were working all the really bizarre hours and everything, doing volumes of work, and I can remember nine o'clock one night we're in the counting lab office and everybody got a beaker and some people had scotch, some had ethyl alcohol diluted down with various things, and there'd been all these reports on the television and all these leading scientists giving the results of the contamination on the test site and everything else. Carroll Eichhorn was the individual—everybody called him Ike—he sitting there at the desk. And he's got whiskey in front of him and he said, You know, I can just see it now. Some reporter's going to say, "Who are these scientists?" And so they're going to go to the AEC, ERDA, whatever iteration it was, and they're going to say, "It's not us," and then they're going to go over to EPA and EPA's going to say, "It's not us." Then they're going to come out there and they're going to look at this room full of drunks.

But we always had ethyl alcohol in five-gallon drums that were painted olive drab, "government issue," "warehouse" stenciled on it and everything else and we claimed we used that to clean glassware because it didn't leave a film or a residue. We cleaned a lot of glassware, because any lab you walked in had one of these five-gallon cans sitting somewhere, in a cabinet,

under the hood, somewhere. And that's what the core ingredient was on the Christmas party punches, which were remarkable parties. It's interesting to go in at ten o'clock in the morning and see people totally sloshed. And they're the ones that had been making the punch since eight o'clock. We used to take ethanol and Tang and we called that a synthetic Screwdriver. And then if we couldn't get Tang we would take ethanol and citric acid and that was a *totally* synthetic Screwdriver. It's amazing any of us lived.

But the individual I mentioned earlier, Larry Hatcher, used to tell people a whole generation of us were raised out there, and young, good money, cheap, very cheap food, housing, what have you, and we had a lot of discretionary income, and it was wild, it was really wild. That's when you had a lot of activity at the bowling alley, the swimming pool, the baseball leagues, all of those kinds of things going on, and it was a community. It was truly a community. And the ladies that were single really loved it because—I'll never forget sitting in the day room at one of the dorms with the woman that became my first wife, and one of the other ladies in the dorm came in and she had had dinner with a date and so they said goodbye and she couldn't even go in and freshen her makeup before the next boyfriend came in to pick her up to take her to the movie. So they led a very active social life.

Yes. Yes, I've heard that too. Interesting. But what you say, it gives a sense of the time. A lot of you were really young and this was your time to come out into the world and be working and making money and doing those things.

And meeting people that were very radically different from the type of people you would've **[00:35:00]** worked with before. I'd come out of a relatively small high school. We had I think 153 in our graduating class. It was a small community. Everybody knew everybody's business.

So meeting people who came from different parts of the United States, raised totally different, different values, philosophies, it was just an exciting time.

So apart from even the fact that you had people doing different kinds of work, there was just that there was a nexus there of people from everywhere that exposed you to people that you wouldn't have otherwise known.

Absolutely.

That's interesting.

And for a young person it was quite mind-expanding. We didn't need drugs in the 1960s. We had each other and we could learn so much from one another. But the stipulation in keeping your clearance, which was critical to do the job, we couldn't do the drugs or anything anyway.

You had to depend on alcohol.

Yes, and there was plenty of that. So drugs just simply wasn't an issue through the 1960s.

That's an interesting—I hadn't even thought of that, Robert, but you probably look at most organizations at that time, except for ones—I mean I don't know about drugs in secure facilities but that's an interesting thing to ponder. You would just lose your clearance so you just wouldn't even consider it.

You were out, no longer had a job, and we felt the job was important. We were being paid well, we enjoyed the environment; we didn't want to lose that. And there really wasn't a drug problem until, oh, probably the mid-1970s you began seeing individual workers that had problems. You'd get them counseling and if that didn't straighten them out then they ended up losing their clearance and they were gone. But early on it was *really* straight-laced. I mentioned I was in a four-man trailer when I first went to work out there. They had dorms, they had four-man trailers, they had a limited number of trailers for married couples but not a large number. And if a woman

was caught in one of the men's trailers they were immediately escorted to the front gate and they were terminated. The men were allowed to pack their personal possessions before they were taken to the front gate. So you're talking about a double standard, I mean it was there. And there just was a line you would not be permitted to cross. And I was asleep one night and there was some noise and I opened my eyes and here's my roommate and a girl in the trailer, which is grounds for all three of us to be terminated. And he introduced her as his girlfriend and he was packing his stuff and they were leaving. But I thought, just because the two of you are leaving doesn't mean I need to. Fortunately nothing came of that, but they were very, very strict about things like that. It was just something that you knew there were ground rules and you followed them.

This is now REECo management.

Yes. Right. But it was the standard rule for all organizations out there. There was no slack. You didn't do drugs. You didn't carry on on the job or on the site. But the young couples that worked out there knew every side road between Las Vegas and the site. So there was never any question about that. Very different. Very different times, and now some of the employees never are screened for drugs unless there's an incident. If you're involved in an accident you can be screened. If you appear to be under the influence they **[00:40:00]** can request that you be sampled. But they just do not have screening. Some of us still do, where they can walk in at any time and say, `Within the next thirty minutes you need to go over and give a sample.` And I get hit with that about once a year.

This is DOE [Department of Energy] today?

Yes.

Just sort of random sampling, yes.

And there arespecific positions.

OK. And this is for security purposes, I would imagine.

Yes, absolutely. If you have certain types of clearances and certain positions. But you can have a top secret and not be sampled for years.

It depends on what the job is then, you're saying?

Right. If you've got a compartmentalized clearance, you can pretty well assume you're going to get hit once a year at some point. So it goes to the extremes now. And there've been a couple of times I've observed people that I thought they were under the influence. But society is remarkably different today than it was then.

It is indeed, society as a whole, and then I think at the test site you have an even more—"extreme" isn't the word I want, but a tighter rein on behavior that you did in the general society, which still was much less permissive than it is today.

Right. Not that that was good or bad but it was different and it's difficult when you talk to people today about the way things were done then, it makes no sense to them. They just don't understand that many things were very different for reasons.

[00:42:19] End Track 3, Disk 1.

[00:00:00] Begin Track 1, Disk 2.

[00:00:14] End Track 1, Disk 2.

I mentioned that when I went to Sandia I realized I needed to get an education and I needed to start planning long-range because the job, the site, the lifestyle, there was no guarantee that that was going to continue. And there had always been the discussions, `Oh, we're going to quit testing someday. We won't need to.` And so I wanted to be able to continue having a comfortable lifestyle and I knew education was the way that I needed to begin that. And so in

1973 I went to UNLV and talked to the advisors, the counselors, and because of my high school grades they would not accept me as a regular student. I don't know if I shared with you or not, I didn't like school—

We talked about that, yes, so this makes sense, what you just said, based on the first—

I graduated with a 1.92 or 1.93 GPA from high school.

Yes, but you also were chosen for that special state thing you told me about.

Yes, but that was just good timing, I think, more than anything. Certainly not the grade. And so they allowed me to go in as a special student, which meant I could take a limited number of classes, had to pull a "C" or better, and after I had accumulated so many credits, then I could convert over as a full-time student. And so I was interested in studying medical uses of radiation because many of the horror stories I'd read about many of things I'd observed with people who were undergoing medical treatment with radiation. I just felt I needed to hear and see the other side of the story. I'd always been dealing with reducing or eliminating radiation exposure, and so they had a program at UNLV and it's the one that made the most sense to go into. So I started it in 1973 and I worked swing shift at the test site so that I could get the day classes because they only gave them during the daytime. And after I took the first ones I was so interested that I ended up some of the time carrying a full academic load plus then driving out to the test site, working swing shift, and then coming back in and going to class the next morning.

So you're taking science courses and you're taking—and let me understand, medical uses of radiation like radiation therapy for cancer and things like this?

Yes. When I did the skeletal anatomy it was rather interesting because I would check out a large wooden box every Friday that had a full human skeleton in it, and I would take that out to work and study the bones while I was doing chemical analyses, and then I'd pack the box back up, put

it in the back of the car, and study at the apartment during the weekend and that. And I never had a security guard check the car during that whole time and want to know what was in the box.

That's amazing.

Because they would've certainly thought it odd if I had said, `A body`.

Yes, right.

And every chance I could I would challenge classes because I wanted to get through faster, usually. Now there was one case where I challenged the class because I simply couldn't deal with the instructor another time. I had one class left that that person taught. I found out what the text was, I got it, I studied it over a holiday, I went in, and at that time you could pay **[00:05:00]** ten dollars and challenge any subject, and I challenged it and I got an "A" in it, and so I didn't have to deal with that instructor anymore. And then they also have what are known as CLEP [College Level Examination Program] examinations that are not the local university; they're a national level program where you can challenge, as it were, a subject area, and you pay a fee, you take an examination, and then you get a certain number of credits in that subject area. And UNLV honors those; most colleges honor those. But if you're an older individual and you've been around they're a wonderful way to knock off a half-year of school, literally. All those introductory courses, you can just sidestep and go straight into the more advanced courses. And so because of the combination of things I did, I ended up getting my associate at the end of two years and my bachelor of science degree at the end of three years. And the bachelor's I got with honors, with distinction. And so I felt really good about that, plus working full-time out at the test site.

That's remarkable actually.

I was just serious and totally focused, so I was able to do it. When I came out of that, they gave me a job as the supervisor for the dosimetry laboratory. And there were some real problems with the lab at that point, and antiquated ways of handling data, dosimeters that were old technologies subject to interpretation. As an example, film badges. Being photographic emulsions, you can have some very interesting physical phenomena occur with the film badges that would appear to be exposures if you don't know any better. Fortunately, as part of my program in school I learned radiology techniques, film laboratories, what have you, physics of film, so I very quickly was able to understand the films. They would bring them in, I could look at them, I could tell them the different types of damages, I could tell them very unique things. I would see artifacts on the films, I'd be able to tell if the person was wearing it or if it was in their briefcase and it went through an airport X-ray machine. If instead of reading specifically in the areas where the filters were supposed to be if you had a point source like an X-ray machine coming in on an angle, you'd get projection of the filters and then you had to read in different places. If you have severe light damage it looks like a massive exposure. But film emulsions have a unique characteristic called reversal, where when they're so supersaturated with light they actually don't get darker, they get lighter. So we could actually take one that had had a light exposure and you can read across very, very close readings one to another, and you could actually see it going from light to real dark in a fairly short area. But then in a much longer area it would drop off to lower reading but still be dark. Classic clue. So I really was able to do a lot of that type of work. And the darkroom that we had originally, and the one I'd always worked in as a technician, was originally installed in the control point in Area 6 by Los Alamos lab, had then been moved down **[00:10:00]** to Building 155 in Mercury, and then was moved over to Building 650, so it was totally antiquated. I gutted out the darkroom, totally built a brand new one, all state-of-the-art

equipment. We started using thermal luminescent dosimeters for extremity monitoring, with far greater precision than what had been done before. We used the thermal luminescent dosimeters for environmental monitoring, instead of film badges, for several reasons. One of which—when they had cattle on the test site, for some reason the cows liked to eat the film badges, so we'd get some in with big hunks gnawed out of them and, you know, it's wasted. So I started with the small infrequently-used type of dosimeters and converted over to state-of-the-art, and then actually had the proposal in and approved by DOE and the process had begun to fully convert over to thermal luminescent dosimeters and discontinue film.

So you're at a time in history when this technology is coming on and this other technology is becoming antiquated.

We could do neutron monitoring, we could do beta-gamma monitoring with TLDs, extremity monitoring—

"Extremity" means your extremities, human extremities?

Your fingers, right. For instance, when you do core recovery in a drill back, they'd have to literally grab the core and put it in a box, and some of the old-time lab folks would actually take that core and they'd hold it in their hand and they'd look at it for a while, making determinations what they were drilling through, what they had hit, et cetera. So you get a fair exposure to your fingers. So we had dosimeters that were very accurate in that instead of uncomfortable, difficult to use, wrapping pieces of film around, and really awkward technology.

That's interesting. I mean this is something that brings up something I didn't know. So you would in the past have done extremity monitoring by actually putting film on the fingers?

Yes. And we started with Teflon wafers and they were far more comfortable but they just weren't very good for very, very accurate exposure readings and low exposure readings. So I

went to very small crystals that instead of shattering, as you would think a crystal would, they'd actually sink into the fatty tissue, and it's like wearing a Band-Aid; they wouldn't even realize they had them on. But you could get extreme precision in those types of dosimetry.

And we were involved in the Nuclear Test Participants Review [NTPR] process that was established partly as a result of reports that the CDC [Center for Disease Control] had put out about the Smoky troops having a higher incidence of exposure—cancers. So each of the military groups set up an organization that was recovering exposure records, what have you. The review teams actually came together quarterly, met, exchanged information that they'd discovered, and worked very diligently to get accurate exposure information. And for those people who didn't wear dosimeters that were with a group, looking at the historic records where that group went and what the exposures were on the ground and hence what their exposure would have been. So a lot of that kind of work.

Yes. Now just to get the timeline, you graduated from UNLV, this is mid—

Nineteen seventy-six.

So all these changes happened post-1976 when you start with your new position?

Right. And working with the NTPR team was *really* exciting because here you're dealing with **[00:15:00]** history but you're dealing with the current scientific capabilities to interpret history, and so I really was enjoying that. And the changes in the laboratory, I enjoyed that, bringing it up to state-of-the-art. It was just a great feeling. And we recorded the issuing of dosimeters in a rather interesting way, and again that was from the early 1950s. It was the way Los Alamos Laboratory did it so that's the way we did it throughout the rest of the 1950s and the 1960s and the 1970s. And that was everybody had a dog tag and so when you went up to the desk to get your dosimeter they'd take your dog tag, they'd put it in this little hand-stamp thing, they'd take

an eighty-column Hollerith card that had the dosimeter number punched on it, put it in, hand-stamp the information from the dog tag onto the card, because there'd be a black ribbon on this little hand-stamp thing. So that would be recorded on the card, and then the card would go back and a keypunch operator would punch in the name, the employee number, the other information on that. So we're dealing with batch processing of data and a high error rate as a result of that because any keystroke error, kind of difficult to figure out what it should've been. And so that was one of the things I wanted to attack very early on too. And the local library had installed what they referred to as a Zebra code, where your library card had a striped number on it, OCR [Optical Character Recognition], and then each book had a number, and what they would do is scan your card and then scan the books and they knew how long you were supposed to have them, so that was automatic, and you walked out the door. And I thought, that's no different than issuing a dosimeter.

Oh, what a great insight.

And so the first systems that I looked at were OCR systems that were essentially library issuing. And then I learned there's a whole family of optical character recognition systems out there, and that then led to which ones are the best ones and ended up where we literally got hand-held readers that would have all the header information. And then the people would come in, you'd scan their badge which had a bar code on it, and you'd scan the dosimeter that had a bar code, and *boom!* They were out the door. And you'd go back and you could call via modem and dump that information to the computer. So we did away with the cards completely, and the time-delay, and everything was real time into the computer once you dumped the data from the hand-held. It wasn't punch a card and set it there and thirty days later we'll run it through and figure out what

we've got. And so that was transitioning when I left the lab. So I felt good that we'd really done some great changes there.

Yes. This is just maybe a left field question, but if someone's looking historically at dosimetry records, I mean we would have to assume that there's a split then in the accuracy rate once you have this new system. If you're trying to do any general conclusions about dosimetry you have to take that factor into account, I suppose.

There was another problem too, with film. The vendor that we used was DuPont, and they went out of the business, stopped making film badges, and so the only vendor that was left was Kodak. Kodak's quality assurance was not that great to begin with, and they stopped selling the dosimetry badges pre-stamped with numbers, so we had to build a machine that stamped them. And the dosimetry laboratory had what I refer to as the "gallopida-gallopida" machine, which was the size of a desk, and it had all these pneumatics running it and everything and it would spray an inkjet spot on with the color of the month and it **[00:20:00]** would then go through like a binary number that it would stamp into it. And as that machine aged it began dropping digits, *et cetera*. And so we had probably a 3 percent error rate, where either it stuck and printed the same number more than once or it just lost a number completely. So when the film would come back, although the outside showed the impressions, when you developed the film you couldn't tell the number. And that drove me crazy.

I can imagine.

Fortunately we had so few people that had positive exposures that it was easy to track down when you got a positive badge. But just the fact that we had all of these negatives with errors in them, from a liability standpoint we were really out there. So we found out who had made the original stamp heads for DuPont and we went to that company and we bought a stamp head, and

then we had our shop people make a very small unit where it had these two like vertical trays and we'd take a package of film from Kodak and we'd put it in, cut the wrapper, pull that out. It would feed, slide across it, it'd stamp film after film, and then stack it up on the other side, which we would then pull out and re-bundle and ready for issue. Very, very cheap solution. Should've been done the first time instead of the "gallopida-gallopida" machine.

"Gallopida" because of the noise it made?

Yes, all these hydraulic noises and pneumatic noises. It was wonderful. It would take three days—no, I take that back, it would take a *week* towards the end to run one month's worth of film through it, because you had to have the technician who would be handling the bundles and that, and then a technician who was keeping it running. When we got the stamp machine they could literally do one month's worth of badges, complete with the color code, in a day, and one person. No mechanic there to keep it running. And for the color we had this cartridge that looked like a giant felt pen, and it literally had a felt tip on it, that would come down and stamp the color in the corner. So when the color started getting a little faint you'd stop, you'd take that, open it up, fill it full of the dye again, and you'd put it back on, and run again.

You say the colors for the month?

Yes. Film badges you needed to change out monthly because the film ages quickly and so you start getting age change or darkening that you can't really be sure, if you just see the film, if it's an exposure or age. You have to know when it was issued in order to make the correction as to what the true exposure is. So if you had an old one *with* an exposure on it, it would've made it even more difficult.

So yes, those were some of the kinds of things that I was able to change. But I was tired of working at the site and we had the dosimetry research project that had really taken off from

the very early stuff I'd been involved in, pulling all the film together in one place and getting all the records on microfilm that were easily researchable. They had a full-blown operation, a large number of clerks that were all entering this data into the computer and that, and that operation was downtown. So they had the dosimetry liaison officer function that handled all the requests for exposure histories and the subsequent follow-up questions, what have you, and so that position came open and I was offered that, so I came to town and did that for several years.

And what year was this, or about what time was this? Just an era.

[00:25:00] Nineteen eight-three, maybe, through mid-1987.

OK. So this is test site workers wanting to know their exposure history?

Well, people going to work somewhere else, where their exposure history would be required, would ask. Good example, people who go to work on power reactors, they've got to take their radiation history as they go along, to make sure they don't go over the limits. Then you'd have employees who were terminating that were just curious. Then you had people who were writing in, widows, *et cetera*, who were trying to find exposure information on loved ones who were ill or deceased. Those were the primary categories that we dealt with.

But among those three is not workers themselves who are ill, so you're seeing more the survivors?

Yes, really did, and a lot of them were the military that had been out at the site and observed one or more shots and so again the thing with the Center for Disease Control—

[00:26:36] End Track 2, Disk 2.

[00:00:00] Begin Track 3, Disk 2.

The person who actually wrote the original article that caught the public's attention was Dr. Glyn Caldwell who later went to work for the state of Arizona. And of course I haven't heard from

Glyn in years, but he had put the first information out on the street that they'd found several former military personnel who had cancer and the only common linkage they were able to find was that they were at Smoky shot on the test site. Great big headlines, caused all kinds of things to happen, congressional committee investigations and everything else. Eventually as a result a lot of that led to compensation for certain cancers, and then the spin-off from that was the Downwinders, and again certain cancers they received compensation for. A recognition years after the fact that people could be exposed and potentially develop cancer, ten, fifteen, twenty years later. No absolute saying that the cancer they received was caused by that radiation exposure, because in some cases the people had extremely low exposures, and the probability that such a low exposure caused the cancer, pretty far out there. There are a lot of other things that would happen, far higher probability, but because certain cancers are known to be caused by radiation, along with other things, the prudent decision was that those people that exhibited those types of cancers would receive the compensation.

This is something that I haven't read the documents on, but since you're on the inside of it I'll just ask you. Is recognition a word that the DOE would use? Someone characterized it, or I heard, more than just sort of an act of compassion in a certain sense because there's no actual way that they're going to say it was a cause. You're sort of talking about that.

Statistically you can't give a cause and effect. And when I went to graduate school I wrote a paper for my business law class where I argued that making a decision to pay compensation for an exposure was not logical and prudent because if you apply that same twist of the law across all business, you then have totally taken away any requirement to show cause and effect for an accident. And of course it wasn't a very popular position to take, but from a legal perspective and a business law perspective, it really changed the way we did things or looked at things. And

fortunately for the business community, nobody has picked up on that and used that as a precedent in a trial, but it's sitting there waiting to become ripe.

No, it's a central question, I think, and the reason I'm interested in talking to you about it is because you're right there sort of on the ground with the science and the politics and the administrative stuff. We're digressing a little bit. I'm curious what you think about this.

[00:05:00] *I think that one of the points that I got from Dina Titus's book [*Bombs in the Backyard: Atomic Testing and American Politics, *University of Nevada Press, 1987] was you have to look at things sort of epidemiologically. In other words, one particular person with one particular cancer at one particular place, there's no way statistically, scientifically, to say cause and effect. But if you look at groups, then you maybe should be able to draw certain conclusions.* If you have all of the information. As an example, the Smoky troops. I don't remember the numbers exactly so these aren't things that can be quoted but I'm going to use numbers for comparison.

Hypotheticals. Let's just use—say right here, just hypotheticals.

There were, I believe, eight people who developed cancer that were military troops on the test site when Smoky was fired. Of those eight, three never left Camp Desert Rock. Three had been in the forward areas but their dosimeters showed extremely low doses or *no* doses. And a couple had reliable doses but not large doses. So how do you account for that population of eight coming down with the same cancer when the only thing they had in common was they were at Camp Desert Rock at the same time period. The most important event in their minds was the Smoky shot. And it made no difference if you were out there and walked into the cloud or if you were two mountain ranges over and saw the flash that morning, you were there. So you've got to be real careful when you look at the populations and recognize many of the conclusions that are

drawn are drawn on assumptions and when you really start digging into it, you can't support that conclusion anymore. And the Smoky event is a classic example. And Glyn Caldwell reversed his position after he had found additional information and studied it for another, I think, three or four years. And yes, there was an increase in the cancers, a specific cancer, for the population of troops that were at the Nevada Test Site but it was not as a result of the Smoky shot as he originally thought. What else did they have in common? Nobody's done a study of that. Now I've seen photographs and I know the theory but it's not been studied, it's not been written up, and it's certainly not been peer-reviewed. The water system for Camp Desert Rock, all of the water was trucked in because Army Well One that sits right up next to the highway, the water quality is not adequate for human consumption, even though that's what they built that well for originally. So they had to truck the water in from Indian Springs, put it in this large concrete trough which then ran by pipe down the hill to a large wooden water tank, and then that fed the system in the camp. They got military tanker trucks wherever they could to haul the water. And I have a set of photographs of the truck being filled at Indian Springs and then dumping the water into that trough to feed the water system, and it's a gasoline truck. Gasoline during that time period had benzene and other products in it which are carcinogens.

[00:10:00] *Yes. That's interesting, yes.*

But nobody's researched what the causal possibilities were. Once they said, `No, it's not radiation,` nobody followed up on the research to figure out what it was.

Now this is before your time obviously, Smoky.

Yes, that was in 1957, if I remember correctly.

Right. I don't remember which year but you probably remember better than I. We can look it up. But as a person who's worked in safety, I guess there's the scientist in you and all. Am I correct

in assuming that just personally you have a particular interest in getting to the bottom of some of these stories, just because you dedicated your life to safety.

I'd like to see that one worked to its conclusion.

You would. Yes.

I would. It's not something *I'll* do probably. Certainly not in any capacity I have now. I enjoy doing research, but what I research is usually quite different from those kinds of issues. Although I can remember one paper I wrote that was the result of research I did for a widow who wanted to know the exposure her husband had. And we had no dosimetry records for him, but she was very specific in what aircraft he was in, what events he was in. I was able to go back to the reports and see where that aircraft was in the air at the point of detonation, what it did, what its mission was, what it did, and as a result I could determine how many miles away the aircraft was and I could report the direction it was going and the distance away and why he had no radiation exposure.

And this was part of your liaison work then?

Yes.

And then you wrote a paper. Is that paper a classified paper or is that something—

No, it's in the nuclear testing archive. ["An Evaluation of the Indirect Bomb Damage Assessment (IBDA) Project Activities During Operation Teapot – 1955," Nuclear Testing Archive, Las Vegas, Nevada. Accession Number NVOO49996, April 4, 1955]

It is. Great.

But even though there's no dosimeter record for him, I was able to answer her question and help hopefully relieve her concerns.

Right. So help me understand that job then. That is your main function as this liaison person, is with the public.

I was, yes. Yes, the general public, the attorneys, the other military teams, employers, anyone who wanted to know the exposure for an individual who was legally authorized to receive that under the Privacy Act.

And so this would also connect back to Baneberry too then?

Yes. Yes, it went all the way back to Trinity.

Well obviously if it went to Smoky it went—yes, OK.

We had records all the way back to Trinity, which we got from Los Alamos.

Right. Did you have inquiries regarding Trinity?

No. But I've looked at the data and saw the famous names, like Oppenheimer and his brother and people that I worked with in the 1970s who had worked on Trinity, still alive, still working at the lab. Retired by the 1980s. But yes, that was always fascinating.

Yes, so it's fascinating for your historical interest as well, I guess. Your interest in history, let me put it that way.

And all the Pacific shots, same kinds of things.

So Bravo, that'd be one where people describe the coral falling out of the sky.

Right.

I've begun to hear those stories now too.

I went to work there in the early 1960s and worked through 1987 when I then went over to DOE. **[00:15:00]** But because of working in the dosimetry laboratory and then in the liaison role, I gained a very adequate knowledge of the entire program, met many of the key people, read the literature, and so had a very comfortable working knowledge with the entire thing all the way

through. Some of the key people that were involved in the Pacific were still alive and in good health in the late 1970s and early 1980s, Gordon Jacks being a prime example, Payne Harris from Los Alamos lab who was the one responsible for the monkeys in the aircraft going through the cloud and the subsequent follow-up studies. Those people were still alive and around, so it was fascinating.

I mentioned to you on another occasion about why that job got to me, and that was trying to give the information to the grieving widows, the pen pals that they became, and no matter what you provided you couldn't relieve that pain. That got to me after about four years. Emotionally it was just totally draining. And so when I got an offer to go to DOE I snapped it up. So I actually transferred over in 1987, went to work, and my first job was doing radiological assessments of contractor and national laboratory operations. And so I had the benefit there of being able to see each of the facilities, each of the contractors, and in a two-year cycle, after seeing all of it, I could put the entire process together: the assembly of the racks, the building of the detectors, the preparation of the location for the shot, the process of lowering the rack into the ground and all of the preparation, the diagnostics, everything right on through. And also the other activities that the local office was involved in. We had a contract with KMS Fusion in Ann Arbor, Michigan and they were doing some of the early fusion research. Their primary activity was the manufacturing of tritiated microspheres that Livermore would then use to compress, to try to get early data and various laser studies of the tritium.

Now when you're doing this, just so I make sure I'm understanding you, you're doing this review of the whole system. Is this still safety stuff or is this now something else?

That was. You know, what were their radiation safety programs?

At all points in the process basically.

Right. Were they following all of the order requirements? Was the way they were doing it efficient and effective? Or unlike a lot of people that do assessments, if I saw that they were having a problem, if they were struggling, I would point them to an individual, to an organization, that really did it well and I'd let them talk. I wouldn't be in the middle of the process—I had another assessment to go to—but I'd make sure they were able to talk and help get that organization moving ahead in that area.

Right. So you saw that the end point of the process was to fix it, not just to assess it.

Yes, I got no bonus points for finding problems, but if we, over time, had a better program, then **[00:20:00]** I felt I was doing my job correctly. And so I felt absolutely no problem existed in saying, you know, `This is a problem here. If you talk to these people they may be able to tell you how you can solve it quickly, effectively, and inexpensively.` KMS Fusion was a good example where when I went in, all of their radiation safety records were in boxes underneath a table in one office. And in discussing the fact that they had no processing place to periodically consign stuff, I found out that was with the entire company. And so I got the laws for the state of Michigan and provided them to them, on what could and couldn't be done with microfilm for legal records. And they then in turn put in place a process where they routinely microfilmed their business records and had an off-site backup copy and were able to go forward, and if the building burned down they weren't in trouble. But they were able to use that for the entire business. And in fact when we went in for the out-briefing, the radiation safety officer told the manager of the company that he had been very apprehensive when I'd first notified them that I was going to come and do an assessment, because they'd never had anyone go there before from DOE. And that he had felt he had had one week of free consultation and not an assessment. But I also found out why nobody had ever gone there before. It was a highly political connection that got them the contract and nobody had enough nerve to

go in and write up something negative. And as I understand it the congressman who was pushing their getting the contract literally died right in the middle of its presentation. So they got the contract and everybody left them alone. But it was fascinating to me that they did have tritium going out the stacks which was within the legal limits. But they also, immediately downwind, had an employees' garden where they grew fruit and vegetables, and so we had a lively discussion about Have you ever sampled those to see if you've got any kind of concentration occurring? Well, they hadn't, and so I pointed out, You may want to consider that. You may want to consider moving the garden to another area which is not downwind from the predominant winds. These are concerns you may want to explore because if somebody gets ill, they're going to remember they ate something out of the garden and then, right or wrong, you've got to sit there and defend it, and if you've not even analyzed to determine what's out there, you got a problem. And I was fully aware of vegetables and that concentrating radionuclides because, well first of all there was the incident in England where they had the reactor problem, and then the seaweed concentrated the radioiodines and locals used seaweed in their diet. I also was aware of an incident on the test site where they had watermelons growing at the end of the EPA [Environmental Protection Agency] farm and Sedan crater is across the road and there is a higher concentration of tritium in that area; still today there's measurable tritium there. And the watermelons were concentrating the tritium because they were taking essentially vapor and converting it into this nice ball full of liquid. And so tritium can be a problem that way. Wherever the water source is, tritium will migrate to it because it wants to be **[00:25:00]** in equilibrium with everything around it. And so it's the kind of thing that small operations that are just starting usually don't even begin to think of. So I gave them a lot of thoughts along those

lines, you know, make them sit back and understand if they do some things now they can save a lot of grief later. So that was fun. I enjoyed that.

Then immediately after that experience, we had the radiation assessment function go into a branch where they also did packaging and transportation. They did industrial hygiene and they did environmental.

Packaging and transportation of—

Hazardous materials and hazardous waste. OK, that was one assessment area. Industrial hygiene was an assessment area. I had radiation safety, and then we had environmental. That became a branch and I became the branch chief.

OK. That branch, what was it called or what is it called? Is there a name for it?

Well, it doesn't exist anymore but at that time I'm trying to remember what it was. I think we were just called the "compliance branch." I don't think they specified more. Then of course we had other branches and they decided they were going to reorganize, and so in that reorganization we had all of the environmental compliance people come in. So we still had the assessment function and then we had the compliance function. And in that new organization I was the deputy director. Then I went from that, and I *really* enjoyed that job. That was great.

Now again so I understand correctly, and then we're talking about a national scope of this, is that right?

No, no, that was local.

That's a local scope.

Although doing the assessments we would cover our contractor operations that were not here in Las Vegas.

Any contractor wherever, that would be part of it because they were a contractor for you.

So that's when I first went over and saw the facility on Kauai that we had contractor personnel at, and so I was able to see the EG&G [Edgerton, Germeshausen & Grier] offices back in Woburn, Massachusetts where they built the detectors—or not the detectors, the cathode ray tubes, the streak tubes. So I got a more global experience but it was still all contracts with the Nevada office. Same thing when I went in with the environmental. We were dealing with the test site compliance but the assessment people were still doing those broad range assessments. Just different people doing different subject areas.

Then after that they decided they were going to have a new organization created called the "quality assurance group," and there again it was going to be a director, a deputy director, and then these folks, some of which were doing compliance, some of which were doing management assessments, what have you, and I was the deputy for that for a while. During that period I got the offer to go to the Pacific, so I went over. I was the deputy to the commander on Johnston Atoll. And that was a unique structure there because DOE had the support contractor, yet we weren't military and the island commander was military and there were military personnel on the island. The commander had a letter of authority that allowed him to direct the contractor, but his executive officer couldn't, and when he was off-island, although I was the deputy, I could not direct the military contingent because of the delegation of authority and the unity of command.

[00:30:00] And so the exec and I learned to work very closely together to get stuff accomplished when he was off-island.

That's interesting. Now what era is this and what what's happening on Johnston Island then?

That's 1983—no, that's 1993.

Nineteen ninety-three. And we're so far forward in history, you have to tell me what's happening at Johnston Island then that they're—

They had used that as a site for atmospheric shots.

I knew that piece of it.

And as part of the treaty that discontinued underwater, space, *et cetera*, shots and lowering the threshold, there were certain safeguards that Congress insisted on before they would ratify the treaty. One of those, Safeguard C, was to maintain the capability to do atmospheric testing again. So that's why we were there, even though the island was being used for totally different stuff.

You were there for that reason, to maintain—even this late—?

Right, because we always had a Fed there.

Nineteen—that's late to be maintaining that possibility, isn't it?

Oh yes. It was absurd because I can remember doing a windshield tour one time with some folks that flew in and they didn't understand why there was this civilian person there and he's in the office with the military command and the whole thing. And I was explaining the treaties, the Safeguard C and that, and we're driving along in this van and they said, `Well, what assets are there on this island that you're maintaining?` And it just struck me funny, and we were driving by this field which was nothing but concrete pads and the bolts that were left. I said, `Well, there's one of our assets right there. That's where we will reinstall the tracking radars if we ever do return to atmospheric testing`. All of the equipment was gone but the pads were still there and that was still designated as one of the assets because that's space we would use. It was that absurd and everyone knew it. But we provided the contractor because we could do it cheaper than the military.

Who was the contractor?

Holmes and Narver was, and then Raytheon took it over after that, but it was Holmes and Narver when I was there. And then we pulled out of the agreement completely and DNA [Defense Nuclear Agency] got out of there and the actual management of it reverted over to the Air Force at Hickam [Air Force Base]. And now there's nothing there. Everything's been taken out, cleaned up as clean as it going to get, and now the only people that go there are Fish and Wildlife [Service]. There were two there full time when I was there but they don't have any permanent people there at all anymore. Cleaned the whole island off, structures and everything.

But that's only what, eleven years ago, 1993? That's very interesting.

When I finished there and the permanent person came in to take over, I then went out to Hickam and filled in as the director for Pacific operations while that individual took leave and then back-to-back training classes and that. So I was at Hickam for another several weeks, almost two months. It was *really* a nice duty. I loved it because they put me up in a hotel on Waikiki, I had a GSA vehicle that I parked at Fort DeRussy and walked one block to the hotel. So I didn't have to deal with the traffic and parking issue, and had an office on Hickam, right on the flight line, and it was *wonderful*. Loved it! And there the contractor was having some real problems with the reporting requirements. If anything happened, they had the military chain they had to deal with, they had the DOE chain they had to deal with, there were different requirements, everybody got pissed off because they weren't told that the other one was told, and it was just a nightmare. So I spent about five days going through all of the requirements for both systems and doing a logic **[00:35:00]** flow chart on this giant white board, and once I got that so it worked, then I sat down and I wrote the procedure. And then I walked in and I handed it to the contractor and I said, `Here, follow this`. And they just couldn't believe that somebody had finally put down on

paper how to work the problem: each decision step, who you notify, the whole thing. It was wonderful. Those are the kinds of problems I really enjoyed dealing with, because you were helping someone solve a problem.

And whenever you say that it hearkens back to what, and I don't know if we have this on the first recording, but I remember the first time we talked you talked to me about service and the whole idea of being a civil servant, and that fits with that. I don't know if you've put that together but it seems like that that's the ethos. If you're working for the government, that's the kind of thing you're supposed to be doing, not just assessing or whatever it is.

It's always been what I thought but it's not a very popular opinion anymore. We're dealing with a different set of philosophies today.

But after that assignment I came back here, and I was not happy with the job I had back here in that management assessment, quality improvement group. In fact, before I left there was some gnashing of teeth, what have you, trying to figure out what to call the group, and the person who was running it, the director, was a very unique personality, and I would prefer leaving it at that. And so one day I said, `We ought to call it the Office of Quality Management, OQP.` They loved it, ran right over, told the manager that's what we were changing the name to, and all of the official reviews and approvals and stamps were put on it and everything else. And about four months later I let it slip; I should've just kept my mouth shut but I let it slip.

We're talking about the folks going in and doing assessments and I said, `Yes, every time the contractor knows we're coming, they use our name.`

And the boss looked at me and said, `What do you mean?`

I said, `Well, they read the announcement and get the telephone call and they turn and tell their co-worker, "Oh cwap" [OQP].`

It wasn't two weeks, we were renamed something else and that's the point I knew I had to get out of that, because it was not working. It was not working. And people kept saying, Well, why did you leave? Why did you leave? And my standard answer was, Well, you know, I felt I'd contributed all that I could and I thought it was in everybody's best interest that I move on, a new challenge. I never told them the problems that we were experiencing, and give you an example. Had a staff meeting called. The boss came in.

The whole office was saying, You have got to tell us what you want. You're not giving us any guidance whatsoever. We don't know what your expectations are. We don't know what we're supposed to be doing. We're floundering. We're lost.

And the response was, You're all professionals. I shouldn't have to tell you what your jobs are.

At which point the director got up, stormed out, and never came back to the staff meeting. So we sat there and we kibitzed for probably ten minutes and finally said, Might as well go back to the office. All got up and went back to the office. So it was incredibly frustrating. I had to get out of that environment.

And so that's the point that I had come back from the Pacific but I had not reported back to work yet, and I got a call at home and I was asked would I be interested in a position in Washington, and I said, Yes, what is it? I was single, there was no **[00:40:00]** reason why I shouldn't take that type of an opportunity, and so when I went back in I got the details and it was to work in the arms control negotiations group at headquarters. Went back, interviewed with the director—

Who was the director at the time?

Gail Bradshaw. *Really* great lady. Really great. And she was very comfortable and so the paperwork was cut, I was transferred over, and then went back there.

OK, let's do this. This might be a good stopping point. Although I want to hear this story, this afternoon is going to get long.

[00:40:48] End Track 3, Disk 2.

[00:00:00] Begin Track 4, Disk 2.

So it was the highlight of your career but it—?

Being at headquarters but it wasn't the most pivotal point in my life. I really believe the time I spent on Johnston Atoll was.

Well, maybe we should go pick up some more of that then.

And when you talk about life-changing events, that was one, and so when we sit down again I want to cover that very specifically, and then from that the headquarters experience, and then the follow-on since then.

Yes, OK. Great.

But I really need to communicate that so you understand why I'm the way I am today.

That's great. OK. Perfect.

[00:00:57] End Track 4, Disk 2.

[End of interview]