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

Interview with Stuart Black

February 21, 2006
Las Vegas, Nevada

Interview Conducted By
Mary Palevsky

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Mary Palevsky: *OK, Stuart Black, thanks for meeting with me for a second time for an interview. You had started to talk about World War II, which was an area I wanted to pick up on, so why don't you go ahead and tell me the story of the one-year draft that you started to say?*

Stuart Black: OK, good. In 1940 the U.S. had a one-year draft because war had started in Europe and they weren't quite sure what was going to happen, I think. And since I was twenty-one, I decided I'd rather join and wind up where I wanted to be, rather than just wherever they wanted to put me. So I went down to join the [U.S.] Navy because my father was a retired chief commissary steward in the Navy and I thought, well, I'd get a chance to travel and things like that. But they wouldn't take me because I wore glasses. Now they were pretty strict in those days, for some reason. Now they'll take anybody, I think, as long as they can walk and have a pulse. But they wouldn't take me, so I decided, well, I'll go try the [U.S.] Army. I went down and talked to the enlistment [recruiter] and I said, I've always wanted to be an electrical engineer, so if I could get in the Signal Corps, that would be nice. And he says, Well, we have a Fifth Signal Corps Aviation Department at McDill Field in Tampa, Florida and we'll put you in there. So I got in there.

During this time, I was of course, on weekends and on leave time, I was doing the bars and the dance scenes and things like that, that most servicemen do when they're young and full of vim and vigor. So one night I was walking down the street and here's a couple of girls outside of the Kresge store, a five-and-ten-cent store they had in those days, and so we struck up a conversation with them and went to a movie. It was Halloween, so we went to a horror movie at

the theater. From then on, we dated for a little while, and then about two o'clock the morning of Sunday, December the 7th, I proposed and Vivian accepted. We went out to visit my father in the VA [Veterans Administration] Hospital in St. Petersburg and we heard about Pearl Harbor—actually the morning we got engaged. So we got married on December the 25th, 1941, the first couple married in the chapel at McDill Field.

Then they sent me to the radio mechanic school, which I wanted to go to, in Kansas City [Kansas] for three months, and my wife stayed back and lived alone because, being a corporal, they wouldn't send your wife along with you.

I came back and worked on B-17s for a couple of weeks, and then they sent me to a typing course to learn to operate a typewriter, and then sent me to Dale Mabry Field, Tallahassee, Florida when I graduated from there. I was then a clerk-typist. And since Dale Mabry was a final training base for fighter pilots, they always got messages, classified messages where to send these people, and so I got a clearance to do the declassification, decoding of the messages they sent. One of the things, they had this little room that was the code room and on the door of the code room was a holster with a .45-caliber pistol in it, and when somebody knocked on the door, you would open the little door at the top with your hand on the pistol to see who it was. It was funny, you know. Of course we never had any real problems with that, but it was there to do.

The theory in World War II was that you were always to train your replacements so that when they got trained, you would go shipping off somewhere else, to another duty station or overseas or whatever. As it turned out, nobody could get cleared for doing that thing, so the rest of the war, until I got discharged in November of 1945, I stayed at Dale Mabry Field. So that was my whole war experience.

Well, a couple of questions about that. Did you have to be taught how to decode these messages?

Oh, sure. It was really relatively easy to do. I mean the system they used then, there were a set of **[00:05:00]** alphabetic strips, long strips with random alphabets on it, and they were numbered sequentially. When they sent you a message, the top ten items on there was the number of the strips, the order in which you were to put them in this thing. Then when you got them in the right order, you could read down there and you'd get the message off of it. So unless somebody had that same set of alphabetic strips, they wouldn't be able to do that.

And the messages were coming from where?

From Washington. From the Department of Defense [War] or in this case, the Army Air Forces. It was called the Army Air Forces in those days, rather than the U.S. Air Force.

That's right. And so you're in Florida, you get these messages, they come by what?

Telegram.

By telegram. And then you decode it and then you know where the pilots are being sent?

Yes, and it goes to the base commander, and he then arranges for shipment of the pilots.

So they're leaving from Florida, from that base.

From Dale Mabry, yes. And they had then, the college there was called Florida State College for Women, I think, or something like that, maybe Tallahassee State, I'm not sure, but it became Florida State College after the war, and coed rather than just a woman's college.

And that was—

In Tallahassee, where Dale Mabry Field was. And so we lived in Tallahassee and I worked at Dale Mabry Field.

Now the other question was, do you have a notion of why they couldn't find anyone to replace you?

They didn't have time to clear them.

Didn't have time to clear them?

Yes, because with so many things going on in the war, the people that do the investigation for clearances were swamped with, you know, changes in command and new people coming in all the time. And so after six months or so, when somebody was supposed to be cleared, if they weren't cleared, they probably would get shipped out instead of me.

Wow. OK. Now what did the war look like, sitting from there? I mean you're sitting there. Do you feel some kind of connection—I'm just asking—with the guys you're sending over, or what is the viewpoint when you're sitting there at that time?

Well, since I was married, I was kind of glad I wasn't being shipped over. And basically it was rooting for them to keep going, to keep winning this battle. Of course, the A-bomb was a surprise to me as it was to everybody else when it occurred because that was a deeply-held secret.

Sure. What do you remember of those days at the end of the war, when the bomb was dropped?

Oh, we were happy. Everybody. There was cheering in the streets, you know, and they produced songs, the country singer had things like "Atomic Bomb;" a song named "Atomic Bomb." It was a big deal.

Right. Now, because the war in Europe was over already, but you were still stationed—

In Dale Mabry, yes.

OK. And what were you doing then, after the war in Europe was over?

It was the same thing, because they were shipping the pilots now to the Pacific theater rather than to the Atlantic theater. Well, actually, they were shipping them to both in the beginning. They were P-51 pilots and the P-51 was a real attack fighter.

OK, you have this engineering interest, so when the atomic bomb happened, did you have any particular interest because of your own background of what it was and how it worked?

Yes, I was interested in that and how it worked, but I still wanted to be an electrical engineer rather than an atomic scientist. So after the war I enrolled at the University of Florida in their electrical engineering course. That's in my history, that I graduated in '49. I'd worked for GE [General Electric] for one summer and they said, you know, I did good work so I could come back when I got my degree. When I got my degree, they were firing engineers instead of hiring them. And fortunately I had applied for the AEC [U.S. Atomic Energy Commission] Radiological Physics Fellowship and got that and went to the University of Rochester in New York, and then went on to the Ph.D.

Right. And your Ph.D. again is in—?

[00:10:00] In radiation biology. It says biophysics but it's a radiation biology concentration.

Right. OK, well, we have a lot of the [Nevada] test site history already [from interview of 01/18/2005]. I had a couple of questions about—now you worked for Del [Delbert] Barth, is that right?

Yes, I worked for him in the radioiodine project. I came here in '64 to join that project and we worked on that until, oh, probably in the mid-seventies or something. It was on radioiodine and ended after three or four years. But we went on to other things, you know, injecting the cows with various radionuclides of interest. And then we switched to the—because of being in the Environmental Protection Agency [EPA] in 1970—we went more into the monitoring of the underground water supplies and the air and soil and animals and different things like that. And then we had several leaders of our lab, what do they call them, the director, yes, the director of the lab changed various times. Dr. Barth became a director in the about '75-'76 era, something

like that, and then he went to Washington [D.C.] to work in the EPA headquarters at one of the divisions there.

I got sent up there several times to work on different things and while I was there I heard about this opportunity to go to Vienna [Austria] as a donator of the U.S. for the operations with the International Atomic Energy Agency [IAEA]. So I expressed a desire to be that. Dr. Barth worked on that, helped me get that, and so I went to Vienna then for those three years.

Right, which you talked about.

And so I had those two experiences with him. When I came back from Vienna, he was retired and working at the university as an adjunct, part-time. He had one or two courses there, I think.

Right. Tell me a little bit about the IAEA. You talked about it a little bit in the interview you did with Suzanne Becker. I don't know that much of the history of it. Was that pretty much the early days of the IAEA? Do you know when that got set up?

The IAEA got set up, I think, in the fifties or somewhere.

Oh, that early? [IAEA was established in 1957 as "Atoms for Peace" organization within the United Nations]

Yes, I think it was fairly early. They were set up to do monitoring of the civilian power plants around Europe, when they started getting built in the late fifties, maybe early sixties. So they were a monitoring agency, and then they just kind of expanded that into all activities that had to do with production of nuclear power or enrichment of materials or maybe even the mining of the uranium and stuff like that. When I got there, why, they were interested in trying to promote nuclear power as a safe and convenient and cheap energy. They wanted us in the group I was working with to devise a method of demonstrating the safety of various electrical power plants, coal and oil and gas and solar power. You have two types of solar power out here: the directed

energy into a mirror or the mirrors that reflected into a boiler and then the silicon chips that are on that big flat thing that's turning around gradually. All of those have concerns because you have to build the things and building and construction is a hazardous thing. Building a nuclear power plant is not that different an engineering project than building a coal-fired plant or even the gas-and-oil-fired. They're a little simpler in terms of the safety requirements, but it's all a construction job. All of the materials have to be mined. The coal has to be mined, and that makes coal very hazardous, and the coal plant emissions are very **[00:15:00]** hazardous. There are also emissions from the gas. Gas is probably less hazardous as an emission source than oil or coal. So you can estimate them using data that's produced by, say, the Occupational Safety and Health Administration [OSHA] on industrial accidents, mining accidents, construction accidents, and things like that. So you find that even with all the material that goes into a nuclear power plant, that there's less occupational fatalities than any of the others.

So you're basically, it sounds like, analyzing the costs and the risks and all these other things and determining as a whole—

Yeah, the overall safety of a procedure from mining extraction to the producing of the power.

Interesting. And so you find that nuclear is the least risky in that.

As far as that goes, yes. Of course people will argue about the waste disposal or about the emission from the plants. For example the Three Mile Island [TMI] accident, which was a non-accident in essence, it was expensive for the owner of the plant because it cost them a hundred million bucks to get rid of that debris from that accident, but publicly there was practically no impact at all other than psychological.

Now when you're doing that analysis, that risk comparison, let's say, are you looking at the cost also of the disposal of the waste?

We didn't look at that because we were not sure how they were going to do that, whether you're going to reprocess it or bury it.

And what's your thought on this whole debate about whether there should be reprocessing or burying?

Well, the experience we've had with reprocessing, there's a place in New York where they tried it. I can't think of the name of it right now. [DOE's West Valley Demonstration Project.]

We'll get it. I should know. I'm from New York, and I'll remember it.

It produced more waste water, highly contaminated water, and side products, so that you had a bigger problem with disposal than just burying the waste itself, burying the fuel rods themselves.

I see. Right. Now have you been involved at all in an official capacity with the Yucca Mountain project?

No. I think in '88 or somewhere in that range, before I retired from the EPA, the SAIC [Science International Applications Corp.] people came in to ask us for a little training on quality assurance and on how to qualify material from older times that had not been under the strict quality assurance procedures that exist these days. And so we did some training like that with them, but as far as I know, that's all I've had to do with them. A little bit of the monitoring because some of our stations are in the area that Yucca Mountain will be impacting.

OK, I want to talk to you about the monitoring stations for a second, but when did you leave Vienna then?

Left Vienna in 1980, in July, about the first of July. We were back in Seattle [Washington] on July the 4th.

But then the EPA project at the test site ends in '81, is that right?

No, it continues but—

But the farm or the—

The farm and the beef herd in Area 18 end in 1981, and their principal activities then were monitoring onsite, offsite, and for some of the Vela Uniform and Plowshare projects in other states like Gas Buggy and Rio Blanco and the one in [Hattiesburg] Mississippi and the one down at Carlsbad [New Mexico] and there were two in Nevada at the Central Nevada Project and then one up near Fallon. So we did water-well monitoring for those sites.

[00:20:00] *Back to the work with the herds and the things you did with the aerosols and everything, did you create—I'm thinking now again of my conversations with Dr. Barth, so there was some kind of report that comes out of that or some kind of finding that comes out of that work?*

Overall report? Yes, there was, and it's listed in my publications, with me and Barth as the authors. [Black, S. C. and D. S. Barth, 1976, *Radioiodine Prediction Model for Nuclear Tests,* Environmental Monitoring Systems Laboratory, U.S. EPA, Las Vegas, NV EPA/600/5-76/027.]

OK. Then I'll find that. I should be able to find that somewhere.

So again, because you've given some details previously, but what's your overall view of how that offsite monitoring project went, and it's ongoing still, is that right?

It's going on still. The Desert Research Institute [DRI] is continuing the community monitoring stations [Community Environmental Monitoring Project, CEMP] portion of it. And I think EPA is still doing the water sampling around the Vela Uniform and Plowshare offsites in Colorado and New Mexico and in Mississippi and Alaska.

Now the other question that comes up a lot in debates about these things, and I know that you're not a person who worked directly on the tests themselves—you're a person who worked on kind of the science related to that—but in your view, the risks that were generated by the testing

program, at the time did you have any thoughts about the testing itself, the possible risks that were generated, whether that was an activity that was worth the possible downside as far as environmental issues are concerned?

It seemed to me it was because they were looking for more compact devices with less fallout possibilities, so the testing was to improve the things, both in the amount of material required to build the things, to get them down to, say, a size that could be shot out of a howitzer, for example, which they did., And smaller yields so that they could reduce the amount of fallout by using smaller yields for certain different things, and combining the fusion and fission devices, and of course the fusion gives you a heck of a lot less radioactive fallout than pure fission devices, so that testing was developing both safer and more efficient types of devices. So I thought it was important to continue.

For a little bit of the history, in the early days they had them up on towers or dropped from balloons or from planes. Now the most fallout is produced when they're closest to the ground, so when they were up higher on towers and dropping from balloons and firing off at a thousand feet or something like that, they produced less fallout. And the standards in those days, when a lot of the health effects were unknown—we knew that, for example, X-rays would produce cancers and so we assumed that gamma rays would also, we knew that alpha particles on the skin don't do much, but that beta particles will cause some damage to the skin and perhaps cancers later on—so the safety standards they had for the offsite population at that time was they would get no more than one-quarter's worth of the occupational exposure. If the occupational exposure was like 15 Rem [Roentgen Equivalent Man] per year, then one-quarter of that is like 4 Rem per year for the offsite population. So they did have standards, it's just, you know, they're not as small as they are today because of a thing that they used for safety reasons,

which was the linear no-threshold trend of radiation effects, which says that if you had any effects at a high level and drew a line down to a lower level which also had an effect and you went all the way to zero, that would mean that even a little bit above zero would have some effect because they claimed this no-threshold. The problem is, how do you find that? I mean to find an effect **[00:25:00]** like, say, 100 millirem [mrem], which is the present annual maximum for the civilian population, you probably would need an experiment with five hundred million on one side and five hundred million on the other. Five hundred million. We don't get five hundred, many of us. Because when you receive radiation at a low level over long periods of time, it may be that the period for the effect to show up—I don't know what you'd call it, there was a name for it and I can't remember it because it's been a while—but let's say you get 50 Rem in a year. They assume that in about twenty years, you're going to start developing cancers from that. And the percentage for the population might be less than you'd expect, but it's going to increase the number of cancers of certain types. Now if you spread that 50 Rem over seventy years, you're going to have to go twenty years past that to get that same effect. So if you reduce the amount of radiation, you may find that the onset of the effects is going to be like 300 years in the future. Well, nobody's going to be living 300 years in the future, that's the thing. So we have these standards so low that we would probably never see any effects from them.

Right. That brings up the question, too, of the debate about whether we understand or whether scientists understand the effects of low-level radiation over time, right?

Yes. The Japanese study is the most comprehensive to date. They started in 1950 which was, like, what, five years after the bombs dropped. But they picked up quite a few, eighty or a hundred thousand people, whom they knew their position from interviews, they knew where they were located in the city, and they were able to reconstruct doses for them. And about every four

or five years, they issue a report on what has happened to these people versus what's happening to the normal Japanese population. Those reports I don't have on hand right now, but I think you'll find that the number of cancers is probably not more than 10 percent or at most 20 percent of the normally-occurring cancers, even in those people that were in the bomb radiation field, so it shows that when you get down to the real low levels, they probably won't find anything. Right now they find none that are exposed to less than 10 Rem. It's not 10 sievert; 10 sievert would be a thousand. I think it's below 10 Rem.

OK. We can fix those things in the transcript, as you know. OK, so let's go back to the time line a little bit. You come back from Vienna, and then you come back to Las Vegas?

Yes, and they were involved in the Love Canal project. Love Canal was a canal that this guy Love wanted to build between Lake Erie and—anyway, it went through Niagara Falls, New York. [Love Canal would have connected 2 levels of Niagara River on either side of Niagara Falls]. And Dow Chemical Company had a plant there, and when they closed the plant, they had bought this abandoned canal to use as a disposal site. Now it's lined with gunite or something that keeps the water in there so that all the water doesn't leak out. So they had a natural place to stick all of their inorganic chemicals and residues and things like that, and then they covered it with a clay cap and they turned it over to the city of Niagara Falls or the county, one or the other, and said, `Don't disturb the cap and don't run any wells into there or anything like that.` Well, somehow that disappeared, and then they sold it to a developer, and of course they ran some underground electricity and sewer lines and things like that through there, and so people began finding smells in their sump pumps in the basements, you know, which we don't have here in Nevada; everybody there had a basement. **[00:30:00]** And so EPA got into the business of monitoring and they brought me back to run the quality assurance for that project. I

did the QA for the Love Canal project to keep the contractors in line, make sure that what they were analyzing was done correctly, as best we could. And that lasted for close to a year.

Then after I finished that, I became a scientific advisor to Dr. Barth. He was then back in charge there as the director of the lab. After that, when he left to go to Washington—or no, he went back to North Carolina, to work at North Carolina, I think. And then they assigned me to the Radiation Monitoring Division, and so I became a branch chief in that division here in Las Vegas and went on to help develop the monitoring plans for onsite and offsite monitoring.

Now how does that relate to the work that Bruce Church did? Did he work for you or with you?

He was basically a monitor. In other words, going out with a Geiger counter and things to do monitoring during the tests rather than environmental monitoring. He quit after a few years and went to work for DOE [Department of Energy] and then became a division chief there in the Health and Safety Division.

OK, but that's separate from you because you're working for EPA.

Yes.

OK. I have to keep all these different strands clear. So you're working on onsite and offsite monitoring for EPA.

It was a matter of as the testing underground got less frequent, the number of tests per year declined, the money that we were getting was declining and we had to improve the efficiency as well as continue the coverage in monitoring. And so, for example, we could maybe substitute a three-month dosimeter to make three months of measurements, rather than collecting air samples every week to at least measure the radiation exposure, if not inhalation exposure. So there were tools you could use to increase efficiency and reduce cost. You can do a lot with modeling, knowing the past history of what it is, to check it occasionally to make sure that the time line

isn't changing, the amount of activity hasn't been changing. So that was interesting. And then they put NESHAPS [National Emissions Standard for Hazardous Air Pollutants] in, I think in about '86 or '87. And it's interesting: for the test site they said that we could use—they had in their NESHAPS program book, the instruction book and thing, they had a list of air sampling data based on National Weather Service [NWS] stations that listed the wind speed and direction over a ten-year period at—not Cactus Springs. What's that little airstrip right outside of the test site?

Indian Springs?

No, not Indian Springs. It's where they used to land the planes from Livermore and—I should know that. Anyway, it's just south of Mercury—[Desert Rock airstrip].

I know where you mean.

And in the EPA NESHAPS instruction book, they said you can use that and whatever measurements you get from stations around that, you can extrapolate what's emitted from the **[00:35:00]** Nevada Test Site. Well, that doesn't seem logical to us because the emissions sources are like Frenchman Flat, Yucca Flat, Rainier Mesa, Pahute Mesa, and we wanted to get measurements in the middle of each one of those areas. So we went to the Weather Service that was under contract to DOE, because they have weather stations all over the test site, and we got weather data from there over eight-or-ten-year periods, if possible, and used those data in those areas, instead of just that one for the whole test site.

In those days, I had to do these kind of calculations by hand, but then later on somebody here in the Air and Radiation Standards Group of the EPA, it was a separate little project here, developed a computer program that would give you the offsite doses, given the air monitoring data, which made it a lot easier because I didn't have to calculate such things from a handbook.

So then in late ‘88, ‘89, Dave McNelis who has a Ph.D. in physics, worked for EPA; he had worked for me during the radioiodine project and he went on to become a division director there at EPA. He was a commissioned officer in the [U.S.] Public Health Service [USPHS], so he retired when he got his twenty years in and went to work for REECo [Reynolds Electrical and Engineering Company]. He formed this group to improve monitoring at REECo because they weren’t doing a very good job in onsite monitoring. They were more interested in test site well drilling and construction and occupational safety, but not radiation safety so much; though they did have a health physics group that worked on the test site. He hired me and he hired a statistician and a couple of other guys and we were called principal scientists, you know, big title, and we were well paid, and we were to develop onsite monitoring procedures and things like that.

That went on until about ‘95 or ‘96. I think then that Bechtel [Nevada] took over, I believe it switched in January of ‘96, and then I became—they called me a senior science specialist then, instead of that [principal scientist]. We had a group there with Frank Grossman and a couple of other people, and also the statistician came with us, that had been in REECo.

And did McNelis come over too?

McNelis, no, he left then and he went to North Carolina, to somewhere else and I don’t know what he’s doing there.

We then continued that stuff, and when Bechtel took over, a lady who had been a hard-hat engineer and worked on Pahute Mesa in the early years, she went to work for Bechtel and she came back here as a branch chief, and we were in the branch that she was head of. She told us that she would like to see us justify all of the monitoring locations we had, so we had to go through and show by history what the radiation exposures had been at various areas on the test

site, what we'd been finding in various wells, and what we'd been finding in soil samples. We had not done any biological sampling, so we had to hire some people to start collecting grasses and other plants and do some animal studies, and so we expanded that onsite monitoring to include a lot of those things. We tried to propose buying samplers that would **[00:40:00]** run on solar power, which could work at the boundaries of the test site so we could actually measure the emissions at the boundary of the test site, rather than estimating them by wind direction and speed from the locations. So we figured out we could do this with about eight air-sampling stations at the boundaries of the test site, and we could also continue the community monitoring stations. We tried to discontinue a lot of the other things, we even wanted to discontinue the community monitoring stations because we figured if you can't find it at the boundary, why worry about the cities? But of course the population wouldn't agree to that.

So that basically, other than writing the NESHAPS reports and the environmental monitoring reports each year which went on, that's about what we did.

Well, thank you, that helps me understand it better. I have a couple of questions. You know, from the outsider's point of view, you've got EPA doing this monitoring, and then you've got REECo also doing the monitoring, and then you've got the Weather Service doing some stuff, right? Am I understanding correctly? There are various monitoring programs, is that right, that have different rationales?

Yes. Rationales, I imagine, yes. So the Weather Bureau is mainly interested in wind direction and speed, meteorology in general for the tests. You know, if you're going to have an underground test, they want to be sure that the wind is going northeast and not somewhere else, in case of a venting.

Right, but if there is a venting, the EPA is monitoring on-and-offsite?

Offsite.

As well as REECo.

REECo is monitoring onsite. They have what they call a Bluebird Team that goes north of the test site. OK, you've probably heard of them. So REECo does the onsite, EPA the offsite. And the Weather Bureau gives them the meteorological data which they can use to station their people.

Right. OK, so there isn't an overlap. REECo or Bechtel is onsite, and then the EPA is offsite.

Yes.

But once you're doing that work for Bechtel, you're saying, you would discontinue the offsite. That would be to recommend to the EPA that they do that?

Well, we did recommend it and I think they did decrease the stuff and supplied us the data. They'd collect the data but they supplied it to us to do the reporting—except for the underground water studies around all the offsite areas, that was retained by EPA. They did the report on that, which most of the time we included in our environmental monitoring report.

Now do you have situations where you're concerned about what you're seeing, either onsite or offsite?

No, as long as onsite is a protected facility because there are areas of high gamma radiation, which you wouldn't want to build any residences or farms on. And there are areas with high alpha activity, which alpha's not a problem unless you breathe it, so as long as you could keep it dust-free, it wouldn't be a big problem. But other than that, there's probably no real hazard then. Now as long as they can continue monitoring the ground water supplies, that should give you any indication of transfer of that underground stuff.

When you went to REECo, though, there was some question about whether their—I don't want to put words in your mouth, but the impression I got was that maybe that RADSAFE [Radiological Safety] needed to be beefed up a little bit?

Yeah, well, they were more interested in personnel safety, the worker safety, and how they were doing, their backs and all the other stuff like that, and not necessarily general population safety or environmental safety, either way. So it's a little bit of a split there.

So somehow you broadened—

Broadened that aspect, yes.

OK. So their main concern is their own personnel.

Sure.

[00:45:00] *Right. At the time, I guess over the years, did you have any situations that you were concerned about when you did monitoring?*

No. The highest exposure any person that we had got during our studies was a soil scientist who decided to stay at Queen City Summit when we were doing the monitoring of—I can't think of these names so easily [Schooner].

We have the book. What's Queen City Summit?

It's a peak, a pass along what used to be Highway 25 north of the site that goes through, what's that old town, Area 51 town? [Rachel, Nevada]

I forget. I'm no help here. I'll find out. Queen City Summit.

So he's a soil scientist who wants to stay up there?

Yeah, it was a Plowshare event that went off on Pahute Mesa right in the northwest corner of it.

About what year, do you recall?

Sixty-eight.

All right, let's look. Let's see what we got here [consulting book]. This should tell us right in the line where the Plowshare was. I'll just look for Plowshares. Sixty-eight had a ton of tests, but here's a Plowshare in '68, Cabriolet.

Cabriolet was one. There was another one. Schooner. Yes, I don't know, was that in '68 or later?

I'm going to look it up. I'll look it up alphabetically, then we'll work backwards. Schooner. Plowshare. Sixty-eight. You're right. At the very end of the year. Cabriolet was at the beginning of the year.

Right. OK. So he was up there on Queen City Summit and he got an exposure of about 380 millirem. As far as I know, even with all of our messing around at the farm and the rest of that stuff, he's the one that got the most exposure of any of our personnel in one year.

And that was a crater shot.

Yes. So there was supposed to be some exposure and we thought it would probably go over Queen City Summit or to the one side or the other, rather than directly over, and so he didn't expect anything, and it wasn't that much anyway because the annual limit in '68 was 15 Rem a year; that's 15,000 millirem and he was getting 380.

OK. So tell me about these craters. They must still exist there, craters.

They're there, yes.

They are not as big as Sedan, though, is that right?

No, Sedan is the biggest one. They had Buggy which was five [tests] in a row. They were trying to dig a trench by having five in a row and they'd blow them all off at the same time and create a trench—because of thinking of building another Panama Canal that would take wider ships like some of the big aircraft carriers, to go from the Atlantic to the Pacific. But it turned out that even

using mostly fusion devices, there would just be too much contamination around, so that particular ditch-digging episode disappeared from history.

OK, so those are all Buggy. Plowshare. There they are. Buggy-A, B, and C, and D.

E. A, B, C, D, E.

You're right. E. Oh, I have to move my eyes down the lines there. Five of them. What were your thoughts about Plowshare at the time? Did you think it was a reasonable thing—?

It sounded like a reasonable thing, sure. You know, I've thought that perhaps if they used all fusion, if they could, but they do have to have a fission trigger to get the pressure and temperature they need to start the fusion process. I thought, well, you know, they might be able to do that, and it would sure be a heck of a lot cheaper. Even though each one of the shots might be five or ten million bucks, the amount of earth they move is so great, you know, that building a canal that way should be fast and perhaps safe. It turned out the number of tests that you would **[00:50:00]** have to use and the depths they'd have to be put, it didn't pan out to be that safe. And then the other parts of Plowshare, like enhancing gas production from tight formations, didn't work out as well either, strangely. They have a lot of success by using water under high pressure to fracture the rocks and that's a lot safer, apparently, and it works. It seems to work. But they were hoping to go down in depths like 5,000 feet, use nuclear explosives to fracture the rock and therefore increase the gas flow through it, and it worked but it wasn't as efficient and it cost a lot more, so that was abandoned. But we're still monitoring the wells.

Now, two questions there about Plowshare. It's interesting to me that, as someone who has, you know, really advanced training in these things, you're thinking, well, maybe there is a way that they'll work without there being excess contamination.

I was hoping there would be, that they could reduce that trigger. If they could get that down to a very small amount, maybe they'd get a successful fusion device.

Right. Now, were most of the Plowshare tests, then, I'm asking, does that mean that there was a fusion element to most of them?

Yes. Sedan was mostly fusion.

That's what I thought. So the others also?

Yes. But they did have that fission trigger and that can—, you know. You know that Sedan was mostly fusion because they measured a lot of tritium around that site, which is a product of the fusion process.

Right. People ask now, when they go out to Sedan, is it safe to stand out there when we read those things.

Sure. I mean if you wanted to sit down and camp for a year, you probably wouldn't like that. But for a visit or even for, you know, staying for a few hours, there would be no problem.

Did you see that test? Did you see Sedan?

No, it was just a year before I came. I was here in July of '64, is when I came here.

OK. Yeah, I've heard people describe it. It must've been quite something.

Yes, quite a sight.

Now, you weren't involved in any of the other—you were involved in Plowshare both here and then off in the other locations as well?

I went down to Dribble in Mississippi one time when they were doing the monitoring, just to help out because we were short of people, being on leave or something, and it's nice to get your hands on some of this monitoring and see what it looked like down in that area, you know. At Dribble they used a salt dome, and they exploded a nuclear device in there and created a

chamber. Then because it was a Vela Uniform project, they then exploded another device in that chamber so that it had an air absorbent there. In essence, could you differentiate a nuclear test from a seismic event by the shape of the shock wave, and if you then could buffer it by putting it in a cavity, would that change it enough so you could disguise it? That was the basis of the Vela Uniform, and they did those in various types of formations, salt and granite and whatever.

OK, so if I'm understanding correctly, they used what was created by this Plowshare test to then do this Vela Uniform test?

No, it was designed as a Vela Uniform from the beginning.

It was designed as it from the beginning. OK.

Yeah, they were going to do four, one to create the cavity and three different sizes of things. One of them was a nuclear and the other two were gas explosions.

OK. Yeah, that was a whole interesting period, wasn't it, when you were trying to figure out the detection question of the explosion itself.

That's right.

So you ended your career, you said, in—?

Ninety-nine, September of '99.

And you were how old?

Eighty.

Unbelievable.

I was eighty in March of that year.

Was it a mandatory retirement when you turned eighty, or how does that work?

[00:55:00] No, I had my eightieth birthday there and everybody was urging me on and so I just stayed until September to get an even number of years for a small retirement from Bechtel, which took over the retirement from REECo.

Right. Did you notice any difference working for REECo and then when Bechtel took over?

Yes, Bechtel was a lot more hands-on.

Really! In what sense?

Well, they monitor you a lot closer and you had a lot more meetings with division heads and section heads, and they laid down strict time lines for production of reports and things like that.

Do you think that it was the company or the era?

I think it's the company. They're used to managing projects and so they have a management style. REECo had a laid-back, easy style, having started back in the fifties, you know, and it just grew with the enterprise.

Right. Isn't that interesting how organizations work that way, you find years down the line a lot of those initial management philosophies or whatever.

Yeah, they'd just kind of ease off and take it lackadaisical.

Yeah, they become institutionalized. Now you mentioned this lady who was a branch chief. What was her name?

I don't remember. Susan Something. Susan—she had a German name**.** [Susan R. Livenick]

But she had worked in mining, you say?

Yes, she had been, I think, a mining engineer and she'd worked at the test site and she said, as one of the few women out there, she got a lot of—.

Well, that's interesting. That's why I'm asking you, just for the [Nevada Test Site Oral History] Project's point of view.

She got a lot of male attention that she might not necessarily have wanted.

Yes, that makes me wonder if I can track her down because she's a mining engineer and that would be an interesting person to talk to.

Well, great, we've talked just about an hour. Is there anything else that you can think of that would round this out?

It seems like we've covered most facets of my experiences.

Great. It's good to get this, and I think in combination with Dr. Barth's [interview], it'll be nice to have different parts of that EPA story, so that's good. Well, great, then.

All right.

Were you going to say something?

No. I think that's all. Thanks.

Thank you.

[00:57:42] End of Track 2, Disc 1.

[End of interview]