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

Interview with William Flangas

November 12, 2004
Las Vegas, Nevada

Interview Conducted By
Mary Palevsky

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Mary Palevsky: *OK, so I want to thank you for speaking with me today, and as I mentioned, maybe we can start by you telling a little bit about your family background and your childhood in Ely, Nevada.*

William Flangas: OK. I was born in Ely—White Pine County, northern part of the state—in 1927. And I was raised there, educated in the White Pine County schools. My father emigrated from Greece in the early 1900s, came to Nevada. Basically he was a cowboy and a businessman. I never really got to know him because, unfortunately, my mother died when I was about six months old and then my father got killed a year later, and so I was raised by my father's first cousin. And so I wound up with—so sometimes I interplay my two fathers. But anyway, in terms of my real father, he came to Nevada and then he served in World War I. My stepfather also came from the same area in Greece—

Which was where?

—and he started out as a miner. They came from a city called Lamia, which is in central Greece, which is adjacent to the pass of Thermopylae where three hundred Greeks kicked the hell out of several hundred thousand Iranians, or they called them Persians in those days. With the fact that, you know, both my immigrant parents on both sides—my stepmother who raised me, of course she came to Nevada just about the time that I was born, and so obviously she didn't know any English. So I wound up in the first grade without knowing a word of English. And in those days—the community at that time, because it was a mining community, it attracted a great number of immigrants, particularly Greeks, Italians, Serbians, Croatians, and Japanese, etc. And

so it was a conglomeration of cultures. So traditionally what the system at that time did is for the kids that did not know English, they put them in the first grade for two years. And then by the end of the second year in the first grade, they were totally Americanized. And so I always [had]—that's kind of a pet peeve of mine, you know, regarding bilingual education. And I always tell people I am eternally grateful that my parents didn't have the political clout to get me bilingual education; I'd have been a minority for life.

Before you go on, we'd like to know your birth parents' names and then the names of your parents that raised you.

OK, my birth father was named Gus William Flangas, and my mother was Polexene Flangas. And then my stepfather, who was—I guess he was really my uncle, related to my father, I'll refer to him as my stepfather—his name was Alexander John Flangas, and my stepmother's name was Fay Flangas.

OK, great.

At any rate, the community—you know, White Pine community—was a community of immigrants, a tremendous number of them, and they kind of segregated. White Pine County was a major copper producer, both underground and open pit. And the way the various peoples were segregated – and it wasn't deliberate, it just drifted that way – the underground miners were the Greeks and the Serbians, the track gangs in the open pit were Japanese. We had a mill and a smelter in McGill which was about twenty-five miles from the mine. Now in the mill, generally the majority of the people in the mill were the so-called Anglos. They were, you know, **[00:05:00]** basically Mormons. In the smelter—on one side where the reverbs were—the furnaces, they were almost exclusively manned by the Serbians. And across the aisle from the ovens, in the converters, basically they were Greek.

That's amazing. But you said the Japanese were trackers?

No, they did the track work, the railroad.

Oh, the railroad track. Thank you.

The railroad in the mine. Now the railroad between the mine and the mill and the smelter was handled to a great degree by the Italians.

Amazing. That's interesting.

Worked out well.

So what kind of population do you have up there at that time?

At that time, White Pine County had about ten thousand people.

OK. And most of them were working in the mine?

Except for a little commercial business, that was the lifeblood of the community. Now when World War II broke out, there were something, if I remember correctly, something like up to several hundred miners working underground in White Pine County. And miners in those days were generally single and generally young. Generally they drifted from Montana to Utah to Nevada to Arizona. And a great number of them, not all of them but a great number of them, you know, they used to call "ten-day miners." They just kind of rotated around the various properties. So when the war broke out and they instituted the draft, the draft board just went nuts with the miners. They just drafted them, because here they were, they're young, strong, generally single. It was just exactly what the U.S. Army was looking for. And within a couple of years, the manpower in the copper production up there was seriously impacted. And about that time, I'm a sophomore in high school, and people like me were the most eligible manpower left. So we took over the track gang, and we maintained the track between the mine and the mill and the smelter. So we would go to school five days a week, and every Saturday and every Sunday and every

holiday and every day of the summer, we were on the track gang. And the nice thing about it is we got the adult wages.

Right. Right. So how many guys are you talking about here, would you say? Your whole sophomore through senior classes, basically, or—?

During the summertime when the major repair work had to be done on the track, there were probably about 150 young men out there. During the winter months, there were probably about twenty or thirty of us that worked Saturdays and Sundays. And in fact, that's kind of a joke with me, or not a joke but a funny story. People ask me, When did you decide to go to college? And I say, One day I was up on the high line, which is between Ely and McGill, it was forty below zero the wind was blowing, and I knew that some place on this green earth, there was something better than working on that track gang.

That's great.

At any rate, we had a great school system up there, and immigrant parents particularly, they were just ultra high on education. I mean they left nothing to chance. Teachers used to get Christmas presents from the parents of their kids because they held them in high esteem. Kind of a shock, you know, compared to what's happened since. In fact, the high school, I remember fondly, at that time there were about six hundred students in the high school. And the high school had one superintendent, one principal, one secretary, and the secretary used to utilize one or two **[00:10:00]** graduating seniors that had taken business courses, and that was the total overhead of the school. And out of that school, of course, all of those that were two or three years older than myself, and then I was on the tail end of World War II so I brought up the rear, but a great, great number of my class and classes before me went on to college. In fact, during summer vacations we would [go] back to our old job working either in the mine or the mill or the track, and at one

time on that track gang we counted up that within a year or two there was about thirty or forty college degrees floating around there, which was a very significant number of people who went on to higher education.

Right. And you attribute that mostly to the fact of the immigrant parents wanting their children to get an education?

Absolutely.

Yes. Did you have brothers and sisters?

I had three stepbrothers.

OK. And are they still alive or—?

Yes, they are. One's a lawyer in Reno, one's a carpenter and he lives in Reno, and the youngest one is a businessman and he still lives in Ely.

Oh, OK. What are their names? Just their first names.

John, Gus, and Ernie.

OK. Great. Great.

So about the middle of my junior year, and this was 1945, '44 or '45, I got antsy and I wanted to go to where the action was, and so I enlisted in the U.S. Navy as a seventeen-year-old, and went through boot camp and out to the Pacific. And what would've been my first invasion would've been the invasion of Japan.

Right. Now what was your parents' response to that, you deciding to go ahead and enlist?

Well, they were very unhappy about that. In fact, my stepfather had to sign for me because I had conned him. I had told him that I was going to go into a radio program and it was going to take a year. So I went into the radio program for about three days and then started agitating to go to the Pacific.

So at any rate, [President Harry S.] Truman dropped that bomb.

Right. Where were you? You were in the Pacific at that time?

I was assigned to it, and then within a couple or three weeks I was there. I was there for the initial occupation of Japan.

Oh, OK. What did you think? It's always interesting to me because as you said earlier, you can look back on things and realize things that you didn't know at the time. But looking back on yourself at that time, what was the response to not only the end of the war but the fact that it was this new weapon? Did you think about it or—?

I had had high school physics, and in those days they were talking about atom smashers and that if somebody succeeded in creating a machine to smash the atom, it would release [a] tremendous amount of energy. And so when I heard about the first A-bomb, in my mind, you know, I thought well, somebody's put together something to smash atoms. And kind of, in reality, that's what they did, but it wasn't a machine that churned out the—and in fact, I still remember to this day with a lot of my shipmates, you know, people were asking one another, `What is an atom? What's a molecule?` And so at any rate, that was it, and the emperor came on the air and he said, `The war is over. The war is over.` Now unfortunately at that time in Japan, there was a very serious dysentery infection, so the Navy—I don't remember, there were a great number of Navy ships in Tokyo Bay, so the sailors were confined to their ships. And the Army had some people on land, but they were kind of confined to their base. And the first time I got to go ashore was in November, and that was a couple of months after the surrender had been signed. And when I **[00:15:00]** look at it and compare it to today's events, when I went to Tokyo for the first time, all the police on all the corners were Japanese. Whatever was running or being done was done by Japanese. Americans were not doing *any* of the civil work, you know,

compared to like we see what's happening today in Baghdad [Iraq] and *et cetera*. Japanese were friendly, they were polite. In fact, for the short time that, you know, I didn't get to go ashore too much, but they were just involved in massive cleanup. I mean that was an energetic people.

So I wound up going on a couple of operations where we demilitarized some islands that were south of Tokyo. No one was sure whether they'd heard the emperor. And at any rate, they had heard the emperor, and then they were promised that as soon as the demilitarization was complete, they could go home. So we blew up the gun emplacements and blew up the radio towers and hauled off all the ammunition they had and dumped it out to sea, and so that was another interface with them.

That's interesting. So they're there still in November, the Japanese troops.

Yes, they were still in uniform.

And then are they working with you to identify where these things are, or do they have to be kept imprisoned or—?

No, no, they were totally in charge. We were the bookkeepers. They did all the heavy lifting.

At any rate, I came back to San Diego, went down to Panama, eventually wound up in the Brooklyn Navy Yard, and then from there down to South Carolina, and then in late 1946 I got discharged. And then I worked for a year, and then I went to college at the University of Nevada in Reno.

What was happening in Panama, just real quickly? How come they send you down there? You just sailed down there—?

Well, the ship that I was on ultimately had to be mothballed on the East Coast, so we went through the [Panama] Canal.

I see. OK. That must've been interesting.

Yes, everything was a great adventure.

Yes. Yes. So you work back in Ely, back in White Pine County, then, for a year?

Yes, I went back there. In fact, I had planned on becoming an engineer and I needed another course, and so I got a full graveyard shift working on the railroad where I was what they call a hostler. We had coal-burning engines then, and so he's the guy that takes the engine down, loads it up with coal, water, oil, whatever is necessary, and he lights the fire and gets the boiler ready, so then when they start running the train, the train's ready to go. So I did that for a year, because I got out in August of '46 and school started in three weeks, and I didn't want to go through bonehead math at college. And besides, I wasn't ready to go to college, you know, from one end to the other, and so I worked a year. And then I went to college, and at that time the GI Bill was out. I had heard about the GI Bill while I was in the Navy, but I didn't believe it. Somebody was telling me that—in fact, he was an older guy, and an older guy for those of us that were my age, it was somebody that was twenty-three or twenty-four. And we had a night watch one time and he told me, he says, `Hey, Flangas,` he says, `you're going to go to college for free.` And this was about three o'clock in the morning, and I was wondering, you know, where he found something to drink. And I argued with him, and he had a copy of the *Stars and Stripes* and he handed to me, he says, `Here, stubborn, read it.` And after I read it, I found it incredible. So when I went to the University of Nevada, of course by then I knew quite a bit **[00:20:00]** about the GI Bill. I went to University of Nevada. I was a native. In those days, there was no tuition for the natives of the state. And then the GI Bill, they bought all the books and they bought paper, pencils, whatever supplies you needed for your classes, and then they gave me seventy-five dollars a month in pay. I lived in a university dormitory and I ate at the

university chow hall, and it was outrageous. It cost ninety dollars a semester for board and room, and here I was getting seventy-five bucks a month. So I went to college like a young rich kid.

Yes. But what's the deal with the high school diploma? Because you left before you finished high school, right, for the Navy?

I did, and I got the diploma because—but I didn't have all the requirements I needed to meet going into engineering college, so that's what I did after I got out.

OK, so that's what you did then.

I could've done that at the university but they used to have what they call bonehead English, bonehead math.

Yes. Yes. Even in my day, they had that.

Still, I think.

Right. Probably so. So that's amazing. And you would need to get the—just because I'm curious, to get the books and the paper, there was some sort of voucher that you signed, or how did that work, that you didn't have to pay—?

Well, when I went to the University of Nevada in Reno, the general school population then, prior to the GIs coming to college, was six, seven hundred, eight hundred total pupils. It was like a medium-size high school. And so when the GIs came, it exploded to about sixteen, seventeen hundred. But even with that explosion, seventeen hundred is not really a big administrative load. So what they did is, yes, I guess we had a card, or the prof signed a card that says, `OK, give him drafting tools and give him some pencils and whatever.`

OK. So Reno is where the Mackay School of Mines is.

Correct.

That's right. So tell me about that. You go directly into that work or you—is it that school that you're doing your studies in?

Well, the University of Nevada at that time was made up of about three or four colleges. One was the Mackay School of Mines, and then there was the College of Engineering, the College of Arts and Sciences, and I think they had a nursing college then, I'm not sure, and a College of Agriculture. And so then I just went directly into the Mackay School of Mines, and I graduated in 1951. So I graduated with a degree in metallurgical engineering.

So I went to work for Kennecott, which was the same company in Ely, owned a copper smelter in Chile, so I went there for a summer and worked in that smelter.

Down in Chile.

In Chile. And then I came back to Nevada, and at that time they were developing what they call a Deep Ruth sinking a shaft. At any rate, at that point I changed from being a metallurgical engineer to a mining engineer, and I've been a mining engineer ever since.

So you worked on that Deep Ruth.

Yes. I was there for the sinking of the Deep Ruth shaft, the Kellinske shaft, and the rehab of the Star Pointer. So I spent eight years there, working for Kennecott.

And how deep is that, the Deep Ruth?

Well, the Deep Ruth, it was scheduled to go to eighteen hundred feet and I think it went down about twelve or fourteen hundred. And then we found another ore body that was out of the old Ruth Mine, what you called a Star Pointer, and we went to work on mining that one. And then the price of copper took a dive, and so they abandoned the Deep Ruth at that time.

And while all of this is going on, about 1956, 1955, '56, I'd better remember because it's **[00:25:00]** getting close, I met and married my wife. And then in 1958 I got a call one day—or just to precede that, prior to that, you know, they were shooting the atmospheric tests at the [Nevada] test site. And then if I was on a graveyard shift and they published in the paper there's

going to be a shot, well, I had the privileges of being a foreman and so I'd come up and I saw a number of those shots from two hundred miles away.

What did you see from two hundred miles away?

Well, it'd be pitch dark, you know, two or three or four in the morning, pitch black, and all of a sudden the entire sky would light up, and about fifteen or twenty minutes later, you know, the sound would come rumbling through. So it was impressive.

So I think it was about January or February 1958, I got a call from people at the test site and they said they had gotten my name and they were looking for somebody skilled in mining and wanted to know if I would consider going to work at the test site. And I said, No, I wouldn't. By that time I'd been married about a year-and-a-half, I had three-four-or-five-month-old son, I was educated enough to know a little bit about radiation, and I said, Thank you, no, thank you.

Because of the dangers of radiation?

Yes, you know, I didn't want to get involved in that. And so then a couple of months later, I get a call and he said, Have you changed your mind? And I said, No. And then in May of '58, I got a call and it was kind of urgent and they said, Look, you know, we're starting to dig a tunnel. We really need somebody like you. If you would just come down and just take a look and, you know, no obligation, and tell us what we ought to be doing and point out some suggestions. And they said, We'll put you up. And [I said], you know, OK, OK. At any rate, I went down, and they were digging E Tunnel then and they were dealing particularly with construction workers that were not miners.

OK. They were digging the tunnel with construction workers, is what you're saying?

Yes. And they had a couple of miners there that knew what they were doing, but the underground operations at Ruth were world-class operations, you know, highly skilled miners.

When I walked in there, I just could not believe what I was seeing. There were about fifty or sixty people in a tunnel when there really should've been only about ten or twelve. And there just weren't any miners there. So the people that were escorting me there says, What do you think? And I says, You need some miners. You know, you can't get any more basic than that.

This was AEC [Atomic Energy Commission] that had called you, or was it lab people or—?

No, it was Reynolds Electric[al and Engineering Company], it was the REECo people, they were the prime contractor. The DOE [Department of Energy] people weren't any more skilled in mining than the REECo managers.

So at any rate they says, Do you know where the miners are?

I says, Yes, I do.

And he says, Can you get your hands on them?

And I says, I think so.

So I called the district attorney in Lincoln County, which is Pioche-Caliente area, and they had recently shut down a prominent underground operation there.

And so I told him, How many of your miners are still hanging around there after that shut down?

And he says, Well, there's probably thirty or forty or something like that.

I says, Box them up and ship them.

What was that mine that had closed down, the operation—?

It was called the Pioche Mine—I'll think of it in a second. It was a lead zinc operation.

OK, that's good. We can figure it out.

At any rate, [I said], Send them down. And so then I called the district attorney in Nye County, Tonopah. His name was Bill Beko and he had kind of handle on what the population was. And it was an operation, I think it was a tungsten mine called Tempiute. And so I said, **[00:30:00]** How many of those guys are available? Because they were in the process of shutting down. It was a bad year for mining. And so he got the word out, and so within a couple or three weeks—and then plus the ones out of *my* operation followed me down because we were shutting that one down, too. And so we wound up putting together the crux of an underground crew. And most of those guys came down thinking they'd be there for a short time, and some of them wound up forty years, like me.

Right. Now when you're giving calls to all these different people, is this part of the world small—do you know some of these guys that you're calling or are you—?

No.

You don't. You're just calling to see—

I knew that they were qualified miners, experienced underground miners, from operations that had run for years and years, and so they were not virgins.

OK. But at some point, what's the point at which you say, OK, I'm going to actually do this thing with REECo? Because at first you weren't going to, so do you remember when you decided OK, this looks like something interesting?

Yes, about the fourth day I just got caught up in the insanity. I put it off for a few more days and a few more days. See, at the time I came down I had already separated from Kennecott and I had accepted a job in Korea. And the job that I was going to take in Korea was to be the number two—they had a minister of nonferrous metals, nonferrous meaning lead and zinc, you know, nonferrous, the non-iron, in other words. So he was heading it up for the Korean government—

he was an American—and I was going to be his assistant. And so at any rate, on paper it sounded like a fairly decent job. And I had to have a security clearance for that. So when I did go down to Mercury, I was waiting for the security clearance to come through, which it didn't. It hadn't arrived at that time, and so I went down there for a few days. And then I was thinking well, OK, I'll just stick around here for a short time and then I'll take off on my other job. And then, as luck would have it, they had a very serious epidemic in the city that I was going to live in.

In Korea.

In Korea. And so then I got thinking, you know, I got a five-month-old son or a six-month-old son, you know, a country devastated by the Korean War, and so—and then the excitement that was going on with that, I just thought I'd stick around for a short time awhile, and got infected.

At this point in time, which you're talking May '58, is all that stuff that I've heard from other people that happens later before the moratorium already in play? Are people already trying to get those tests in?

[President Dwight D.] Eisenhower had declared unilaterally that on October 31 of 1958, the United States was unilaterally going to stop nuclear testing.

So he had declared it at this point.

He had declared that. And so that was the panic, you know, that invited me down.

OK, thanks for clarifying that.

And then REECo just expanded and expanded and expanded. There was a great deal of concern about that deadline coming up and trying to get off the maximum number of events that we could.

Right. Right. So again, just curiosity—because of your background and your education, and you talked a little bit about this in the other video—this whole question of going from mining for ore

to mining for experiments, you know, these physics experiments, these underground bombs or

[00:35:00] *devices or explosions. Are you thinking about that from the outset, or are you just thinking we got to figure out how to mine these tunnels, or how does that go?*

There were two kinds of testing going on out there, you know, the atmospheric events and then there was a testing that was done, you know, some surface events, and then of course the underground events. And the underground events were just in their early stages at that time. So the Livermore lab [Lawrence Livermore National Laboratory] which was—the big gun in the Livermore lab was Edward Teller. And he had convinced, you know, going back in history, there were a lot of the people in the Los Alamos [National] lab who, after the devastation in Japan, they were very reluctant about continuing nuclear, that maybe mankind can't handle it. Teller was a Hungarian refugee, and he knew that there was no way that we would be the sole proprietors of nuclear weapons. And it didn't take the Russians very long to detonate a bomb, and then after that first bomb, then the big commotion was to develop a hydrogen bomb. And so there was opposition to developing a hydrogen bomb. And then Teller convinced President Truman that we need to develop it or we're going to be sucking back wind. At any rate, that's when they formed the Livermore lab. Teller also accurately predicted that the atmospheric testing is going to become taboo, and it was important that we figure out a way to do it underground. And so consequently there was an *awful* lot of anxiety on the part of the Livermore lab to be able to do nuclear experiments underground. And that's just about the time that I entered that equation. And as subsequent events turned out, Teller was dead right, that the world outcry and whatnot said—and then President [John F.] Kennedy signed the test ban treaty in 1963 [Limited Test Ban Treaty], and that was the end of a lot of things.

Right. So you come in after Rainier, right, which was the first one?

Yes. Rainier was detonated in September of—

Fifty-seven, I think.

Fifty-seven. And I came to the test site in May of ‘58. After I’d been at the test site a couple of days in that major tunnel, I was asked to take over what we called B Tunnel, which was a smaller tunnel further up the hill, which I did. And then they had two events scheduled that year. One was called Tamalpais and the other one was called Evans. And they had to get them detonated before October 31. And so I built that crew up there from just a couple dozen to at the end I probably had about 150 REECo people in there. But, you know, thirty or forty of them were miners, but there were electricians and there were plumbers and there were sheet metal types and iron workers and carpenters and, you know. And then in addition to them, there was a just a *horde* of laboratory people to put in their experiments. And so that was a little bit of a cultural shock for both parties. Miners pride themselves on how many feet of tunnel they can dig in a day, or how much shaft they can sink. And production is paramount. That’s the only reason. You’re there to dig. You survive by digging the maximum. And don’t get in the way. Now the laboratory types, of course, they’ve got these experiments and a lot of them are delicate, and here **[00:40:00]** they are underground. And so I wound up as the middle guy there, convincing the underground types that we have to dig the maximum amount of tunnel we’re capable of digging, but that’s only half the story. The other half of the story is we’re going to set up some delicate experiments. We’re going to pull in cables. We’re going to bring in monitors. We’re going to do a lot of things, and that has priority, you know, and the guys look at me and say, `Priority over digging?` At any rate, it took a while but I had some real sharp subordinates and we had the respect of the miners. They didn’t really believe, but they obeyed. And then there were a couple of significant young physicists there with the Livermore lab. One of them particularly is Dr.

Gary Higgins. He was very, very prominent in the nuclear business, and significantly, looking back on Gary, Gary and I were born about a week apart. I was born in Nevada; he was born in Minnesota. We went in the Navy about the same time and we went into the same program at the same time, although not at the same location. So he stayed with that program and I went to the Pacific. And so then he went on into his education and he got a Ph.D. And in fact, he was not only a Ph.D., he was one of the co-discoverers of one of the new elements at that time and particularly in what they call radio physics. So that was his technical, professional background. But he was raised on a farm, and he was not a scholar-type. He was a farm boy. And it didn't take him very long to associate with me that we had two cultures there that had to be meshed, and I took care of my end and he took care of his end, and before long we had developed some interfaces and developed a team that totally understood one another. Now that didn't happen in a day or two, but by the time September rolled around, we had a pretty efficient team going.

That's very interesting. What was the element that Gary Higgins co-discovered, do you remember?

I've got it written down some place.

We'll get it later.

But I'll get it for you. [Gary Higgins was on the team led by Livermore physicist Albert Ghiorso that discovered elements 99, Einsteinium and 100, Fermium.]

Yes. Is he still alive?

No, he died a couple years ago. So as time went on, he ultimately was assigned the Plowshare program. He was the director of all Plowshare. And he had done some great work on that. And in fact, we bootlegged a couple of Plowshare experiments for him underground. So he turned into a

great personal friend, and as a matter of fact, my youngest son Gary is named after him. So Gary Higgins died, I don't know, a couple years ago.

That's very interesting about the cultures and how you actually carried that off, because I hadn't really focused on it. But that's right, you're bringing things into that cavity or down that—

In that tunnel.

—that's not normally what happens in a mining operation, obviously.

Well, early on, in the first day or second day I was there, in comes a laboratory type. He's got on thongs, he's got on shorts, he has no shirt and no hard hat, and he's going underground. So I was the superintendent of that tunnel and I'm totally accountable and responsible for not only the safety of my own people, but I'm accountable for the safety of the lab people. So at any rate, he **[00:45:00]** was one of those Ph.D.s, and so I was as polite as I was capable of, which was probably not too much, but I told him that you can't go in the tunnel like that. And he promptly let me know who he was and whatnot. And at any rate, I told him that I was running this tunnel and he had to get a hard hat, he had to get some shoes. I didn't care if he wore his shorts or not, but it really wasn't too smart. So I guess after he did a little reflecting—see, these guys, they just did not know—they thought they were going into a laboratory some place, you know. They didn't have the background that we had. So that was the sort of thing that we had to get people's attention on. And we got it. And it wasn't anything outrageous. It was like your mother used to tell you, this is for your own good.

Right. But it's very interesting the way you put it, and I think you've put it very succinctly, that these are physicists and they figure they're going into their underground lab, but they're not thinking about what you know about what this underground area consists of and what the dangers are, et cetera, et cetera.

You've got moving trains and you've got overhead ground that's not fully supported, you've got tight quarters, you have poor lighting. Sometimes ventilation gets interrupted, you have moving machinery, you got people drilling and blasting. Now the miners, you know, they're accustomed to that. And *even* with all their skills, sometimes they get into trouble. Now here comes some guy that didn't have a clue as to what he was getting into. Gary, you know, he stepped right up to the plate and I told him what my concerns were, and I already knew his concerns. I accepted the fact that we weren't there to dig tunnels; we were there to provide a test bed for a nuclear event. And so over a period of time, there were some very, very tight relationships built up. And when it was all over with, within a few months there wasn't a better coordinated, better integrated combination of craft and military and scientific and whatnot people that existed anywhere.

Yes, it's interesting, and I'm just thinking as I'm listening to you, that I've talked to scientists, many scientists, who came out of World War II into testing, so I imagine some of that experience informed all your guys' approach, whether you were the miner or the scientist.

This is a little off the subject, but you said you bootlegged a couple of things for Plowshare. What do you mean?

Well, see, I came out of a copper operation that used block caving for mining. In other words, in block caving you go undercut a large area underground and you deliberately get the ground in motion. And when you get that ground in motion, it grinds and breaks and whatnot, and so you don't have to *mine* it out, you know, you crush it in place. And so when we recovered, and we'll talk about that later, but when we recovered the Rainier cavity, you know, when I looked at that, the bomb had created a natural block cave operation. And so when Gary was looking for the peaceful uses of the atom, like developing harbors and developing canals and *et cetera, et cetera*, I told him, I said, `As far as the mining industry is concerned, it would cost hundreds of thousands of dollars to accomplish what that gadget did, and it`

has a direct application. And of course in **[00:50:00]** those days, it wasn't as restrictive. I had an awful lot of leeway and there wasn't all that routine, you know, a work order for a box of Kleenex stuff. And so I told one of my guys that I brought down from Ruth to put in a couple of drop points in that cavity and deliberately draw that material out. And it ran like fluid through a sieve. And so we amply demonstrated that a nuclear weapon could be used to develop a large underground ore body.

Oh, OK, so you're in—I know we're a little ahead of ourselves, and so I understand—

So when I say "bootlegged it," there was no drawing, there was no work order, there was no—you know.

OK. You're being an experimenter. You're saying, OK, here's this thing, let's see—so you're able to draw the material out from the Rainier cavity with ease.

Yes, we did that.

Interesting. Interesting. One scientist—

And that's been well written up. [See W.G. Flangas and L.E. Shaffer, "An Application of Nuclear Explosives to Block Caving Mining," University of California, UCRL 5949.]

Well, I'll have to look at that. That's interesting, because one scientist I did talk to up at Livermore was Chuck Violet, who said he did a lot of the design at Rainier.

Chuck Violet? You connected up with him?

I did indeed, and he had a long—

Tell me about him.

Later, because this is your interview. It was interesting, but he told me that that was his design for Rainier.

Yes, he was a key guy on Rainier.

Yes, and he talked to me a lot about that particular event because I was curious about it because it's an important event because it was that underground thing. But at that point, I guess they brought in another mining company to do that digging, as far as I understand. I don't think REECo did that. I'll have to look into—I'll have to—

Yes, we did it. From the time I got there, we did all the digging.

Yes, but this was prior to you getting there.

Oh, Rainier was dug by a contractor, a consortium.

That's what I'm saying.

Yes, Rainier was a dog hole. It was about seven, eight foot high and about seven, eight foot wide and it went back there a couple thousand feet, and it was just what the miners call a gyppo.

A "gyppo." What does that mean?

Low cost.

Oh, low cost. OK. Well, Yes, and what's "dog hole" mean? Same thing?

Same thing.

All right. All right. OK. Interesting. OK, so let's go up to you mentioned Tamalpais, which I know we need to talk about, and what else did you mention? Evans. The two events that were in that tunnel, is that right?

Well, there were several subsequent to that after the moratorium was lifted, but in the fall of '58 those were the two. Now we shot Tamalpais early in October of '58, and when we shot it, the early readings were up in the 10,000 R range. I mean those were those short-lived half-lifes and they were—so by the time we had shot Tamalpais, you know, we had been working twenty-four hours a day, seven days a week. We piled manpower in there to gain every possible inch that we could. And guys like me, I was there around the clock. Sometimes I'd be there for two or three

days and be sleeping on my desk and grab a couple hours, and there were just too many things going on and there was constant hordes of laboratory people coming in for a week or two. One set of experimenters, they'd get their thing done, then another wave, and another wave, and then we had to reeducate the new wave. And then of course preparing the one event for detonation and digging the other one for completion. It just called for a lot of tight supervision and tight coordination. So by the time we shot Tamalpais and heard those readings, I just went home. And I guess I got home late that night and went to bed—shit, I didn't even take my **[00:55:00]** clothes off, just went to bed.

So she wakes me up at two o'clock and says, You got a telephone call.

And I says, OK. Two o'clock in the afternoon.

And he says, Hurry on back.

And I says, What's up? And he says, Well, the radiation levels are down to about 400 mR [milliroentgen], which is, you know, it's acceptable for reentry and [they're] very eager to make the reentry.

So by the time I got there, it was a little after four. And so I get up there, and in the meanwhile, others had rounded up my crew. And so I got briefed at the portal there, you know, with the Livermore honchos, and they told me what the radiation levels were. And then so I accepted what they said on radiation but my concern was explosive mixtures, and particularly carbon monoxide.

So at any rate, so I said, What about the explosive mixtures?

Now I'm dealing with three Ph.D.s at this point, and one of them says, he says, There is no explosive mixture.

And I says, How do you know?

He says, I measured it myself.

OK, so I went in the tunnel and instinctively I knew something was wrong, you know, just instinctively the hair was standing up on the back of my head. Something's haywire here. So I go back out again and I says, I'm not sure but there's something haywire here.

And so the guys says, Look, he says, I'm telling you, he says, there is no—

[Brief pause in interview]

[00:56:58] End Track 2, Disc 1.

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

So at any rate, to finish up with Tamalpais, what had happened is—so I go back in the second time. And by that time I had a few people in there starting to get some rehab going, get the ventilation started, open up the blast door, *et cetera*. So I come back out again and I ask a question, you know, Is there some exotic gas here that maybe I don't know anything about? And he assured me that there was *no* explosive mixture. So then my antenna just kind of focused on oxygen deficiency, see, and one of the things we learned in the copper mines was that you could get into an atmosphere where there's an oxygen deficiency. You can't smell it, it's almost like carbon monoxide, only it's just oxygen deficiency. And the way copper miners check for that, now you could not ever do that in a coal mine, but in a copper mine you light a candle. A candle will snuff out at 16 percent oxygen. A human being will snuff out at 14 percent. So if you have a candle and it's burning this high and then the flame starts narrowing, it's time to get the hell out of there. So I lit a candle and I went all the way to what we call the 650 station where we had a sandbag plug there, and I was holding the candle chest high all the way back, and the candle burned normally. So that ruled out oxygen deficiency. So the REECo superintendent, the RADSAFE [radiological safety] superintendent we called him, he had climbed up on top of that sandbag plug and he was taking radiation measurements—

And behind the plug is where the experiment was, is that right?

Yes, that was down there another thousand feet further down. See, there was a portal and then there was a steel door at three hundred feet, and then at six hundred there was a sandbag plug. And at twelve hundred foot was another steel door, and another four or five hundred feet further up was where the gadget was detonated. So anyway, this was all close to the portal. So he says, Hey, Flangas, he says, hand me that candle. So I handed him the candle and all hell broke loose. What had happened is that intense radiation—or at least I was told this—had ionized the water vapor and we had a layer of pure hydrogen up in the back of that tunnel. And because hydrogen being lighter than air, the hydrogen had accumulated in the back. Because there hadn't been any locomotives or people going back and forth, the atmosphere had not been disturbed. The meter that they had at the portal—in those days they were primitive compared to the meters that we have now or even after that—if you get it saturated, it reads zero. So he's reading a meter that had become saturated and it was reading zero.

Would it have been able to register the hydrogen in any case, do you think?

If they had not saturated the meter. At any rate, I hand him the candle and he set off the hydrogen. Now I was at the base of the plug, that sandbag plug, and he was up on top of it.

How high would you say that was high?

About seven feet. And he had pulled away a few sandbag plugs so he could look over it. And then when I talked to him a few days later he said he saw a flash of fire go all the way down there, and I remember his words. He says he was fascinated by the sight. Well then, it exploded, that hydrogen exploded, and then there was that steel door on the other end. So once it exploded, bounced off of that, came back. In that onrush, he fell to the base of the plug, and **[00:05:00]** when we found him later, that plug had been almost totally disintegrated. He was unconscious

and he didn't get carried up by it. Now I'm over here and the next thing I know, I'm tumbling. I was going head over heels down that tunnel. I didn't have a clue.

But you're conscious.

Oh, yes. At any rate, when I picked myself up, I was at the 350 door, and my miner's lamp was shattered, my mouth was full of dirt, there was just commotion, it was just a bedlam. I had no idea what had happened. I think probably what happened, and I've thought about it all my life, what I think had happened is when that shock wave picked me up and was propelling me down the tunnel, the door—see, by that time Bud Edwards, you know, prior to all of these happenings, Bud Edwards, one of my shifters, had lifted up the track section there and opened the door. And see, we had to lift the track section in order to close the door. So now he reinstalled the track section. So when this blast came down there and it whacked that door and it folded the door over the track section—and it was a steel six-inch door and it had folded it over into a U—and it left a crawlspace about that high [indicating height]. So what I surmise is that as this shock rolled down there, it bounced up against that door, slammed it up against that, you know, it folded it over in a U, and then bounced back. And so I probably hit that turbulence on its way back. If I'd have been a millisecond or so sooner, it'd have been like a mosquito hitting a windshield.

This is my question. How come you just didn't get smashed against that door there?

I don't know. That's my theory.

OK, so it's being buffered, in a sense, because it's coming back at you.

Well, it hits that and then it comes back just like an air cushion. So I hit the air cushion on the way back, is what I *think* happened. So at any rate, I picked myself up, I'm wondering what the hell, and I stumbled around in the dark, no light, everything shattered. We had laid plywood up and down to protect the cables. The plywood was just shattered to sawdust. And I'm stumbling

over the cables, I'm stumbling over everything. And there were a couple or three guys in a side drift there, and this explosion blew right past them. So everybody's hollering in the tunnel, you know, What the hell, what's going on? So we kind of found ourselves there, and then we found the RADSAFE superintendent, and we got ourselves organized, and we had figured out which way was out, and so we came out. And the RADSAFE superintendent had gotten a concussion and whatnot, but he survived. *I* didn't have a scratch on me. Everybody outside, by that time they had called emergency and everything else, everybody surmised everybody in the tunnel was dead, and that was a good presumption. And then we had that small hole there, and we just poked one another through there and we got everybody out.

So outside they had heard it.

Yes, they saw the door curled over, smoke and dust and debris came floating out of there, and I guess it must've made a hell of a noise. I don't know; I was inside. So that's the story of Tamalpais.

OK, now you guys came out essentially unscathed. This is a terrible question to ask. What happens to all the scientists' stuff that is in there? Did that get ruined? Could they do—?

Oh, it was destroyed.

Completely destroyed.

Yes.

So they couldn't—

Well, the cables apparently—there was enough—this was on the twelfth of October and we had till the thirty-first, so we just mobilized and went right back at it, and we had that tunnel cleaned up in several **[00:10:00]** days. And I wasn't privy to what the lab was doing, but I don't think

they were able to put all the experiments they wanted in there, but they did get Evans off on the thirtieth of October.

Oh, wow. But back to you. I mean that must've shook you up some, you know, did it or are you the kind of guy who just sort of picked yourself up and dust yourself off and—?

Well, I figured that, you know, most of my miners barely had high school educations. I was one of the few miners there with a college education, and so I figured that no matter what, we probably ingested enough radiation that we were done for anyway. The truth of the matter is that we didn't. We did pick up some radiation but we did not pick up any significant dosage.

But you thought you had.

Oh, yes, so I was pretty calm. I was just mad. This is a hell of a way to go.

Wow. So how long did this assumption last? Until you thought maybe—?

A day or two. So then we went on a rampage of work and we got Evans off. And fortunately, you know, nobody was killed, and that set into motion the ultra tight controls on reentry that we had from that day forward. We the professional miners took too much for granted from the physicists, and the physicists, you know, they tended to be a little bit of a—have a snob attitude, you know, that, We know what *we're* doing, huh? Not all of them, but there were some of those guys that said well, I got a Ph.D., that makes, you know, anything you know, I know better. So there were some hard, hard lessons learned there, and we learned them and we practiced them well.

Yes. When you say you were mad, I mean were there meetings of any kind where you talked about some sort of debriefing of all this, or how did you sort of get from this accident that thank God no one was killed, then, to procedures—?

I was asked to write a report as to what I thought happened, and I wrote a report and it was completely erroneous. I think it's been established that it was an explosion. At the time, I didn't think it was an explosion because in an explosion generally there is flame. In an explosion there are burns. In an explosion generally there's a sound concussion. There wasn't any of that. A few days later I found out from the RADSAFE superintendent that he saw a flame going down from the sandbag plug to the blast door. And I didn't know that at the time, and so I just thought that maybe as a result of the event, you know, a nuclear event creates a million pounds of pressure and a million degrees centigrade. In my mind at that time, it did not seem preposterous to believe that perhaps a fissure had opened and with those temperatures and pressures, a considerable amount of gas or even compressed air, whatever, had floated in there, and then the following day, as things cooled down and whatnot, and just at that moment, just a sudden release of contained atmosphere. That's what I thought. Now after the moratorium, we went back into Rainier—

Let's stop here because I'm almost at the end of my CD.

OK.

[00:14:47] End Track 3, Disc 1.

[00:00:00] Begin Track 2, Disc 2.

Yes, why don't you continue with Tamalpais.

Well, once we got everybody accounted for in the tunnel, by that time they'd rounded up some ambulances. And I didn't feel like I needed an ambulance, but they insisted that I go down with the ambulance. And so we went down to the dispensary, which was in Mercury. And so by that time a big crowd of people, you know, they'd heard about an explosion, and at any rate, the dispensary's right next to the movie house, so there was a lot of people there, wondering what's

going on. So then the thing that amused me the most was there was an argument between the manager and whoever was handling the dispensary about bringing us in because we were covered, I mean we were just covered with—it wasn't soot, but it was dust, and our hair was imbedded with the plywood fragments and our clothes were, you know, we really looked like a Halloween gag. So a question was raised that if you take these patients into the dispensary without deconning them, decontaminating them, you're going to contaminate the dispensary and then it'll take a while to get the dispensary decontaminated for anything else that happens. And so I [laughter] listened to that for a while, and all I want to do is go take a shower. And obviously I wasn't hurt and I didn't need anything and we had been covered with the meters in terms of whatever. We were reading, but then that was just the dirt and the dust that was on us. And we ingested very little. And so finally got released and I went to my quarters and got in the shower and had to shower for about an hour before I could ever come clean. Anyway, I finally get cleaned up and get in some fresh clothes.

And so at that time we were still doing atmospheric testing and we had what we called—they had a half-a-dozen or more doctors, I mean medical doctors, and they were conducting experiments with pigs because I'm told, I'm not an expert in that area but I'm told that the pig's skin and a human's skin are very much alike. In other words, you can do some experiments on skin that way. And so naturally everybody gets a nickname, and so we used to call those guys the pig doctors. Most of them were captains and majors and I think there was a colonel in that bunch, but they were *bona fide* medical doctors and they were in the Army and they were part of this testing business. So they mobilized the pig doctors, and every one of us was assigned a doctor. And I used to laugh about that. I can't remember my doctor's name. He was a good guy, and he

was just about my age, and the joke was that I had taken him away from his patient. I had deprived a pig of his personal physician.

So he's keeping an eye on you for awhile, the pig doctor?

Yes. Well, you know, urine tests and blood tests and physicals, and when it was all over with, they figured that we had picked up some very, very low levels of radiation. We did not pick up any alpha. We had some beta contaminant. I don't remember whether it was strontium-89, 90, **[00:05:00]** something like that.

So is this the point at which you're less worried, then, about what's happened to you in there, when the reports start coming back or—?

No, no, the minute that they came out of the tunnel and the minute they put a meter on there and showed that it was all just surface contaminant. Now if they'd have put a reading on there and it come out about 3 or 4 R, I'd have figured it was—so anyway, we had that behind us very quickly.

At any rate, that's the story of Tamalpais.

Right. Right. So then you put together protocols so that you don't get those surprises.

Oh, did we ever. Did we ever.

How do you fix that problem of the meter reading wrong because it was saturated?

The meters had instructions on them, you know, just how you prepare them to take readings.

So you follow the instructions?

Well, I didn't know how to run a meter, and I didn't have one, and I had blind faith in the people that had them. Never from that day forward did I ever have blind faith. Me or any of my troops. We raised legitimate questions when we felt them, you know, and they were legitimately

answered. But there was a lot of blind faith initially, on both parties. And you can see why that that should not be a surprise.

Yes. No, that makes sense. And so then when you're saying you don't have blind faith, does that mean on your crew, that certain people look for those things, or you have ways to verify whether what you're being told is correct? How does that actually play out in what you do?

Well, when we started making reentries after that, we did not depend on a single reading by a single individual. And to be perfectly honest about it, where was the experience anyplace in the world, where was the history, where was the mechanics, where was the knowledge of what to expect in a situation like that? There wasn't any. And so after we made a few more reentries, we pretty well, both ourselves as a contractor and our customer the laboratory, put a lot of points on the curve. And from that point forward, there were never any blind movements. Total accountability every step of the way.

Yes, I'd like to understand a little bit more about the reentry, but just I want to make a comment that what's so interesting about your story is that instinct that you had, that sense that you had, that sense that something was wrong in there, is just—it's an interesting phenomenon.

Instinct. You know, in my eight, nine years underground before I went to the test site, I was at a world-class operation with world-class personnel, and after you call your best shots, still some strange things happen, and you learn to trust your instincts. If something doesn't look right or doesn't smell right, it rouses your interest. And so I knew that the day before that there had been 10,000 R of radiation and I'm in this tunnel the day after, some twenty-four hours later, and so just something—everybody has instincts. Now I'd been underground long enough to have developed some. I didn't get the right answer this time, but I was totally right when I instinctively felt that something was wrong.

[00:10:00] *Yes. Yes. So on this reentry process, what you just said was interesting because there's no precedents for going into a long tunnel to recover—*

Scientific instruments and readings.

The instruments, that's what you're going after, you're going—just so I understand the mechanics of it, you've got the cables and stuff going out. *Nonetheless, you need to go* in, *and there's instruments laying along the tunnel, or what? How does that work?*

Well, people think of an underground event as shooting a bomb. It's really not a bomb. It's just a massive physics experiment with a tremendous number of sub-experiments that have to be—you gain all the possible information you can get, and then that goes into the development of the next event, then the development of the next stage of the thing. And so you collect an awful lot of information, a lot of it transmitted all the way out by cables, a lot of it by imbedded instruments that you have to physically pick up *after* the event.

OK. So they're imbedded in the walls of the—?

Walls and the bottom, and in fact in one event we had a high-speed camera that was imbedded in a—somebody had taken off of one of our Navy battleships, had taken what was known as a sixteen-inch gun, in other words, where you fire projectiles out of a sixteen-inch gun, and took a portion of that and put a high-speed camera in there, you know, close to an event where it was able to get, you know, EG&G [Edgerton, Germeshausen, and Grier] had developed some very, very fast cameras, and all it had to do was survive for some microseconds, I guess, in order to observe the blast. And it took the pictures, and we recovered the thing, and that went into the book of knowledge of what happens in a nuclear explosion. As it turned out, B Tunnel was the first totally explored tunnel in terms of what the physicists call the phenomenology of an underground explosion. Because after the moratorium, we dug an incline and recovered, you

know, went right back to ground zero, and then we put a raise up on the outsides and penetrated the cavity a hundred feet above ground zero. Then we went down below ground zero all the way, following the outlines of the cavity, and that was the key information that says what really happens. And this was way back in 1959. You know, there was some fear on the part of some of the scientific people, if you go drilling a hole into a cavity, how are you going to know for sure that there isn't several hundred thousand pounds of pressure there that'll come flashing out of there? So all of these things were approached very gingerly and carefully. But once we totally explored Rainier, we put an awful lot of points on the curve. So in addition to Rainier, we recovered a couple other ground zeros, and then after that we never had to anymore.

Once the device goes off in ground zero, which before it goes off is a small—I know you guys dug some really giant rooms, but generally—.

Well, take Rainier, for example, 1.7 Kt [kiloton]. In other words, 1.7 Kt is 1.7 thousand tons of **[00:15:00]** TNT [trinitrotoluene]. It was in a small room. The detonation room was probably, I don't know, I'd have to look it up, but if I remember from memory it was probably six or seven foot wide and six or seven foot long and six or seven foot high, and there was a gadget. OK, when that went off, within a few microseconds it created a million degrees of centigrade temperature and a million bars of pressure. This instantly vaporizes about three or four feet. The ground turns into a vapor, and then it melts a significant amount of rock and it expands it into a bubble that's maybe what, a hundred thirty foot in diameter. Now the pressure holds this cavity open for maybe a couple of minutes. And meanwhile that pressure is bouncing off various [surfaces], you know, 360 degrees down this way, up, and as it hits each strata, some of it's deflected down, some of it penetrates. You've got an awful lot of motion going on. As that cavity is held open for two minutes, say, two or three or whatever it is, the melted material that is

plastered on the edges of the cavity is dripping down, and it collects in a puddle at the bottom of the cavity. And then as the pressure dissipates itself and then the temperature comes down, then the cavity can no longer sustain itself and it collapses. And then because of all that pressure bouncing up against all those layers of rock, it just goes up about another, I don't know, several hundred feet, and it collapses and fills what used to be the cavity. And so in 1959 we went in there and defined what happened. We dug out an underground nuclear explosive.

And that's another thing that comes up with Rainier, and this was done in 1959. After the Eisenhower moratorium, we scaled down. REECo scaled down from several thousand people to just several hundred. And where I had something like a hundred and fifty, hundred and eighty people in that tunnel, I was down to about ten or twelve. So what we did is we started that incline that went back into Rainier, and that's when we did that Rainier exploratory work. OK, once we started there, when we reached what was the edge of the cavity, some of the melt, you know, it was maybe a couple of inches plastered against there and it was highly radioactive. I mean it was big time radiation. So we covered that with lead plate. We fashioned lead plate and covered it, and it was the kind that, between the lead plate and then every—you know, we knew that you couldn't stand there when you went past it. That was only just a few inches, so as you went past that area, you just kept going. We continued digging until we got down to the axis of the ground zero. Now the problem we encountered there was once we got into the cavity, it was relatively cool, radioactively, but the ground temperature was anywhere from 160 to 170 degrees. And then anytime we would blast, opening up a round, there was an awful lot of water vapor there, and then the steam just boiled out of there. And it was hot steam—the visibility was essentially zero—and it took awhile to dissipate that steam. Now my concern at that time was that we were using dynamite to blast our way through, and here we are at 160, sometimes a little **[00:20:00]**

more, degree ground. So I put a call in to the manufacturer of the explosive and told him what we were doing and wanted him to get with his technical people and get back to me as to at what point does it become dangerous for us to be using the dynamite in that hot ground? So he came back, he said that they would not guarantee it beyond 180 degrees. So what we were doing—and of course we were doing that even before I talked to them—when we would drill out the holes to blast, we would take cold water and wash the holes out and just put an *awful* lot of water in there to cool the holes. And then we would put two or three people loading in there, and where it would normally take about ten minutes to load out a round, we were loading it and wiring it in a matter of minutes, and shooting it. But still we didn't want any premature explosions. So that was another point on the curve that we learned from that.

Yes, and this is a couple of years now after the Rainier shot, right?

Yes, Rainier was shot in September of '57 and we dug out the ground zero—let's see, the moratorium was '58—probably early '59.

OK, so it would be a year-and-a-half.

Yes.

Amazing. Now the melt that you're seeing, is that like the trinitite that they talk about up at Trinity?

Glass.

The same kind of thing?

Yes, glass. See, and that was just a narrow band on the side of the cavity. Then we followed the cavity down and we got down to expose the melt on the bottom.

Now this is a really basic question. How do you get the lead up there without staying there too long? You're saying you're trying to get through there fast.

Well, it's like if this is the melt right here you got a lead plate like that, and we burned some holes in the lead, then we put it in there and then drive a couple of spikes in there to hold it up.

But you have to do that quickly.

Oh, yes.

OK, that was my question.

And then measure the next plate so there's no screwing around trying to measure and find. We adapted.

Now how does the decision-making go, the actual process with this interface that you talked about with Gary Higgins, of actually deciding what the scientists are going to ask you to do, and then how you design that out? So they want you to go in there and do certain things, or you guys come up with it, or how does that work?

No, no, we were the contractor. They made the suggestions and we told them if it was doable. Now Gary lived with us. When I was there, he was there. And when we ran into something we didn't understand or he made a request, he would lay out, `Here's what I think we've got to do`, and we would devise a way to deal with it. And then if we had to set up some special people observing, special measurements or whatnot, he made arrangements for that. And so it turned into a very, very tight relationship. It was important work. We knew that. It was necessary. We knew that. And we did our level best to accommodate their needs. And Gary busted his butt to make sure that we did not get into something over our head.

So am I understanding correctly that you would be doing this and you might have some scientists or engineers with you?

All the time.

All the time, you did. OK.

Yes. Not all of them were as involved as Gary, but in these particular operations, he was totally involved.

Now you brought up the necessity of the work. Can you talk a little bit about what your own thinking is about the Cold War at this point, the arms race? Is that something that you think **[00:25:00]** *about as you're doing your work, as the larger context, or is that—? Just explain to me how that works in your own brain, or not.*

When I got discharged out of the Navy in 1946—and there were a bunch of us there getting discharged the same day—there was some young officer who showed up there and he says, `Everybody knows there will never be another war.` And we believed it. And he went on and he says, `Now you guys, you're discharged. Some of you are going to go to college, some of you are going to go back to your jobs, some of you are going to go back to your wives,` *et cetera, et cetera.* And so there was just a little bit of a—of course everybody wanted to believe that. But I remember in the fall of '45 when I was in Tokyo Bay, an American B-29 somehow or other wound up in Russian territory and it crash-landed there and they interned them. And the war's over now. And in that spirit of not offending them and whatnot, it offended everybody on the ship. So hearing the words on being discharged and knowing what we'd encountered before, I don't know to what degree others had it but I was immediately suspicious of anything the Russians were going to do. I just think we made an awful mistake in not recognizing their intents early on. And so now, as time went on, the Russians got more and more intransigent, they got more and more belligerent, they occupied countries. In my mind, I knew that some day I would be back in uniform some place, and I think a great many of us felt that way. And so now the Russians have got the bomb, we've got the bomb, they're developing, we're developing. It was a race. And we weren't privy to what the State Department and the Department of Defense were thinking, but we were all—not all of us, but a vast majority

of us were veterans of World War II. A lot of them were veterans of the Korean War. And then all of us that were thirty years or thirty-three years old were all the leftovers of the Great Depression. I didn't know what the Depression was. I was born in '27; the Depression ended in 1939. I was what? Twelve years old. But when I look back, I knew that there was a depression, but those that were four or five years older than me, they knew what a depression was. No such a thing as ever going to a movie. There was never such a thing as having an ice cream cone. I mean that just didn't happen. So you take the sentiment of the two wars and then you take the sentiment of the Depression, there was a tremendous amount of loyalty and a tremendous amount of suspicion of the Soviets, and there was a tremendous recognition of a great number of people that what we were doing was important, that we were in a deadly war. Now obviously there were plenty of them that didn't give a damn either way and didn't know whether Russia was something to eat. But the people that we were dealing with, the physicists, they understood the ramifications of the race, and we recognized that, too. And we recognized **[00:30:00]** that it was important work. And as it turned out, the Russians literally raped three generations of their people, trying to get nuclear superiority. And my generation knew that that could not happen. Or if it did happen, we would not like the result. So that was the attitude.

When you say "raped three generations," you're talking about what? What do you mean by that?

The Russians poured their resources—you know, they were devastated by the Nazis. They poured their resources into becoming the world's dominant nuclear power. They were spending money trying to become number one nuclear at the expense of their schools and their hospitals and their bridges and their infrastructure and their class of living and whatnot. The Russians distinguished themselves in secrecy and totalitarianism. They occupied Estonia, Latvia,

Lithuania, completely bullied the Finns, occupied Rumania, Bulgaria, East Germany, Poland, constantly agitating and constantly trying to overthrow what we consider our class of living. Bolsheviks, they were pretty well organized and they were pretty well indoctrinated. They *knew* where they wanted to go. And the nuclear race turned into a nasty race. And I'm not privy to how close they came or whatnot, but instinctively again I know that there were times when they led this race. And eventually we bankrupted them. And in fact, by the time I got to Russia in 1993 and I met my counterparts—and we had the inspection team mutually, and so they got to inspect what we did and we got to inspect what they did and *et cetera*. And I remember on the going-away party, which is traditional with the Russians and now with us, of course we haven't had any inspections since 1993, but it was traditional on the last day to have a joint goodbye dinner where everybody proposes a toast and comradeship and health, happiness, and peace, and whatnot. And I remember this one Russian got up and gave the best toast I ever heard in my life. See, people were toasting to friendship and cooperation and so he says he's going to offer a toast to our grandchildren. He says, `May they never meet on the field of battle.` So that said it all. So not all the Russians were Bolsheviks, but the non-Bolsheviks didn't have the opportunity to go to the polls and vote out the commissar that was depriving them of any kind of a standard of living.

So that was the mood. Most people. Now you got to be careful about that because there's always somebody that says, `I don't give and damn and don't care and don't bother me`, but I think the prevalent mood of particularly my generation was that they knew that this was significant. And the lab reflected what we reflected because basically we were all about the same age. Now as time went on, the original Atomic Energy Commission [AEC] was a small **[00:35:00]** number of people**.** They were highly dedicated, highly professional–they were just

dedicated to the business at hand. And they were a streamlined organization. There was no great big bureaucracy with them. Now along came ERDA [Energy Research and Development Agency], and I don't remember what year [1974], but it dramatically changed when it went from AEC to ERDA because that was our first contact with a bureaucracy. I was accustomed to somebody out at the lab rolling in in the middle of the day or the middle of the night or whatever it was and says, Hey, here's something we hadn't planned for. If we don't get it, we're going to have to delay this or it's going to pile up on there. He says, Can you do this? And then you say, When do you have to have it? And he says, Well, if we could have it within two days—we could immediately crank off and do it. And then some weeks or months later, along come the bookkeepers and write up the appropriate paperwork to cover it. But we weren't reckless about doing things without a work order, but there were times when—because a work order takes time to process, time to estimate, time to go through the signatures, go through all of that. If we'd have done that, if we'd have had to do that in every significant situation, we'd have never succeeded. Now yes, there were some abuses of that, but by and large there were very few abuses and very significant accomplishments. When ERDA came along, they started putting a damper on that. Now along come the DOE and "Katie, bar the door." All of that became very, very formal, and the answer was, Well, when I can get the work order? Well, you'll get it in two weeks. And, What am I going to do for two weeks? And there was constant tension. And then of course the DOE introduced, you know, the compliance all came in, and we can talk about that for a long time.

Yes, we'll get to that. We'll get to that.

But the complexion of everything changed drastically.

Right. Yes, I want to talk about those administrative changes, but maybe we'll stay with the time line, except for I did have that one question. For laypeople really to understand what this whole organization looks like when you're going ahead and working those tunnels, and let me just start with this. When you say you're at your office, your office is out there. Is Area 12 camp there now, so that's where your—?

Well, they've still got the camp but it's been kind of gutted.

No, I meant—but I'm talking in the past.

Oh, my office was in Area 12.

That's where that was. You're not back at Mercury. You're out there.

No. Area 12.

OK. Yes, because I've seen the remains of it a few times.

Yes. Yes, I was never more than five minutes away from any of those operations. When we were not in around-the-clock crises, in other words, I worked a normal day shift and went home.

OK. So you commuted, then, daily unless there was some—?

No. To commute meant getting up at four in the morning to get to Area 12 on time, and then if you left you got home at eight o'clock at night, and it just didn't make sense, so I always had quarters in Mercury. I used to go up there on Monday morning and come home Wednesday night and then come home Friday or Saturday, whatever was fair.

OK. Well, so let's talk about Mercury a little bit because you hear all these stories about—I hear stories about what Mercury was there and how it built up to be this community with the movie theater and the bowling alley, but what's it like when you're staying out there? Because you're not with your family at that point, right?

[00:40:00] Well, not everybody was in the field. There was a lot of administrative and of course there's a fire department and then there's the hospital and *et cetera*. And they have to be manned around the clock, so there was a population. The warehouse, the motor pool, those operations belonged in Mercury and there were people that were working them around the clock. And so that was one situation. Now the ones like the people in the forward areas, they were working day shift, swing shift, graveyard, and rotating shifts and whatnot. And then when it came time close to executing an event, there would be times when, in a typical event, where the mine force was probably in the neighborhood of forty or fifty, there'd be four hundred people underground in a twenty-four-hour period, maybe sometimes six hundred, which was this vast throng of what were commonly nicknamed "users." These were the experimenters who were not only installing their experiments but tweaking them and proofing them and making dry runs on them, because you don't get a second chance. Once you pull the trigger on the event, it's history. You don't get to be able to come back and say, `Hey, I forgot to connect this up.` And so for a great number of people, we also had living quarters in Area 12. A lot of the miners used to just come up there on Monday and go home Friday. And there were people who actually left every morning and came home every night. My neighbor across the street, he was kind of a smartass, he used to refer to me—because he knew I'd leave on Monday and I always came back toward the weekend—and he used to always refer to me as his neighbor and he says, `My neighbor is a weekend gardener with sex privileges.`

So this brings me to the question of the secrecy and how much people that aren't test site workers know about what you're doing. People know in those days that you're working out at the test site, but how secret is that from your neighbors and from your family?

Up until very recent years, that was a tightly [held secret]—people had clearances and they were told, `You don't talk`. If you read it in the paper and somebody says, `Hey, here's what I`

read in the paper, you don't comment on it. Secrecy was very well established and very disciplined, in my opinion.

But did your neighbors know you worked at the test site?

Oh, yes.

OK, so that much was—

Everybody that worked at the test site, you know, somebody knew that he worked at the test site. There were a lot of people that didn't know what he did at the test site.

OK. OK. And what about with your family? So you can't talk about things with your family either?

No. Marilyn used to say—she'd tell me something that she read about and she says, What about it? And I said, Well, you read it. You know. We just didn't do it. It was respected. Now with this new generation, I really don't know. I don't know. I'm in no position to judge because I've been gone for nine years. But the test site I worked on recognized the classification and respected it.

Right. For people who don't experience that in their lives, and you guys are really the exception in American society, I think people wonder, I certainly wonder, was that difficult, for example, not to come home and say to your wife and your kids what you've been doing during the day, or do you even think in those terms? Now I'm asking you to look back, not so much at the time, but looking back.

[00:45:00] Well, actually the things that we were doing were non-classified, like digging a tunnel, you know, there's no secret about digging a tunnel. As a manager, I had access to the experiments and the schedules and whatnot. Never was I much interested in that. I didn't have a need to know and I wasn't interested *in* knowing. Now I sure as hell would be interested if I

knew I was making a reentry and there was hydrogen in there. But basically for the position I held, for the years I held it, I probably know less classified information than maybe some of the janitors in some of the buildings. Because I didn't really want to know. Sure, I had a security clearance and there were certain secure documents that some of them were for my information, some of them I had to know. Those that I had to know, I read. There was a tremendous number of security documents that were just there for my information, and I would never read them. And so I didn't really care. I think that what's distressing is when—we always put a high degree of discipline on classified information, and now in recent years I pick up the paper and there's an alien out of China who was taking some highly classified documents home on his own computer. You look at that and you've got to wonder. Like for example in one situation we got involved in a situation where there were about ten of us. We got involved with that tritium situation. It was unknown at the time and it snuck up on us. Like on low pressure days the tritium, which is highly soluble in water, you probably know a little bit about that. At any rate, under certain atmospheric conditions it would bleed tritium into the tunnel, and no one was aware of that. And then I don't remember how this was discovered, but all of a sudden there was one particular time when there were ten of us, we just had a big dosage of it. Now tritium is highly soluble in the body fluids and the way you treat that is that you got to get an exchange of body fluids. So at any rate, when it was discovered that we'd had this dosage, and it was a beta contaminant so it wasn't a—over a long period of time it could create some real havoc, but if we could get rid of it real quick, the effects would be essentially small. So at any rate, they'd put on a national search at that time, you know, how to deal with the tritium. Again, that was plowing new ground. Nineteen fifty-nine.

Thanks. OK. I wanted the year. Great. [DOE documents also indicate beer used post-moratorium, after Operation Nougat, Antler and Chena tests in 1961]

So at any rate, I was asked questions like, How much water do you think you can drink? How much tea? How much coffee? How much cola? You know, Chinese torture is to feed people water until you kill them. And then after about two days of national search, I don't know where it originated, the message came back that probably the best medium of exchange would be beer. **[00:50:00]** So when the laboratory talked to me about that and they says, How much beer do you think you can get those miners to drink, that kind of teed me off because here we are loaded up with tritium and I didn't think this was anytime for frivolity. And then he said, No, he says, I'm dead serious. He says, Our information is that human beings can drink more beer because of the malt action than any other liquid.

Really.

Well, take a look at people you know. They start drinking a lot of beer, they start heading for the bathroom. If people drank as much whiskey as they did beer, they'd die. How many people can sit there and drink eight or ten bottles of this water?

Wow. OK, that's interesting.

So at any rate he says, We think that beer will resolve this problem. So I had the honor and the distinct pleasure to round up the other nine and give them their instructions. And you probably read that in a book, where they figured I'd lost it. They figured that maybe I needed a vacation or something. And I told them no, this is for real. And then I complimented the laboratory for finally making an intelligent decision. So I took all these guys, because I didn't want anybody on the road, and told them that they're going to stay there until they drink the maximum amount of beer they could drink for several days.

This is out at Mercury or—?

No, up at Area 12. So we sat down there and we started drinking beer. And the RADSAFE people were there. Every few hours they'd take a urine sample and analyze it, trying to get the level, and then start plotting graphs. And after a few days, the graphs were totally accurate. As those curves came down over time and distance, some of them came down abruptly, some of them further and you could correlate how much beer everybody was drinking. And within a few days, we'd reached tolerable levels. And so obviously some other people besides the ten knew that we were drinking beer, but they also knew that they weren't to talk about it. And so maybe up to about ten years, every once in a while somebody'd roll in and say, `I want to work in the tunnel because they give you free beer up there.` But nobody would comment on it. But that was a well kept secret for a great number of years.

That's interesting, but now I'm going to ask a really mundane question about it which is, you're in a room with these guys, you're all drinking beer. Do you remember what you're talking about? Do they bring food into you? I mean what is it like? Are you guys—?

Oh, we drank the beer and we went and ate and came back and drank more beer. When you get a bunch of miners drinking beer, they start talking about girls. They knew that this was a health situation, but they enjoyed it.

Sure. Well, I'm saying, you start to get drunk and then you're going to have to—I mean I'm just saying, wouldn't it have been interesting to record that conversation?

I remember being able to drink seven, eight cans and I'd had enough. And there were others that drank ten or twelve. Now I had one guy, came from the same town I did, and he drank twenty at a sitting, and his curve—he was the first one cured. Now I had an old Mormon hoist man—

[00:55:00] *Hoist man?*

Yes, he was in his sixties, and he refused to drink the beer.

And I told him, I said, Hey, this is not a religious situation. It's a medical situation.

He says, I understand that.

And I says, If you're going to get this stuff out of your system, maybe you can drink water and do it, but you're not going to cleanse your body.

And he says, I hear you, and I'm not going to drink the beer.

And at that time I was probably what, I was probably about thirty-three, he was about sixty-three, so I said, Well, what the hell, he's old, who cares? So several months later we took an assay and he still had some of that in his system. Now I've lost track of him. I don't what if any permanent damage he ever had. But I know that the ten of us came back to normal very shortly. So he provided a point on the curve that—

And so it wasn't a couple, three years ago somebody brought to my attention, he said, Do you remember anything about a beer incident?

And I says, Yes, matter of fact I do. And I says, Why do you ask?

And he says, I saw a paper that was written on that which is kind of the Bible.

And I asked him to get me a copy but he never did. So apparently somewhere in the literature there must be the report on this. And I would suspect if there was a report written, that it would be public because people could get exposed to tritium without being involved in the nuclear testing.

Right. Right. That's so interesting. And this was after an event in a tunnel that the tritium seeped?

Yes, Yes, this was in 1959. See, we went in the moratorium October 31, '58, so this had to be in the spring of '59.

And you were doing something in the tunnel and something from previous—who knows?

We don't know. See, mine ventilation constantly improves, and what was acceptable ventilation then is not acceptable now. And so under the standards of ventilation that we had then, I can see where it could've piled up. And it came as a shock because we had constant monitoring and the monitors missed it. That's the way we learn.

Interesting. You know, you're bringing to mind this whole larger question because one of the critiques of the test site is just what you said, that it's experimentation that's going on in this open air laboratory, really, out there, and that you guys are all sort of putting your bodies on the line for this knowledge that you don't have. I mean the knowledge is building as you go. Your two stories are great examples, the Tamalpais story and this one. What are your thoughts on that, as someone who was involved in it?

In 1958, 1959, 1960 we were operating within the margins of the current knowledge. Those of us, particularly in '59 and '60 when these experiments took place, we're the ones that crossed that threshold as to what really happens in an underground explosion. After that, occasionally, sure, situations cropped up. But basically the laboratories had a good handle on what happened. It just happened that we were the cutting edge of physically proving what happened. And then after that, you know, from then on we were just a big, major company doing massive underground construction with tremendous numbers of people. But the things that we were **[01:00:00]** doing, you know, we were building like that pipe there that I showed you the picture of, a three-hundred-thousand-cubic-foot vessel, probably the largest vessel ever built, and plumped down to less than a micron where a micron is one one-millionth of an atmosphere, that was new, but it was a matter of mobilizing the resources to do it. Now digging into the ground zero of the first underground nuclear explosion, there wasn't any criteria. There was no former

knowledge. And then there was the fear of, say, Well, why don't you drill a hole into it? Well, we did drill some holes gingerly, but there was a fear that well, supposing that we tap some high pressure gas or molten material? So we inched our way through. And we took a lot of the mystery out of a lot of that. Which is all to the good. The Nevada Test Site was an underground laboratory for the testing and improving of nuclear weapons when the U.S. was in a rat race with a determined enemy to get nuclear superiority. And there's not enough Americans born to deal with the rest of the world conventionally.

Say more about that. What do you mean by that? "Not enough Americans born to—. "

Well, if we were back with bows and arrows, how much of the hostile world could we take on? The U.S. nuclear threat is a deterrent. And all of us hope that it never will happen, but I wouldn't want anybody else having a nuclear threat over me. So we kind of got off the track here a little bit but—.

No, but I think this is important because one of the good things, I think, about the conversation is that these other kinds of questions can come in with the chronology.

We are right at ten minutes on this and it's getting close to 4:30. So we can maybe choose one more—if there's anything on your list that you want to talk about.

Well, maybe we can—just give me a second.

Yes, I'll pause it.

[01:03:11] End Track 2, Disc 2.

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

Well, one of the significant factors when I first came to the test site were the labor difficulties. Now in the mining world, all of the people that work underground belong to one union, and although you have some carpenters, you have some wire men, you have some sheet metal types,

some plumbers who work underground, they all belong to the same union. Of course they may get a different rate of pay.

And the union is—?

Well, you had the United Mine Workers in the coal mines, the copper mines were organized under the, oh, it slips my mind right now. [Mine, Mill, and Smelter Workers Union]

We can get it.

At any rate, so at the test site, you know, the work, the on-and-off before 1958, you know, they'd gin up and run some tests and then abandon it and come back a year later. It was all done with construction crafts under the Building Trades Union. And so consequently people like me who were raised in the mines, you know, the mine carpenter, the mine electrician, he was just part of the mine crew. Now we wind up in a situation where the electricians do not recognize [us], you know—they had an electrical superintendent who was in Mercury, and now he's doing work for but he's not reporting directly to me. And so that created—initially there was some real conflicts over that, but most of those guys recognized that this is different and they accommodated it without too much—but there were the diehards that, `This is our work and we don't report to miners and blah, blah, blah.`

So during the 1953-58 time frame, the nuclear testing operations at the test site were somewhat sporadic programs of peaks and valleys. We'd have some substantial buildups for short periods of time, and then they were followed by major reductions. And the test series were initiated and conducted on the basis of most urgency with continuity of actual operations a priority consideration. They weren't in there for the long haul. They said, `We're here for a month. Do what you got to do, pay what you have to pay, and get it done,` because that was the initial rat race with the Russians.

Now following the resumption of testing in 1961, that engendered a massive buildup. Excessive earnings of craftsmen received nationwide negative publicity. There were craftsmen that were knocking out a thousand bucks a week in those days. Now for example the daily payment of travel time for all employees working at the NRDS, the Nuclear Rocket Development Center or site [Nuclear Rocket and Development Station], the daily payment of travel time for all employees working there, from Mercury to the job site and return, they were on the payroll, and this leaked out and it was sensationalized *all* the way across the country. You know, people were making more money on travel time than the average wage rate for a full day's pay for others. Now these revelations spawned an intense negotiations from 1962 to 1967 to substantially eliminate major uneconomic practices and implement a project labor agreement. And our U.S. senators were constantly being bombarded by that time, you know, `You're wasting money over there`, and it was a black eye toward the test site.

And so following some intense negotiations, and some unrest, and maneuvers and counter-maneuvers, and legal actions, and general strikes and walkouts, REECo successfully concluded the first project agreement with Local 12 on May 13, 1963. That was the very first one. And then that was followed by the first project maintenance and operations agreement in June 1965. The first project construction agreement was successfully concluded for the Nevada Test Site and **[00:05:00]** NRDS on October 23, 1965. And this was preceded by a twenty-five-day strike and so, you know, we came to the center kicking and screaming and scratching all the way.

Now after 1967, labor-management relations were far less strident and somewhat routined-out, although walkouts and stoppages occurred on occasion. Contract renewal negotiations, jurisdictional disputes, bargaining over wages and benefits were negotiated in good

faith by both parties. And ultimately, and with professional mutual respect, some very excellent labor relations were established with the various unions. And we established an economic base. The abuse that came, you know, the contract says that if I'm here one hour late I get a full day's pay and so and so, these were exorbitant conditions. And so we routined all them out and wound up—so we became—for the amount of work and the numbers of people and the amount of changes came, we were very competitive. But that came after, you know, the people initially on the test site, they got accustomed to some very good money and they didn't want to give it up very easily.

Yes. Yes. Now explain this to me. They're getting that money all the time through REECo, right?

REECo was the prime contractor.

So REECo was agreeing to pay that money because the need was so great at that time?

Yes. Actually we were getting pressured by the laboratories. In fact I heard comments from responsible people in our organization, irresponsible to me in the total picture, `Just pay them. Just get it done.` And then some of those guys were smart enough to agitate, go frighten them and say, `Well, if we don't get this, we're going to walk out.` And they played that. And it took us a while to get control of that. I don't want to give the impression that the abuses were rampant, but there were enough abuses that took place that created some fearful national news. And that was a detriment to the program, to the laboratories, and et *cetera, et cetera*. And so as a prime contractor, we had an obligation to resolve that, and we did. And there are people who have no respect for the union contract and say, `I'm not a member of that, I don't care`. You know, the world doesn't work that way. When you sit down and you bargain a contract and you negotiate a contract, now you agree to certain conditions and you agree to certain pay raises and you agree to certain methods of discipline and you agree as to what

constitutes grounds for discharge and that sort of thing. Once you sign your name to that, you can't be nickel-and-diming that and looking for loopholes. *Either* party. And so we established a climate where we bargained hard and we bargained economically, but we never did nickel-and-dime our agreements. And quite frankly, in later years, if a craftsman had a choice between dealing with his business agent or dealing with his superintendent, he'd pick his superintendent because he'd get a better deal.

So that was a key political issue in those years.

Right. Right. That's great. And what I need to do, we're right at the end, so I think we should stop, but what would be great for me to do is to look into some of that history because I don't really know it. I've heard people allude to it, but now you've given me a good sense of—

You mean the labor.

The labor stuff. Right. So that's a thing that I need to understand. So let's stop for today.

OK.

Thank you very much.

[00:09:54] End Track 3, Disc 2.

[End of interview]