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

Interview with
Dale L. Fraser

March 2, 2005
Las Vegas, Nevada

Interview Conducted By
Mary Palevsky

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Produced by:

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

Director and Editor
Mary Palevsky

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

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

Mary Palevsky: *Thank you very much for the interview, and I would appreciate it if you could start by telling me a little bit of your background, where you were born, when you were born, your full name, and how you ended up at the Nevada Test Site.*

Dale Fraser: Very good, and you're welcome. My name is Dale L. Fraser. I was born and raised in Ely, Nevada, which is a copper mining town in eastern Nevada. I went on to the University of Nevada at Reno and got my bachelor of science in geological engineering. I spent a couple of years in the Army, then worked for several heavy and highway contractors. Then in 1961, with the resumption of nuclear testing at the Nevada Test Site [NTS], I came to the NTS and applied for a job and was hired in December of 1961 as an engineer.

And just so we get a sense of where you were, what year were you born?

Nineteen thirty-five.

And then, so you're in the Army in what years?

Nineteen fifty-nine, sixty, early sixty-one.

And you were stationed in the States or—?

Yes. I went through the ROTC [Reserve Officers Training Corps] program at the University of Nevada, Reno, was commissioned, and went in to two years of active duty. I was stationed on a Nike Hercules site just outside of Chicago for two years.

So you came to the test site after the moratorium ended.

Yes. After I got out of the Army in February of 1961, I worked for about a year for several highway contractors, and then it sounded like the Nevada Test Site [Figure 1[1]] was a good place to go in the fall of 1961. I had some friends here, so I came down and applied for a job, got a job as an engineer.

With REECo [Reynolds Electrical and Engineering Company]?

With REECo, yes.

A mining engineer, then.

It was more of a general engineering type, so I wasn't underground at the time. I was more of a civil engineer at that time.

So just a couple of Ely questions. Who were some of your friends from Ely that were here?

Bill Flangas. Glenn Clayton. Guys I had known from my hometown who [I] worked in the mines with prior to going into the Army; so I knew quite a few of the folks that were here at the NTS at that time.

So tell me a little bit about the kind of work you did and how things were going, and then we can get to some of the general information about REECo, which I really want to hear.

Well, when I came here in December of 1961, the NTS was very active. Testing had just resumed after the Soviets had broken the moratorium. So I think with REECo they'd gone from maybe a few hundred or a thousand employees late in 1961 rapidly up to nearly six thousand employees early in 1962. So if you had any credentials, you could probably go to work at the Nevada Test Site. And I went to work in the engineering office, and after a couple months I was able to get out and get where I wanted to be and that was out in the field. So I worked on a project called Small Boy, and that was the last atmospheric test on the Nevada Test Site,

[1] Mr. Fraser compiled photographs, documents and charts related to the interview. Figure numbers/notations in the original interview were edited to match his supporting materials.

conducted in July of 1962. And after that was executed, I went to Area 9 in support of the Livermore program. And I worked in support of that program as an engineer and later as a superintendent until 1965.

And then I decided that I'd like to go out and do some other things, so I went to work for another contractor, Lockheed Shipbuilding and Construction Company, who was big in the construction business at that time. I worked on several hydroelectric and tunnel projects, primarily in California. And I did that until 1970, and then came back to the test site in 1970 as an assistant division manager, Operations and Maintenance Division, for about a year. And then I became the department manager in the support of the Livermore program, all the construction effort in supporting that program, which I held until about 1974, at which time I was assigned to build the CADAC facility at the control point [CP] in Area 6 on the test site, which was a new Livermore facility for the CP-One.

CADAC?

Control and Data Acquisition Center. It was a large computer facility, diagnostic facility. I spent **[00:05:00]** about a year at that, and then managed the general construction on the test site, not specifically test-related, for about a year. And then in 1976, I became the operations and [maintenance] division manager for REECo. I held that until 1979, at which time I became the deputy general manager to Harold Cunningham, who at that time was the general manager. When he retired in early 1986, I became the general manager, and then held that position until the expiration of our contract at the end of 1995. So I was president and general manager of REECo and a vice-president of EG&G [Edgerton, Germeshausen, and Grier] during that period of time. Most of that period of time.

So obviously from what you have just told me, you had skills or interests in administration and management, in addition to your engineering—

Engineering, construction, and management. One kind of leads to the other.

Does it?

Yes.

Because you start, I guess, moving up and having supervision over more people and—

Yes. Starting as a superintendent, you might have supervision over maybe a couple of hundred, and then as a department manager you might have three or four or five hundred. And then when I became manager of the Operations and Maintenance Division, I probably had two thousand to twenty-five hundred. And then when I became general manager in early ’86, we were around fifty-eight hundred—excuse me—yes, about fifty-eight hundred. And that gradually dropped toward the end of nuclear testing down to about two thousand at the end of ’95.

And remind me again of when EG&G took over, or how did that happen?

Well, a little of the background on the REECo efforts here at the NTS. REECo was formed in 1932 by L.J. Reynolds as an electrical contracting firm. And it prospered pretty well, and by the 1950s they’d become one of the major electrical contractors in the United States, electrical construction contractors.

Was it founded here or—?

At El Paso, Texas, actually. And then they became involved in the nuclear program very early on. They did a lot of the electrical construction at the Manhattan Project at Los Alamos [National Laboratory]. Then continued on into the fifties with some of what was called the classified ABC projects. They were the prime electrical contractor on the gaseous diffusion plant at Portsmouth, Ohio, which was a very large project. Matter of fact, I believe on that one project, REECo had like two thousand electricians on that job. And then about that time, I think it was December of 1950, REECo and two joint venture partners, Robert E. McKee Company and Brown and Olds Mechanical, were given the contract at the test site, which is now called the Nevada Test Site, to start building the infrastructure: the roads, the buildings, the utility systems. And then during the first atmospheric testing, Operation Ranger early in 1952, REECo also provided support to those activities, things like the scientific cabling, the power, and those sorts of things for the atmospheric tests. And then continued supporting the program in the remainder of 1951 and ’52. And then late in 1952, REECo and its joint venture partners were awarded a prime support contract to the then AEC [Atomic Energy Commission]. REECo held that contract for the next forty-five years, clear through 1995.

Now in 1967, EG&G Incorporated acquired REECo.

It was ’67.

Nineteen sixty-seven. And EG&G had also been in the nuclear business on the technical side from the very inception. And then shortly thereafter, the joint venture between REECo and Brown and Olds and Robert E. McKee was dissolved, and REECo operated as a separate entity, a sole, wholly-owned subsidiary of EG&G. So that’s kind of where we wound up for the remainder of the forty-five years, as a wholly-owned subsidiary of EG&G.

[00:10:00] *Well, we can back up a little bit from the jump from ’67 because you have some material you were going to go through about REECo. Because as much information as you can give me about both your personal involvement and what you observed the nature of the company because from what we have said, it was a very complex undertaking.*

It was a very complex and dynamic program. And when REECo got the prime support contract in 1952, they began doing a broad, wide variety of diverse functions. REECo did most of the construction work on the NTS and the Tonopah Test Ranges [TTR], both the permanent construction of buildings, roads, utilities, as well as the test construction, which was very significant for each test. So we performed virtually all of that on the test site and the Tonopah Test Range.

Now explain something to me because I know that Holmes and Narver was an architectural engineering firm, so I've never been clear on divisions of labor between the two or the kinds of things the two were doing at the test site.

We worked very closely with Holmes and Narver. Holmes and Narver was basically the architect engineer. They did the design and we did the building. So that's the way that worked. We did a tremendous number of different activities for the AEC and later ERDA [Energy Research and Development Agency] and later the DOE [Department of Energy]. In addition to the conventional construction, both test and permanent, we did virtually all of the underground construction, what's commonly called mining, and this was also a very big effort. Between the construction, test and permanent, and the underground construction, we would normally have several thousand employees engaged in those activities. It was not unusual in the underground to have four to six major tunnel complexes going at one time, and employing a thousand personnel underground at any one time. REECo constructed fifteen major underground complexes, which represented more than forty-three miles of tunnels, and something like twenty-four vertical shafts excavated conventionally.

In addition to the underground and surface construction, one of the big efforts was drilling. That would be both the large-diameter shaft drilling and the slim-hole drilling, exploratory, post-shot, and drilling of that nature. And REECo provided most of the drilling that was ever done on the test site. During the early years of underground testing, '61, '62, when I first came to the test site, there were something like thirty-plus drill rigs drilling in Yucca Flats, drilling primarily emplacement holes. So this was before the real advancement of the technology of shaft drilling, so it took a lot of drill rigs to accomplish the mission at that time.

After we evolved and improved the techniques of shaft drilling, we could normally get by with three to five drill rigs [Figure 5] drilling emplacement shafts on a three-shift-per-day, seven-day-per-week basis in order to keep up with the program.

Let me understand this, then. You need more drills for a single shaft, or is it one per, or—?

Well, when we first went into the underground nuclear testing in 1961, it was obvious we had a great need for vertical shafts. And you have two options. You can drill them or you can sink them conventionally, in a mining fashion. Mining was too slow and too expensive for the number of shafts they needed. So it was obvious that the shafts had to be drilled. And the state of the art of shaft drilling at that time was that you would start with—and I'll call a shaft at that time thirty-six inches in diameter or something in that range—you would start by drilling a twelve-inch hole from the surface to the terminal depth, and then you would come back and you'd go down with a twenty-four-inch cutter and drill it to twenty-four inch, and then come back and drill it to thirty-six inches. And that was too slow, too costly. So it was obvious that we had to improve the technology there. And that was one of the big challenges.

[00:15:00] So over the next several years, the art of shaft drilling dramatically improved. Starting with the techniques that I've just described, we went next to—let me look at my chart here. I described the method of drilling these shafts like in '61, early '62, with the multiple passes. By 1962, REECo, with the drilling architect engineer, Fenix and Scisson at that time, and the heavy equipment manufacturers, began working on new techniques. By 1962 we were drilling forty-eight-inch-diameter holes with a single pass using tandem hole openers. What that means is you have a drilling assembly with maybe a twelve-inch cutter on the bottom and right above that maybe a twenty-four-inch cutter, thirty-six-inch cutter above that, and a forty-eight-inch. So instead of having to drill the hole three or four times, you can drill it all in one pass.

Tandem, you say that is?

Tandem, yes. T-A-N-D-E-M hole openers, it's called. By 1963 the hole openers were used for stabilization. We went to larger drill collars for weights and drilling pipe increased to about eight-and-five-eighths inches, and we were drilling as large as sixty-four inches in diameter. By 1964 we had a mandrill weight of up to fifty thousand pounds, and we started using air foam as a circulation system to get rid of the cuttings, and we achieved eighty-six-inch diameter. By 1965 the mandrill weight had increased to seventy thousand pounds with the integral stage bit and roller stabilizers to keep the whole assembly stabilized.

By 1972 we had made huge breakthroughs. We went to flat-bottom bits up to one hundred twenty inches in diameter and three hundred thousand pounds of weight, using split weights and an integral dual string. And what the integral dual string means is that it's a dual drilling pipe. Then the outer pipe would be thirteen-and-five-eighths inches, the inner string would be seven inches in diameter. The drilling media, which was air and water, would be pumped down the annulus between the two pipes and it would jet out across the bit and lift the cuttings up the inner string. So that was a big breakthrough.

Let's stop here for a second so I can understand some of the mechanics of this. You're obviously working with these various entities.

Yes.

You have an engineering problem, you have a construction problem, all these things to create these things, and these are being just made for the test site alone?

At that time we were probably the only ones in the world having the need for that many deep, large-diameter shafts.

And the mandrill weight, I mean physically does it have to be lifted onto the drill?

You load weights onto the mandrel. You have what's called a large mandrel, which is kind of the inner structure. It hooks to the bit body at the bottom. Above that you'll have your roller stabilizers. Then you'll have a mandrel, which is a round steel structure. You load the weights around that, around the mandrel.

We're going to call that Figure 7 so I know that's a perfect illustration of it. Amazing.

So by 1975, through other refinements, we went up to weights of about four hundred thousand pounds of total weight on the mandrel and bit, and the shafts were drilled at rates of up to a hundred feet per day and with a bottom offset of less than six inches off plumb from top to bottom.

Oh, and that's what you were saying before about the mandrill, that somebody else uses a plumb bob.

Yes. The four hundred thousand pounds I talk about, probably two hundred thousand pounds or so of that is applied to the actual cutters. The remaining two hundred thousand pounds is held back and acts as a plumb bob. That's what keeps your hole straight and plumb.

Amazing. And then what did you mean when you said there was a breakthrough with the drill bit, a flat—?

[00:20:00] Yes, I'd talked about the multiple passes starting with the small bit, then the larger bit, and then I talked about the tandem hole openers, which is one above the other. The flat-bottom bit is just cutters mounted on a flat surface full diameter.

Yes, this is Figure 8, and this is a picture of it. So then you don't need to have the tandem.

That's correct. It's drilled in one pass, full diameter, through one cutter face.

So there's something special about all these bits here that allow it to do that?

It's just applying all your cutters on one surface, rather than one above the other. And you can apply a lot of weight. You can get very big and large in diameter.

And let's call this Figure 9. Here's your evolution of big hole drilling. This is great.

Yes, this chart describes the evolution of shaft or big hole drilling at the test site, from 1961 through 1975, when we pretty well had developed the techniques to meet our total needs.

Now so I can understand the relations to the test itself, there's something about the nature of the tests that's requiring—?

The tests, beginning in 1961 when we first started emplacing nuclear experiments into these drill holes, we started with probably shafts of thirty-six inches in diameter. The tests rapidly became much more complex, much larger, dictating larger diameter, deeper shafts, and that dictated the need for the evolution of shaft drilling.

So the tests themselves were larger in yield?

It could be yield, it could be the amount of diagnostics that was needed underground, the size of the diagnostic canister, the number of cables that went from the diagnostic canister back to the surface to the diagnostic recording part, all dictated the need for larger, deeper shafts.

And what were the manpower implications of this? Who's operating these? People have to go down those shafts sometimes, right?

If we're just drilling a shaft for the emplacement of a nuclear test, normally you do not have to go down that shaft. You just drill it, case it if you need to, but we didn't have to do a lot of casing. We had to do some. And then you emplace the nuclear experiment in that shaft. We did have experiments where the scientists wanted an excavation at the bottom of those drill shafts.

So in that case, we'd drill the shaft, we would line the shaft with steel casing, and then we would put miners down to do excavation in the bottom of that drill hole shaft. That was quite a specialty.

I guess, because they wanted a larger ground zero or—

They wanted certain experiments that dictated an excavation at the bottom of that shaft.

How big could that get?

Cavities of maybe twenty, thirty feet in diameter, maybe some short drifts.

So were there certain kinds of miners that were—?

Yes, we had a cadre that kind of specialized in that. We did quite a bit of it, oh, during the sixties and into the seventies.

OK.

In total, we probably drilled in excess of five hundred and fifty of these emplacement shafts at diameters of forty-eight inches up to generally a hundred and twenty inches, ten foot in diameter.

Five hundred fifty over how many years?

More than five hundred and fifty, and that would not include the smaller ones at thirty-six inches in diameter, so overall we probably drilled more than six hundred shafts. I'd think, at a total of, oh, more than a million lineal feet, like a million fifty thousand lineal feet of drilling. Depths on the test site to more than three thousand feet. Probably averaged something less than two thousand.

So this is underground testing in shafts alone. This isn't even getting into—

In drill shafts. This doesn't get into the tunnels. That's correct. Going along with the rapidly evolving test program for the underground, you had the same kind of evolution needed **[00:25:00]** on the construction side of it. For instance, in 1961-1962 time frame, when we were emplacing in like [a] thirty-six-inch-diameter shaft, the emplacement weight of the down hole assembly – that’s the device assembly, the diagnostic canister, the cables, the down hole messenger, whether it’s drill pipe or cables – might have weighed twenty to forty tons, and there might be twenty or thirty diagnostic cables on it. One of the most critical areas in which we had to deal with on the nuclear program was the safety of lowering these heavy assemblies into the drill hole. But in ’61, ’62 we were dealing with weights of twenty to forty tons and we would use cranes, generally cranes. Oh, our largest crane at that time, late ’61, early ’62, was probably a ninety-ton capacity truck crane, something like you’d see running up and down the streets in Las Vegas. And this is probably the most critical time of a nuclear test is when you’re actually doing the lowering, at least the critical time for that type of test. The program dictated almost immediately the need for larger, heavier experiments. So very rapidly we had to start acquiring equipment that would handle heavier loads, and equipment that could finitely control the lowering of these assemblies. So in 1963 we probably went from ninety-ton emplacement cranes to two-hundred-and-fifty-ton crawler cranes. By 1968 or ’69 we were up to five-hundred-ton specialty cranes called ringer cranes. I have a picture of one of those here.

Yes, let’s have a picture of that. I need to get an idea of what you’re talking about. OK, and this is Figure 14.

This would be a ringer crane with a capacity of five hundred ton. And by the 1970s we were using these and emplacing down hole loads weighting up to nearly four hundred tons.

So then is this technology of the crane itself evolving, or these kinds of cranes have other applications?

They do have other applications, but we probably had about as many of these big, heavy-lift cranes as any contractor in the country because you just didn't see that many of them around. This was another example of that ringer crane in 1972.

We'll call that Figure 13.

And that's the Flax event, U2dj, in Area 2, and that was probably our heaviest down hole load up to that point in time, of almost eight hundred thousand pounds, four hundred tons.

The device and its things—

All the down hole assembly.

The whole assembly. Oh my gosh.

And as you can see, by this time you had the large canisters, you had lots of cables, we were going down hole on heavy drill pipe, and there were certain lines-of-sight sections within the—

Those are the lines-of-sight on the left.

Yes.

And this is the hole itself here?

That is the crane, and the boom of the crane is sitting right over the hole. Mm hmm.

This is an amazing picture! What's this?

This would be a ground zero area.

We'll call this Figure 12.

This would probably have been in the mid-sixties, depicting the typical layout of a down hole operation. And you see the buildings that are used, the temporary buildings that are used to assemble various components. You'll see the crawler crane, which has a capacity of two hundred and fifty tons. We were probably emplacing weights of a hundred to a hundred and fifty tons with that crane. And you can see the drill pipe that's used to lower the assembly. You see the cable trays from the surface ground zero back to the recording trailer parks.

That's what these things radiating out are.

[00:30:00] Yes, those are cable trays. The cables go clear from the diagnostic rack in the hole, up the hole, and clear back to the recording trailer park.

So these recording trailers are far enough away that they're not going to be—

They would be outside the influence of any crater or that sort of thing. These are all shock-mounted and that sort of thing.

What kind of distance—it's hard for me to get a sense of—these are trucks, so would it be a quarter of a mile?

From the surface ground zero back to the trailer park in this case, they would vary experiment to experiment, but I would say that's probably five or six hundred feet.

All right. Very interesting.

And then I think I've described the equipment used up into the seventies, where we had down hole weights of up to seven or eight hundred thousand pounds. By the mid-1980s there was further evolution, further need for larger cranes because of larger, heavier diagnostic assemblies down hole. We actually by the mid-eighties had cranes [Figure 16] that would go up to nine hundred and fifty tons, and we actually emplaced experiments of more than a million pounds, or five hundred tons. And the crane would look—here was a picture of one experiment, Contact. I don't remember exactly what the weight of that was but you—

Go back to this for a second, Dale, and I want to put a number on this, Figure 19. This is the assembly?

That is the diagnostic rack.

OK, the diagnostic rack.

That's where the experiments are above the device itself.

That is gigantic.

And the cables go from—yes. The diagnostic rack at times could be a couple of hundred feet long.

When we were out at the test site and saw that British test that didn't go, I don't think— were we looking at heights—when you go up to the second floor, you see where the device itself—

Are you talking about in the tower? In the assembly tower?

Yes.

Those towers would be anywhere from a hundred to a hundred and fifty feet high, in modules of twenty-five feet. But the thing you need to remember is you might only have a hundred feet of the canister hanging in the tower but there might already have been some of it put in the hole and then you assemble these at the collar of the hole.

Got it. That's really impressive.

Now this would be a Manitowoc 6000 with the Lampson load extender and it had a maximum rate of capacity of nine hundred and fifty tons.

So this is this Manitowoc crane.

Most of the cranes we used from 1970s clear through the 1990s were Manitowocs. They build a lot of good heavy-lift cranes, and their control system for lowering was extremely good. There's a story which I believe to be true. We had bought a new crane, I think it would've been in the late sixties or early seventies. I think it was the five-hundred-ton ringer crane. And we sent several people back to the factory for the final tests. One of them was one of our crane operators. And during the load test, they actually set an egg down and lowered a very heavy load right down on top of the egg without breaking the egg. That's how good the control systems and the operators were, that we had to have for doing this kind of work.

Incredible. So this is Figure 17. That's a good picture because you see it in reference to the size of the guy. There's another one of it. That's Figure 15.

This was probably a sixty-hundred-and-fifty-ton Manitowoc with a Lampson load extender, and this is probably a partial picture of the nine-hundred-and-fifty-ton Manitowoc with the Lampson load extender.

So this is Figure 17, the larger one.

Yes.

This is great because you get the scale of a man to the diameter of the—

That's very large equipment.

Yes. It is very large. With the mountains in the background. Incredible. And Figure 15 is a smaller one.

Yes, that's the sixty-hundred-fifty-ton Manitowoc with the Lampson, going through a load test.

Oh, this is a load test.

That's a load test.

So they've got the weights on it there.

We had an excellent crane certification and testing program, naturally, by virtue of what we were handling.

[00:35:00] *Sure. I guess. We have got that one. Great.*

And we talked a little about the evolution of the shaft drilling and some of the equipment used for emplacement and that sort of things, but also another example of evolution, you might say, would be in the tunneling, underground excavation. During the fifties and sixties, most of the tunnel excavation was done using conventional drill blast. And probably by the 1970s, almost all of our underground excavation was done with mechanical machines, alpine miners and tunnel boring machines.

Right. I talked to some of the miners about that.

So there was a lot of evolution in that arena, as well.

You know, we talked about the construction, both surface and underground, and the drilling. We had a lot of other functions [Figure 4] that we performed for the DOE at both the Nevada Test Site and Tonopah Test Ranges, like vehicle and heavy equipment maintenance. We maintained a fleet of light-and-heavy-duty vehicles, generally more than three thousand, and probably a thousand pieces of heavy construction mining and drilling and miscellaneous equipment, so that was a big effort. We maintained the facilities and utilities on the test site and Tonopah Test Ranges: hundreds of buildings, hundreds of miles of road, primary and secondary, several airstrips, a number of water wells, water distribution systems and sewer systems. In terms of power distribution, we had the responsibility for the operation and maintenance of several power systems that included hundreds of miles of high-voltage transmission and distribution lines, numerous substations and switching centers, both at NTS and Tonopah Test Range.

The power's coming from where and—?

We had two power feeds. One was from Nevada Power to the south, and the other was from Valley Electric to the west, I guess it would be. So we actually had two feeds into the test site, to our main substation.

But once it arrives there, you're in charge of all the power, is that correct?

Yes, we have the distribution of power on the site. And at Tonopah, we got our power from Sierra Pacific at the northwest.

We also had responsibility for supply and warehousing. We had the operation of several central and remote supply warehouses to meet the logistical needs of all the test site and Tonopah Test Range.

We provided the medical services at NTS and TTR. We operated a central medical facility and a varying number of remote facilities. We provided the full spectrum of occupational medicine, emergency services, industrial hygiene, sanitation. The medical staff consisted of doctors, nurses, paramedics, industrial hygienists, and sanitation professionals.

We had the responsibility for onsite radiation protection, so we had the health physicists, the radiation monitors, so we did the monitoring and the dosimetry for all the onsite activities. EPA [Environmental Protection Agency] had the responsibility offsite. In conjunction with the radiation protection program, we had analytical laboratories that we operated, both chemical and radiation laboratories.

We were responsible for waste management, where we operated and provided the management of low-level radioactive waste, hazardous waste, and sanitary waste.

We provided the housing and feeding, so we had both central and remote housing and feeding facilities at both the NTS and TTR. The housing was bachelor housing, and we had that in as many as four locations at one time, with occupancy rates in excess of three thousand people. The feeding was conducted at both central and remote locations, and we fed more than ten thousand meals per day for long periods of time.

[00:40:00] We did the environmental restoration, particularly during the 1980s and ’90s, where we performed a number of environmental restoration programs to remediate the results of the nuclear testing at the test site and Tonopah Test Range.

That would be interesting to know more about. Environmental restoration. OK, keep going.

A lot of cleanup activities in that regard.

In terms of communications, we operated and maintained a vast communication system both onsite and offsite. The system included radio, microwave, TV, diagnostic signal cable, satellite communication, and alarm systems.

Did you have to worry about, with radio and things like that, things being secure?

On some activities and some nets.

So how would that work? You'd have secure channels or something that people would talk over or—?

I'm not sure how we did that. I got to believe in terms of the radio communication, we probably didn't do anything, any secure communications, over the radio. Probably did over some hard lines, yes.

We also did the fire protection at NTS and later to some extent at the Tonopah Test Range. We had both central and remote fire stations, fire fighters.

In addition to those, we handled a number of other activities which I'll just touch on, and that would be like property management. There's a tremendous amount of property to be managed on the test site, both real and personal property, hundreds of thousands of pieces of property. We participated in the Nuclear Emergency Search Team [NEST] effort. We did environmental and ecological monitoring. We operated a printing plant. We had site-wide training activities. Commuter bus services. Plant engineering. Just a whole host of other direct support activities to the government.

[redacted]

[redacted]

"The black world." I've never heard that expression.

Highly classified.

That's what that means.

[redacted]

Tonopah is something, probably because it's been so secret all these years, I don't know that much about. At the time, was everything that was happening up there highly secret?

Pretty much like the test site. For years prior to the 1980s, Sandia National Laboratory had activities up there under the DOE Albuquerque office. So we supported their activities. [redacted] And then we had a fairly large cadre that remained and maintained the facility for them.

I'm really ignorant about this, Dale, so these are going to be really elementary questions. From the beginning, is Tonopah having to do with—if Sandia's there, it's not only airplanes, then, is it, or—?

That's correct. That was a separate program [redacted]

Is it a weapons-testing program?

It's related.

[00:45:00] *So when you say Tonopah Test Range, I always think of airplanes, but there were other things going on.*

There were other activities there.

Would they be related to testing at the test site?

There were several nuclear events conducted up in that area. You'll find those in your book here. And it's called, I think, the Nellis Air Force Range [NARF].

So they call it the Nellis Air Force Range.

Yes. [Operation] Roller Coaster. You can find that in the book.

Now that's different. I'm going to go way off here but I'm reminding myself of something I need to look up. There was also an effort, and it may have been in the sixties, for a supplementary test range, but that was elsewhere. Do you know what I'm talking about?

Central Nevada?

Yes.

That was a little further north. We provided some support to that, not a lot. There were several experiments there.

Yes. But that didn't last, from what I could tell.

No, and I do not know the reason, whether they got what they wanted and that was all that was needed.

Because I interviewed a guy who was a security guard there, and I didn't even know about it, so I did some search on the nuclear testing archive and I found the reference to it.

Anyway, we did have a lot of effort at the Tonopah Test Range over the years.

[redacted]

[redacted]

[redacted]

Would workers go back and forth between the two?

Yes. That was one of the advantages of having REECo do work on both as we had the ability to move people from project to project, program to program, and we had a lot of Q-cleared people, employees.

That's a good question I want to get to, about the clearance procedure, how REECo was involved in that, but one more question about Tonopah. So there had to be either mining or drilling or some kinds of similar activities up there, as well, for these tests, I assume.

Yes. But Sandia had several kinds of programs up there, not necessarily nuclear-related.

So Sandia and not the other labs.

Sandia was the primary occupant there.

So it works that you're working for the feds, AEC, ERDA, DOE, and then they divide out how they want your work to be among the labs that they're supporting, I guess.

Yes. It was kind of a teamwork thing [redacted] we had done some minor work for them previously, previous to 1981, so they came in to the manager of DOE/NVOO [Nevada Operations Office] and told him what they wanted, and we sat down with DOE, and DOE actually had some representation on the site at Tonopah, from the test site, and that's how things flanged.

And at that point, you are in high management at that—

I was the deputy general manager.

And that was when Harold Cunningham was the general manager.

Yes.

Now what do you have next here?

Well, we also did the surface-based construction and surface-based drilling for the Yucca Mountain Project. And actually some of that drilling started back in probably the late seventies or early eighties. And then we hired a subcontractor to excavate the tunnel, and that would've been the [Peter] Kiewit Company.

Kiewit?

Kiewit. And since we knew our contract was coming to a close at the end of '95, we turned that contract over to the integrating contractor on Yucca Mountain, which would've been TRW. So we weren't there when the tunnel was completed.

Now that brings up a question about the contracting process itself, because you're saying you knew REECo was not going to have the contract after '95.

Yes.

Building up to that point, and I know that Harold Cunningham and I discussed this but you have to remind me, how did that work? Obviously it wasn't a year-to-year thing on such big contracts.

No, we normally had five-year contracts, and then they had the ability to extend those. I'm sure that in 1952 there was some bidding process which gave REECo the first prime support contract. Again, in 1967 or '68 we had to recompete for it. And then it was five-year extensions clear up **[00:50:00]** through 1995. And about 1993 or 1994, EG&G had decided to get out of the DOE support business. At that time, they had the REECo contract here in [Las] Vegas, the Energy Measurements contract here in Vegas, they had the Idaho National Engineering Lab at Idaho Falls [Idaho], the Rocky Flats [Colorado] Plant, the Mound Facility in Ohio. So probably the largest DOE contractor was EG&G at that time. And for business reasons they decided to get out of the DOE support business. And so we knew probably in 1993 or 1994 that we would not be recompeting for our contract.

What did you think about that?

I understood it. By that time, there was a moratorium in place, after 1992, so things were dropping pretty dramatically and the corporation, EG&G, just decided to go in another direction.

Did REECo employees, EG&G employees, move over to the new contractor?

By that time, both EG&G and REECo were scaling down considerably because of the moratorium. We were down at the end of the contract to about two thousand employees, and I think Energy Measurements might've been down to a thousand or less. And so the new contractor that came in, Bechtel Nevada, did pick up some of those employees. I don't remember exactly how many. And lots of employees were laid off. But there were significant layoffs taking place anyway.

Maybe this is a good time to look at that chart you have of the employment numbers. That graph. You have a graph or something.

OK. Do you want me to finish just a couple more of these activities?

Yes, why don't you finish those up? Let's do that.

I talked about the Yucca Mountain. We also supported the Nuclear Rocket [and] Development Station, NRDS, in the 1960s, and later the MX [missile experimental] program, which was also done at Jackass Flats. We went to Idaho on DOE's geothermal experiments. We sent a drill crew and drill rig up there. And also to the gas stimulation projects at Farmington, New Mexico and Rifle, Colorado. So we sent rigs offsite periodically.

Talk to me a little bit about MX. I have talked to some of the miners about it, but give me an overview of what that was doing and why it was at the test site.

They wanted to do some prototype testing at the test site. We sunk a large-diameter shaft probably thirty-five or forty feet, fairly shallow, that they could do some of their testing in. Also, we had I think it was at the R-MAD [Reactor Maintenance, Assembly, and Disassembly] facility, where they had some experiments. The MX missile was the concept of making our missile system mobile, so they were testing a lot of their hardware to do that.

I remember they would have them on rails and things like that.

Rail and rubber-tired carriers.

So they were doing that at the test site, testing those things?

Testing that kind of equipment. Yes.

OK.

We also provided support to offsite nuclear tests conducted at Amchitka, Alaska; Farmington and Carlsbad, New Mexico; Fallon, Nevada; Hattiesburg, Mississippi; and the Nellis Air Force Range, NARF, and in central Nevada. In 1988 we sent a drill crew and a drill rig to the Soviet Union to participate in the Joint Verification Experiment [JVE].

Right, in 1988.

Actually flew that drill rig and equipment to the Soviet Union. [Figures 20 & 21]

Yeah. That was '88 that that—

Nineteen eight-eight.

Right. And what was your involvement with the JVE?

Well, I was the general manager at the time, so we selected the people to go and the equipment to go and gave them whatever support they needed, and then the team that went over, which was DOE and laboratory and some of REECo, we were directed by the DOE at that point.

Tell me a little bit, because the JVE is an interesting historical event, I think, because you've got the sharing of information among these nuclear enemies. How did people react generally? Were they worried or—?

Well, the people that I associated with, I don't think they were particularly worried about it. Quite frankly, to me it came as a surprise. But then a lot of things politically were changing at that time. So once they started getting their hands around it, it went pretty fast. And we went **[00:55:00]** over there to participate and they came over here to participate. And I think everybody by that time thought it was probably a very positive thing.

Did they?

I think so. You might've had a few hard-core people that didn't believe that, but for the most part I think people believed that that was a good thing.

I just would imagine culturally it would be so odd.

It was.

I was thinking about it this morning, because we have a student who's very interested in the JVE, one of my graduate students, she's interviewed a lot of people about it. For some reason I was thinking, normally when peace begins to be made, it's the big, high-up guys who are starting to have to be diplomatic and change their tone of voice. But at the test site, because of the nature of the JVE, you've got all levels of people having to get their minds around going from an enemy to a—

Of course, the decisions were being made at the very highest levels of government.

I know that.

So we were all good soldiers and we just marched on. But I think for the most part people, after all those years of testing and high security, I think people kind of accepted that that was probably the way to go.

That's interesting because, as I said, normally it's not all the good soldiers that have to do that. The soldiers just hang around and let the big guys talk. Here it was you all had to—

Participate in some way.

In this experiment.

That's correct.

Yes. Very interesting. OK, where are we with the other stuff?

The REECo workforce.

Let's talk about that. Let me see. Let's go about ten more minutes on here.

OK. During the forty-five-year tenure at the Nevada Test Site, REECo and its subcontractors employed right at a hundred and twenty thousand different people. The manpower levels varied to meet the various program needs. During the campaign style of testing in the 1950s, the employment levels would vary between a couple of hundred and maybe two thousand.

What do you mean by "campaign style"?

The program was such that there'd be a series of tests conducted in Nevada, and then when that series was completed, there'd be a series of tests conducted out in the Pacific, and then back to Nevada. So there was a lot of ups and downs in our employment level during that period of time. While the testing was being done in the Pacific, we might've been making some sites ready, but it was mostly a maintenance of capability at that time.

And then during the inception of the underground program, 1961, our employment levels rose dramatically, probably to a high of nearly seven thousand people in probably 1965 or '66.

Right. Let's call this chart Figure 2, and this is the workforce graph.

So from a few hundreds in the fifties up to maybe two thousand in the fifties at peak activity, with the inception of underground testing beginning in late '61, it went up very dramatically to over six thousand. There were several fluctuations in there. And in the mid-sixties it got up approaching seven thousand. Then dropped off some in the 1970s to the probably three thousand level. And then by the mid-eighties it had climbed back up to between fifty-five hundred and six thousand. And a lot of that can be attributed to other programs at that point in time, like the activity at the Tonopah Test Range.

So we can't look at that and just say REECo at the test site. This is REECo—

That is correct. That is REECo, period. And then by the end of 1995 REECo was down to about two thousand people.

Here's another chart that I'll call Figure 3, your colored chart on employment levels.

Yes.

What happens to people? Are they laid off or is some kind of deal made that they'll be hired back or how does that work?

Well, it's normally layoffs. I need to describe the nature of our workforce, probably. Over the years, probably the majority of, probably generally about 70 percent of our workers were craft **[01:00:00]** union workers that we hired out of the various labor union halls in Las Vegas. We had generally about twenty-four to twenty-eight separate labor agreements with like fourteen to seventeen different labor unions. In the fifties and early sixties, we were signatory to the Las Vegas Area Master Labor Agreements. That's like the agreements that practically all the other Las Vegas construction contractors would be signatory to. Their bargaining unit groups like the Associated General Contractors would have these type of contracts with the unions, we were under that kind of contracts. This didn't work too well at the test site. We were having a lot of jurisdictional disputes between the crafts and that sort of thing, some strife. So in the mid-sixties, we started negotiating separate project labor agreements with each of the unions, and we got out of the Las Vegas Area Master Labor Agreements, by about 1967 when we were strictly under project labor agreements with each of the various labor unions.

So what would be an example of the kind of strife that you'd have at the test site in the old days?

Well, there was a lot of jurisdictional disputes. The carpenters would want a piece of the work we'd assigned to the iron workers, or the laborers would want a piece of the work we had assigned to the operators. So we had quite a bit of that. We had some work stoppages in the early-and-mid-sixties. We got on to the project labor agreements in 1967. After that, we generally had good relationships with the unions. But we did have several periods of strife. In 1970 at contract negotiation time, we had a strike which lasted several months. And then things went along very smoothly until seventeen years later in 1987, we had another strike at contract negotiation time which lasted almost three months.

Would all the unions agree to strike together?

Generally. Now all of our agreements weren't open for negotiation at the same time, but once you get a picket line set up, most union workers will honor that line.

So it wasn't that you were negotiating at the same time but that it was already—

We generally had a number of our agreements open at the same time and we would be negotiating with a number of unions at one time. But once you failed to reach an agreement with one or several, and if they put up a picket line, most of the union workers will not cross it. At least initially. Now as time goes by, some will start crossing the picket line.

And what were the bases for the disputes at this time? Was it wages or—?

It probably varied over time, but the last one in 1987, it wasn't so—wages were an issue, but it was other contract language issues. You know, some unions have their agenda just like we have our agenda. But we did have those periods of strife, but generally we had very good relationships with the various labor leaders and unions.

And when you're saying you went on a, what was the phrase you used, project—

Project labor agreements.

So for each project—

No. For each union, we had a separate agreement. We would not be under the Las Vegas Area Master Labor Agreements. We had what's called project labor agreements which applied only to the Nevada Test Site and Tonopah Test Range, as opposed to the general area.

Got it. So that you can negotiate those contracts to meet your needs.

That's exactly right.

And anticipate possible conflict with that. Great.

Yes. That's correct.

And let me understand organizationally how this works. You're getting your money, you're the contractor for the government. So then do they have any input about the kinds of agreements you're negotiating with the various unions as far as wages or things like that?

We were responsible for negotiating and administering our labor agreement. But naturally we would sit down with the DOE and tell them where we were at and where we planned to go. And they were generally very supportive of us. And in determining where we were going to go on **[01:05:00]** wages and conditions, we would look at, naturally, the local area, what their wage rates were, and we were generally a little lower. And one of the reasons for that, in the construction industry sometimes your jobs downtown would only last a few days, a few weeks, we had lots of employees that worked for thirty years for us without ever leaving, and that includes craft workers. A lot came and went, but we had a lot of workers that made a career at the Nevada Test Site.

I was asking about the wage issue because I can't remember who was talking to me about it but there was something at one point, and it may have been early on, about the high wages that miners were making and whether that was—people talk about in the early days how much the test site was paying miners, but maybe that was because of this kind of thing, it was the temporary nature of it.

It could have been, and I wasn't here during the late fifties. Since you referenced miners specifically, there weren't many miners in the Las Vegas area, you know; there was Teamsters and carpenters, and so we probably brought the initial miners to this area, meaning underground construction workers. But in the early days, at times, there was lots of overtime, so there was considerable overtime pay. Particularly in the early days. But when we had a labor negotiation, we would look at all the local areas and the industry wages and practices in determining where we were going to be.

Also, our workforce was ethnically very diverse.

Now talk about that.

And our minority percentage as a percentage of our workforce was always higher than the Las Vegas area at large.

Was this by design?

Yes, it was.

So talk about how that worked.

Particularly during the 1970s, that was becoming an issue. We had a general manager that was very strong in terms of equal opportunity employment, and that was our policy and that's what we reflected. His name was Ron Kiehn. And we followed that same philosophy throughout the remainder of our contract.

Now would you be drawing from—was there a diverse work pool in the Las Vegas area at that point, would you say?

Yes, and more and more so in the later years. But how we kind of achieved where we thought we needed to be was when we called the union hall for a worker, they would refer who was ever at the top of the list. But once we got this pool of workers, then when it came layoff time or promotion time, then we had some control. So we watched our statistics very well, and it wasn't a quota program, but it was just basically equal opportunity.

OK. Let's pause here.

[01:08:16] End Track 2, Disc 1.

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

We can continue.

So I think we covered kind of the background of REECo and the functions and roles that REECo performed. We covered some of the challenges and innovations in construction and drilling. We covered the REECo workforce. We haven't yet talked about the relationships between the various participants in the testing program.

Let's do that.

Which of course was the DOE and its predecessor agencies. The other federal agencies like the Defense Nuclear Agency [DNA], the Weather Bureau, the U.S. Geological Survey, a number of federal agencies. The national laboratories.

What about Defense? How much was Department of Defense [DoD], or is that a whole other world?

No, that was not a whole other world. They were integrated into this. That's the Defense Nuclear Agency.

OK.

They generally were in charge of performing the weapons effects tests, which were generally conducted in the tunnels.

Talk to me about that a little because I wasn't clued in. Someone said to me the other day, or several people had said to me, We were trying to see the effects of a weapon in space, or something like this, and I just hadn't got—

The weapons effects tests, which were conducted in the tunnels generally, tested the effects of a nuclear explosion on the various military hardware. And those were always very complex, very large. It would normally take several years to prepare a nuclear weapons effects test in a tunnel. [Figure 11] In addition to the excavation, you had very large mechanical installations, large electrical installations, large signal installations. And like I said, it would generally take a couple years to prepare one of these activities.

So generally in the tunnels, you're not testing the device itself. You're testing its effect.

Well, you're testing the device and the effects of the device on military hardware. This would be a picture of the hardware used in a nuclear weapons effects test.

OK, we'll call this [Figure 10].

These are test chambers, very large. This tunnel section is probably thirty-five feet high, thirty feet wide. Very large chambers. Vacuum lines-of-sight pipe. So you can see, it took a lot of construction and technical effort to prepare one of these events for execution. This is the Diamond Sculls test probably of 1972 at T-Tunnel.

Talk to me more about Diamond Sculls because I think someone told me that was maybe the lar—was that one of the largest tests?

Well, large in terms of mechanical installation. It was one of the larger weapons effects tests. One of the larger ones. In terms of the hardware that was installed underground. This is a large test chamber. Very large vacuum system.

So help me understand this better. The military literally puts a piece of equipment in there to see how it's going to affect it, or pieces of what might—how would they figure out—let me back up a little bit, Dale. When you look at a weapons effects test with atmospheric testing, you're seeing the houses and the railroads and the bridges and stuff, but this is different than that.

To some extent. It's what effect that the nuclear detonation would have on certain military hardware. So they install certain portions of this military hardware in these test chambers and other devices underground to determine what the effects of that test will be on that hardware.

OK. So now you're talking about a battlefield situation or even satellites and things like this?

Both. And the Defense Nuclear Agency normally fielded that kind of experiment, as opposed to **[00:05:00]** the more physics-type tests that the national laboratories tested in mostly the drill holes and drill shafts.

But the laboratories were involved in these tests as well?

Absolutely. They had great participation. The laboratories were always responsible for the nuclear end of the business.

So it was just the design of the test might be different if it was for an effects test.

That is correct. That is correct.

Got it. So it could take a long period of time to prepare one of these tunnels, you were saying.

Generally a couple of years. And I think I told you we had excavated some fifteen different complexes. And generally you'd have more than one test in a complex. You'd drive off with various tunnels in various directions.

So you could still use the main tunnel.

You can still use the main line, and sometimes a portion of the test drifts. That's just kind of a picture of the mechanical installation. There were also huge diagnostic cable installations, power installations. And then it had to be contained, so there was stemming and closure systems. They were very exotic, very complex.

So in continuing with this relationship between all the participants, and we just talked about the Defense Nuclear Agency, you had of course the three national laboratories which were the scientific folks that were always directing the technical end of the program. You had the architect engineers and other contractors. There was a lot of participants. And like on the weapons effects tests, other entities would come in and place certain hardware in these experiments. So there was a lot of participants, particularly on the weapons effects tests.

That's interesting. So different branches of the government or something would come in, or the military?

Branches of the government and military contractors. The Lockheeds, folks like that.

Right. And you were saying that there was a good sense of cooperation among them.

Yes, it was very complex and very dynamic and a lot of participants, but I felt generally the cooperation or the teamwork was just outstanding. Everybody knew pretty well over time what their role was and they just went about doing their job. It was a real can-do attitude throughout the entire program over all those years.

So that pretty well covered some of the prepared notes I had.

Great. When you're talking about the relationship with the different people, I think some of the criticism later was, and I don't know enough about this history, that some of the relationships were too close. But it sounds like from what you're saying that that was needed in order to get the things done.

Absolutely needed. You had to have face-to-face communications every day to get this job done because it was so dynamic and things were changing and moving so fast that you really had to have that kind of interfaces.

When you're working and moving up through the organization, what's it like for you personally? Do you feel a lot of stress, pressure, excitement, all of the above, or just as a career, what—?

Well, it was very dynamic and challenging, so there was some pressures at times, but overall it was very enjoyable. It was very rewarding because you could see things being accomplished that you thought needed to be accomplished.

And now I'm just going to ask you some random questions, because I wanted to ask you about mishaps and accidents and things like this. So when did you come in relation to Baneberry? Because you said you came in '70.

I came in March of 1970. I was assistant division manager for the Operations and Maintenance Division, which did all the construction and equipment maintenance and facility maintenance **[00:10:00]** and test support and all that. So I was assistant division manager when Baneberry occurred, which was December of 1970. So I was based in Mercury at that time.

And what was that event like from your perspective?

Well, it was pretty much a standard kind of drill shaft emplaced test that apparently was done in some geologic media that wasn't very good, and you had prompt massive venting.

Did you see the venting from the test site?

Oh yes. I was in Mercury at the time, so we could see at least some of it.

How did you get notice of it? Was it from seeing it or did someone call you and say—?

Oh, everybody knew immediately what had happened because you know when there's a test being conducted.

Oh sure.

But it changed quite a lot of the procedures for conducting a test. Prior to that, most of the time activities, except for in the surrounding area of a test, might go on pretty much as usual during a test, with the exception of a certain perimeter around the test. But after Baneberry, the whole forward area of the test site was always evacuated prior to a test.

Oh really. So people came back to—except for—

To Mercury, yes. Or you would have them report later in the day or something to Mercury. But prior to Baneberry, activities, with the exception of that perimeter area around the test, were conducted pretty much as usual, except that prior to the event you'd make sure that people weren't up on the towers or buildings or something. Other than that, business went on pretty much as usual. But after Baneberry, it was pretty much that the forward area of the test site was evacuated before the test and for some period after the test until things were stabilized and well-known.

And what other kinds of, I don't want to say accidents but unexpected things do you recall happening?

Well, over those years there was a lot of unexpected things, none of them quite as dynamic as Baneberry but with that large workforce with all those activities, we did have some fatalities, industrial-type, because we were doing a lot of fairly hazardous work, heavy construction, mining, drilling, so we did have some fatalities. But really, most of our fatalities came in vehicle accidents because our workforce was very mobile and people were moving every day and a lot of times in bad weather conditions and stuff like that. We had quite a few fatalities in vehicle accidents, as well as some construction kinds of fatalities. Overall we had a very good safety record and program, but with that kind of work you will have some accidents which are very serious.

I mean it seems to me with the heavy equipment and you're going underground and just—

Oh yes, it's a hazardous business under the best of conditions.

Did you have some other notes you wanted to—?

No, this just kind of followed my notes and I think we talked about most of the things that I'd kind of made notes on.

Talk to me a little bit about how the environmental restoration activities come on board. You said in the eighties, I guess?

Well, as I recall, particularly in the late eighties or early nineties the need for cleaning up some of these areas was recognized. So these areas would be surveyed radiologically and for other factors, and then the DOE would decide what they wanted to clean up and to what extent, and we would go about the business of cleaning them up and restoring them as cleanly as we possibly could. And there were quite a number of those projects.

Did you have to hire different kinds of people to do that or did your—?

No, because the people we normally had working for us were very familiar with that kind of **[00:15:00]** environment. Health physicists, industrial hygienists, engineers that knew a lot about this sort of thing. So no, there might've been times when we had some specialty kind of subcontractors, but generally we could do most of it ourselves.

And what's so striking to me to hear you talking about REECo is the scale of the operations of what you all were doing and very complicated technical—

It was very broad and it was supporting a lot of participants in a lot of different functions. But over time, everybody got very good at it.

So I'm wondering if as you reflect on this, you've said things about the can-do attitude, but if there are things that you think people may not know about what REECo did at the test site or what the test site did that really stands out to you as you look back, although you've expressed a lot of that through what you've just told me.

I'm sure there are a lot of things if I thought about it, but it was just being able to actually gear up and get ahead of a very dynamic program. Anticipate. And that's the kind of thing that dictated the close teamwork with all the other participants. We were doing what the scientific laboratory people needed done, so you had the architect engineer involved, us, the Department of Energy, other federal agencies, and it was just a complex, dynamic situation. And you had to be on your toes to kind of stay up to speed on it.

And do the people generally—because it's work in the service of this science that's really cutting-edge science, did you feel—what was the relationship with—the people that you're working with, the REECo people, with the physicists? What was that like?

Well, at some levels, of course, we didn't have much to do with the actual theoretical physicists at Los Alamos, Sandia, or Livermore but they had a lot of their technical people onsite and we would work hand-in-hand with those folks. Naturally we got to know the test directors very well and what they wanted and needed.

Who were some of the test directors that you worked with?

One was just here a few minutes ago, named Joe [Joseph] Behne.

Oh yes, I have met Joe.

He was a Livermore test director in later years. When I was managing the support to the Livermore lab, there was Fred Beane, Phil Coyle. Phil is now a very high government official in the Department of Defense. Dr. Charles Williams. You may have heard his name. He later became a deputy manager here at NVOO, but when I met him he was a captain or a major in the military but assigned to the Lawrence Livermore lab. He was one of the early test directors who went on to become the deputy manager here at DOE/NVOO and then went to Idaho Falls as the DOE manager there. Tom Scolman from Los Alamos National Lab. Bob [Robert] Campbell from Los Alamos National Lab.

What was Campbell like? I'm asking for a particular reason. I interviewed him and I just was reviewing that transcript to give to John Hopkins up at Los Alamos to give to his daughter, so he's on my mind.

I knew Bob Campbell very well. He was a hands-on guy. Didn't say a lot but meant what he said. And I thought he was just a tremendous leader. No-nonsense guy.

That's what the interview was like, too, no nonsense. He was there for a long time as test director.

Yes, he was. He was an old-timer in the program.

So maybe we can look through a few more of these pictures—

Sure, and I have some others that I'll—I'm going to touch this write-up up a little bit and then I'll go through and see if I got any other pictures that you might be interested in, as well.

This is great. You did me this great overview.

You've seen that, the manpower charts. Some of the drill rig—one thing I might not have **[00:20:00]** touched on in the—

Wow, look at this. This is [Figure 6]. OK.

In the early days of shaft drilling, 1961, ’62, ’63, when I told you we’d have [as] many as thirty-plus drill rigs drilling these emplacement holes, they were what we could get out of the oil field at the time. And each time, for each hole, you’d have to assemble that drill rig. When you finished, you’d disassemble it and haul it to another location. We eventually developed a rig transporter system where we would jack the rig up, put beams through it, load on these tractor-type carriers, and pull it with bulldozers. So this picture’s actually up on Pahute Mesa where we were moving the Emsco 3000. So it saves a lot of time and money not having to assemble and disassemble a drill rig every time you want to move it.

Amazing. And again you have the person there to get the scale of this thing. That’s a good one. Great.

So instead of taking days or weeks to disassemble, move, and reassemble, with the rig transporter system you’d finish drilling a hole and a day or two later you could be drilling on another hole.

This is an administrative question. When you realize that you want to be able to do this, this is also and it’s generally under the monies that you’re getting from the government, if you have a new, innovative program that you want to do that is going to cause expenditures that you hadn’t originally—how do you do that with the government?

Well, there was continuous communication with our counterparts in the DOE and the laboratories. And when we’d express our needs or they would express their needs, we would have capital equipment budgets and in working with them, we’d decide how we were going to spend that money.

So you would do it within the budget, the capital budget you had.

Yes. Or if we had to build something, it would probably be in an operating budget. But we worked so closely with them that pretty well everybody knew what everybody else was doing and why. And we had good financial accountability, very good financial accountability.

Tell me more about that.

Well, we had budgets as high as five hundred million [dollars] a year, REECo did, like in the mid-eighties, and we could account for all that money very well. And DOE provided a lot of oversight, naturally, to all of our activities, financial and otherwise. And there were continuous meetings. The system just evolved to work well and we worked these things together.

So what you're saying, and you've said it many times, is there's a real dynamism to the organization itself.

That's correct.

I'm going on through these. You've already spotted that one.

Right. And that one.

That one. That one.

We got most of them, I guess.

Yeah. I had some others. I'm sure I've still got them. Again, that's a typical ground zero area, probably in the late 1980s, early nineties.

That's Figure 17. OK, we've got that one.

"Contact."

Got that one. We've got most of these. These are great. That's the same as the other one, Contact.

Yes. That's the Flax event at U2[d]j in 1973 [12/1972].

This is a good one. What's this? This is Contact again.

That appears to be a picture at the point of being ready to start down hole, the marriage is complete. And you can see one of the most impressive things here is the number of cables that we're talking about here, which is probably a couple of hundred diagnostic cables which would go down hole.

So we'll call this Figure 18. And when you say "marry," these are the two different canisters here?

This is the diagnostic canister—

On top.

And this is the device canister.

To the device.

Again, this is Contact.

I'm going to call that Figure 19.

So as you can see from those cables, there's a lot of channels of data coming back up.

Absolutely.

[00:25:00] That tower there is 125 feet or a little more. But it's very similar in nature to these.

And what's this?

[Inserted photos 20 and 21: Loading Cardwell KB-500 drill onto USAF C5-B cargo transport]

This is a tunnel-boring machine that was used at Yucca Mountain.

We'll call that Figure 22. So that machine, that's the front and it goes in—

Yes. Twenty-five foot in diameter. Now we bought the machine, REECo bought the machine, but we hired Kiewit to do the tunnel-driving there, and TRW wound up inheriting that contract.

That's about all the pictures I have with me, Mary.

But that's great, though, because what this does is give us a good overview of some of this equipment with your explanation, because I've seen some of these pictures and not have real good explanations for them. Not these specific pictures. Pictures like them

Great. So I don't think I have anything else. You've given me a really nice overview. Is there anything else? Well, I guess the one other question I had. What brought you back to the test site? Were you asked to come back at that time?

Yes. In 1969 I was on a water tunnel project in southern California. And there'd been a big reorganization at REECo, so I'd gotten a call, so I came up and interviewed, and decided I'd like to come back to Nevada, so I did.

Had you left because you were unhappy here or were you just—?

No, I just was young and wanted to do some other things. And I don't regret that.

And then what about family life? People talk about how intense that work was. I don't know anything about—

It took a lot of hours at the test site by the time you travel and put in a long day and come home. I'm sure it was very hard on home life for a lot of people.

That's what they say. Just the distances.

Just the distances, yes. And sometimes there was a lot of overtime and sometimes you'd have to work ten, twelve hours a day, sometimes seven days a week, so that does get very difficult.

Well, I think you've given me a lot of really great information, unless there's something else you can think of that you want to talk about.

I can't think of much else right now.

Great. All right, then we can stop.

OK.

[00:27:48] End Track 2, Disc 2.

[End of interview]