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Los Angeles Department of Water and Power

POWER SYSTEM ORAL HISTORY PROJECT

POWER RESOURCE MANAGEMENT:

AN INTERVIEW WITH LAWRENCE SCHNEIDER

Interviewed by Thomas Connors

The Bancroft Group

Dates: October 23 and 30, 1989, November 21, 1989

and January 23 and 31, 1990

CONTENTS

BIOGRAPHICAL SUMMARY

BORN: May 4, 1912

EDUCATION: BA, Civil Engineering, UCLA and Berkeley, 1934

CAREER:

1935	Hired by LADWP, Transmission Line Engineer, Boulder Transmission Line
1939	Supervisor of saggers on Third Boulder Transmission Line
1941-49	Associate Engineer, Power Design & Construction Division
1950-59	Cost Engineer, Power Design & Construction Division
1960-63	Executive, then Senior Engineer, Cost Control, Power Design & Construction Division
1964-66	Staff Engineer, Power Resources Section, Power Executive Office
1967-69	Pacific Intertie Project Manager
1970-71	Navajo Transmission Line Project Manager
1971	Project manager for rebuilding of the Sylmar Converter Station after the Sylmar Earthquake
1972	Engineer of Construction, Power Design & Construction Division
1973-75	Assistant Engineer of Design & Construction
1975-77	Engineer of Design & Construction
June 1, 1977	Retires after more than 40 years with LADWP
MEMBERSHIPS:	American Society of Civil Engineers, Electric Club of Greater Los Angeles

TAPE NUMBER: 1, Side A

October 23, 1989

TC: Let's start by talking about your background. Where and when were you born?

LS: I was born in Chicago, Illinois, and came to Los Angeles when I was two months old. I have lived in Los Angeles legally now for over seventy-seven years. And all my schooling was here in Los Angeles, except that I graduated from the University of California at Berkeley.

TC: Let's go back a little bit here. So you would have been born in, say, 1912?

LS: I was born in 1912, yes.

TC: So your parents moved out here, obviously, when you were young, a couple of months old.

LS: Yes, I was two months old.

TC: And what brought your parents here?

LS: Well, my mother at the time got a very bad bronchial cold and our doctor recommended that we go to southern California. So my dad, who was a tailor, uprooted us--I also had a brother who was three years old--and we came here to Los Angeles.

TC: And then he opened up a tailor shop here?

LS: A tailor shop here, yes, in downtown L. A.

TC: And did he stay with that sort of work throughout?

LS: He had his own shop, and at the early age of about fifty years he retired and dabbled in real estate.

TC: So your education prior to college was Los Angeles public schools, then.

LS: Yes, I went to public schools here in Los Angeles. I started, actually, at Alpine and Figueroa in a grammar school. I went to three grammar schools. We moved towards the south of L. A. so I wound up at John Muir Junior High and then Fremont High School.

TC: Where did you live then? You said you moved. When your parents first came here . . .

LS: I had originally lived practically in the shadows of the Water and Power Building. I lived at Alpine and Beaudry. And then I lived at Angelina, just west of Beaudry, which is very close to the Water and Power Building. Then we moved out to 53rd and Hoover Street and then later moved out to 72nd and Broadway.

TC: What were the neighborhoods like in those days over there? I know that they've changed considerably.

LS: When we moved out to 52nd, the big thing there was the Goodyear Tire and Rubber Company, the big factory. We didn't have too many factories. But just south of there, we had a lot of truck gardens, carrots, cauliflower and things like that were grown. There weren't any storm drains and so the streets, when it rained, were pretty well flooded. If you went out to 72nd, across the street were truck gardens. So everything was building right in front of us, just like today if you go to the outlying areas, like Canyon Country and such.

TC: Yes.

LS: I experienced the same thing. Tract homes and things like that.

TC: What about the courses you took in, say, junior high and high school? Were you in a program that would encourage you towards engineering?

LS: Yes, I was taking courses that would get me toward engineering. In junior high, I had electric shop and I also had all the mathematics you could have. So I paid particular attention to the technical part of mathematics, and I had all the shops. I had electric shop, carpentry shop, automotive shop. They were very good in those days.

TC: Yes.

LS: And we knew about automobiles. Where today kids just know how to drive them, we knew how to take them apart. But in those days, you could work on a car with a monkey wrench and a screwdriver.

TC: Yes, sure. You need a computer now. Just growing up in Los Angeles, and I've spoken to people about the old days in L. A. and you get different kind of . . . I suppose you could call it a folklore, you know.

LS: Yes.

TC: Different names crop up and I'm wondering if, in your childhood, the names like, for instance, General [Harrison Gray] Otis of the [Los Angeles] Times was a name that comes up. He would have been long dead by the time you were

becoming aware of things, but did you hear his name, say, or the name of Harry Chandler? Were you told about the Times bombing in 1910?

LS: Oh, yes. I was told all about that and read about it. I also went by all those buildings. I lived downtown and as a kid I'd walk by all these areas; it was just a matter of ten to twelve blocks from where I lived. I saw the old Times building that was bombed and then they moved and then the building of the new Times-Mirror [Building] which eventually took over the whole square.

TC: Yes.

LS: But you'd hear about General Otis and Harry Chandler because they were names to be reckoned with in the history of that era of Los Angeles.

TC: The other story that comes up is about the transportation system, the good old red cars.

LS: Yes, the red car system served the various towns, and there was green space between them. But the red cars, you had the Venice Shortline. Venice Beach at one time was very popular, so a red car went out there and had it's own right of way. Then you picked up such towns as . . . Well, you could go to Pasadena, you could go all the way to San Bernardino. And then you would go out to San Pedro. They were building the harbor while I was a kid and so you had the red car that went out to San Pedro. But there was a lot of space in between, which was a good thing. We had what you call greenbelts. And

then Long Beach became a popular resort. The SP [Southern Pacific], I think, owned the Pacific Electric and owned a lot of Redondo Beach. In those days, there were big saltwater swimming pools, which were quite popular, and there were dance halls, which you don't see today. It's quite different. You probably had the same back east, but in those days Los Angeles started to emulate a big city.

TC: That's right. I guess, in the period when you were growing up and becoming aware of things, that's exactly when Los Angeles started to begin to recognize itself as a city or as something that had a future as a large city.

LS: Yes.

TC: What would the red cars have cost to travel on?

LS: Probably about ten cents was all it was. You can't discount the yellow cars, too. The inner city had the yellow cars. We had the cars where the center part was closed off when it became cold, but the outside was open and they had seats that sat sideways and things of that nature.

TC: So the yellow car would just, say, come out along here?

LS: Out to the city limits at that time. They would come out to as far as Western [Avenue], then the limits would be extended, like to Pico [Boulevard] here or to Rimpau [Boulevard].

TC: Yes.

LS: I'm talking more familiarly about the west side because, after moving south, I then moved west. I lived by Rimpau and Adams and I now live on Shenandoah and Airdrome, and I'm very

familiar with the west and south part of Los Angeles. But you had the yellow cars that went out to Boyle Heights and Eagle Rock; in the south, they went as far as Manchester. And then they even had a little dinky that would go to what we called "Athens on the hill." So, actually, we had a very good transportation system.

TC: The period of the beginning of the decline of the electric cars was when?

LS: About 1939.

TC: The last one ran in the sixties sometime, I think.

LS: But the decline started about 1939. You could say they hit their peak and then they started their decline. Water and Power had a building at Fourth and Hill and down the block was what they called the Subway Terminal Building. And when I was working in the Water and Power Building I was exposed to the red cars which came out of the Subway Terminal Building. The red car also had another terminal building on Main Street and that would go out to San Bernardino and Long Beach.

The red cars were owned by the Southern Pacific Railroad, so they were the full gauge cars, you know. Actually, they were railroad cars, as opposed to the yellow cars which were narrow gauge. The standard railroad gauge was four feet, eight and one-half inches width and the PE was really a full car.

TC: Did they generate their own electric or did they buy that from the Department or the Bureau [of Power and Light]?

LS: Well, originally, in L. A. you had the Los Angeles Gas and Electric [Company], which eventually was taken over by the Department of Water and Power, so they might have bought it from there. But being direct current [lines], they would buy the electricity and they had stations at strategic points, at which they then motor generated it to direct current. They were direct current lines and they would have to have stations point to point for voltage control. I don't know whether they could have generated a little, but it wouldn't be any large extent.

TC: The other area that Angelinos and the old-timers from this area talk about is the air quality in the old days. I'm just wondering, was it significantly less smoggy in those days?

LS: Oh, very significantly. Actually, it was in 1939 that I felt my first eye sting and smog.

TC: Really?

LS: But they began polymerizing the gasolines about 1939, which really made quite a difference . . .

TC: What was the difference? They polymerized . . . ?

LS: Polymerized the gasoline. By which they could then extract more of the gasoline fuel out of the oil than in their original process. It didn't have that chemical chain of natural gasoline.

TC: And that created more smog?

LS: I think it added to it to a degree, yes. Because it probably was less stable. Or it was the type that probably would not dissipate through the air.

TC: Yes. Now, as a kid, you must have known of the Department, or at the time, the Bureau of Water Works and Supply and the Bureau of Power [and Light]. What was its stature in your boyhood memories?

LS: Well, I was very intrigued with it and sent for literature, even, while I was in high school and wrote different articles on it.

TC: Oh, no kidding?

LS: In order to get funds, you know, they had bond issues time and time again.

TC: Yes.

LS: So we became quite aware of Water and Power. And then in 1928, of course, when they lost the St. Francis Dam in San Francisquito [Canyon], they had to control water usage, so that was very significant and was called to our personal attention. Then also, the trolley cars, instead of stopping every other block, in order to conserve electricity, would then change the stop to about every four blocks. So you became very well aware of the disaster. We used the streetcars quite often. We didn't have the automobiles like they have today. If we wanted to go downtown, we went by the streetcar.

TC: Yes.

LS: So we were very familiar with the use of electricity. These were trolley cars, you know, and they had overhead trolleys.

TC: They would have had engineers and conductors?

LS: They had what they called the motorman and then the conductor. And you had a change box. The yellow car was only a nickel in the early days. You entered in the back and you put your money in the change box and the conductor would see to it that you did that. If you went any longer distance, you would probably have a ticket indicating that you paid more. Also, you could transfer to the cross-town streetcars, so you were issued transfers, and the conductor, naturally, would handle that. With the red car, of course, he would walk up and down the cars. You would have several cars attached to one another. If you went to Venice, you could have three cars that were coupled together, as opposed to the city cars that only had, as a rule, the single ones.

TC: Did you ever get out to San Francisquito when the dam was up and operating?

LS: Yes, in 1928 I was a Boy Scout, and we had a trip to San Francisquito Canyon. We went to Power Plant [Number] 2 up in San Francisquito Canyon, and the dam was still there. That was just before it was washed away, and so I got to see the San Francisquito Dam; and the power plant was the first hydro plant I ever saw.

TC: In that dam disaster, a lot of the blame was put on [William] Mulholland's engineering, his design. Would you say that

that's a fair assessment, that there was a mistake in construction?

LS: A fair assessment that probably the engineering techniques of the day were not as good as they should have been, because the foundation material, which included mica schist, was not suitable for a concrete dam. The foundation and abutment material were very poor and so the selection of the location and the type of dam was definitely inferior. So those connected with it either didn't develop the technique or the information wasn't that plentiful at the time. It was shortly thereafter that the state formed a section that inspected and approved the plans of all dams. But in due respect for the Water System, they did go on to develop some of the best techniques of making earth-filled dams, to wit, you had Ralph E. Proctor, an engineer for the Water System who developed the Proctor needle, where they developed how to test the material as earth-filled dams were compacted and built up.

TC: Yes, I've heard of that Proctor needle.

LS: Yes, the Proctor needle, which is just a device, a rod with a spring device. As you force it down through the material, you could tell the degree of compaction. And then they also extracted cores which you could take to the laboratory where you could then use instrumentation to test the compaction and also the granular consistency of the material. They also developed the sheep's-foot tamper technique of compacting. And moisture control is also very important to the formation

of the dam, as is having sand and filter systems, so if you had any leakage, they would conduct it past the dam.

TC: As a power engineer, how did you learn so much about dam building and water engineering?

LS: I went on to be a civil engineer and part of my education included dams. The first job I had was on a dam failure in the San Gabriel Canyon, in which the contractor blew up the abutments and the dam was never built. It was designed as a concrete dam, and so the County settled a million dollars or so for that particular incident. After I graduated, my first job included working with the lawsuit that the County then instigated to recover their money from the contractor, and so I went on to study a lot of things about dams.

TC: That's interesting. You went to Berkeley. That's where you got your civil engineering degree, right?

LS: I got a B. S. degree, yes.

TC: So you would have graduated in 1934 or so?

LS: In 1934, yes. I started at UCLA [University of California, Los Angeles] and went two years, but they only had pre-engineering courses. So I took two years at UCLA when they first moved out to Westwood, and then I went on to Berkeley in 1932. I was there in 1933 when the big earthquake, the Long Beach earthquake, hit Los Angeles. My family was here but I was up at Berkeley at the time. That was the one earthquake that I missed out of seventy-seven years.

TC: Was there a great deal of damage in that one?

LS: Oh, yes, there was a lot of damage because most of the masonry buildings were un-reinforced. In fact, my folks lived on the second story in a wood-frame building. There was a certain amount of damage, but across the street brick buildings and storefronts and corners were torn out. The high school I went to, Fremont High School, sustained extensive damage, but it was repaired. It was shortly thereafter that the state passed a provision in the code by which schools had to design for earthquake forces and also certain minimum reinforcing.

TC: When you went to UCLA then, you took your basic curriculum, I suppose, of college math courses and whatever you could take towards engineering?

LS: All engineering. If you took a pre-engineering course, you took all mathematics. You were mixed with math majors and then you had physics and chemistry. In fact, in my class was [Glenn] Seaborg who went on to be the Chairman of the Atomic Energy Commission. There were a number of students that went on into nuclear physics, which developed nuclear energy and the bomb.

TC: In your class, the UCLA class or the Berkeley class?

LS: Yes, at UCLA.

TC: Then he went on to Berkeley.

LS: Then he went on to Berkeley, yes.

TC: Oh, no kidding.

LS: But, you see, at that time there was [Ernest O.] Lawrence, and he was one of the foremost with regard to the cyclotron.

TC: Yes.

LS: I was there when Lawrence was doing a lot of his research. And then he had [Robert] Oppenheimer, who was a graduate student at the time, so a lot of that technique was being developed at the time I was there. Of course, when I went on to Berkeley, then I went on to more specialized courses. I had my surveying at UCLA and at Berkeley I specialized in civil engineering, which is more than they do today. Today, as a rule, you have more general engineering. Then we had highly specialized courses, including structural courses. Oh, we had a minimum of electrical. As I look back, I mixed with a lot of students from universities all over the United States, and I would say for a civil engineering course, Berkeley had a very good course, which would be comparable to what they had in Michigan and Wisconsin. They brought in professors from Michigan and Wisconsin who were giants in their field. They had Raymond E. Davis in concrete, one of the foremost in concrete. Surveying, they had a textbook in surveying. Davis, [Francis S.] Foot and [William H.] Rayner, and as I look back, it was quite an education.

TC: Yes, some of the top names.

LS: Yes.

TC: I guess they were wooing these guys out here to beef up these programs.

LS: Oh, yes. As you're going to see, the University of California went on to get Nobel Prize winners. And today, Stanford

really woos the east. And when you say "woo" you have to take from the whole United States. I remember when I was at UCLA, when they finally brought Einstein out of Europe and he was on a lecture tour, I was able to see him at UCLA at one of his lectures.

TC: No, kidding? You saw Einstein speak?

LS: Oh, yes.

TC: Was the lecture in German and translated?

LS: Yes, in German and, I guess, they translated it. I knew a little German. At the time, they filled the auditorium.

TC: Did you know the German from home?

LS: No, from taking it. A little at home, but mostly from courses at high school. I didn't take any language at the university. It was not required at these universities.

TC: So when you graduated in, say, 1934, what other jobs did you have prior to coming to DWP? You mentioned this civil engineering job and the lawsuit involved in the San Gabriel Dam.

LS: The San Gabriel Dam. Yes, that was the only job I had prior to that.

TC: Who was that for? Who hired you? Was it the County?

LS: Oh, I worked for a consulting engineer who was attached to a lawyer and the County Council. He was an old-timer and had quite a reputation--his name was Finkelstein. He was an expert on dams and having worked on dams, the original

Arrowhead Lake dams and Big Bear Lake dams and a number of other dams in California.

TC: Oh, really.

LS: And the man might have been around seventy-five years of age or more when I was hired. I got the job really because my dad became acquainted with his son and referred me to him. At the time, he had an office in Burbank.

TAPE NUMBER: 1, Side B

October 23, 1989

TC: Tell me about what Westwood was like when you first went out there. How many buildings were up? I suppose Royce Hall and the Apollo Library were there on the quad.

LS: Yes, we had four buildings. We had Royce Hall, the library and a chemistry building and a general education building. We had no gymnasium and we had a temporary wooden building. Later on, we had a little mechanical building where I had drafting. And Westwood Boulevard went through the campus and I could park my car all day long on Westwood Boulevard. I didn't have to worry about paying parking fees or paying a parking garage.

TC: How about the Village at the time? Was there much to it?

LS: The Village, that was a real estate development. It was Janss [Investment] Corporation, and the buildings were white with tile roofs. It was beautiful. And Janss or his son had a drugstore there. And there was a Ralph's Market and several other buildings. There was only about a dozen buildings at the time, but the streets were nicely laid out. It was a very rich subdivision.

TC: Was it a commuter campus more than a residential campus?

LS: Yes, at the beginning, more or less commuter. I commuted all the way across town, which was quite a burden on me. I used to go on streetcars. I went on three streetcars and a bus

when I first started UCLA; it was quite a chore to get there. And then finally I got an automobile after a year and I would drive all the way from 72nd and Broadway over to UCLA. And you had a few fraternity houses and sorority houses and they developed more and more. I didn't know of any resident halls or too many apartments. Today, I have two granddaughters living in apartment houses adjoining the campus. Of course, my son went to UCLA and he lived part-time in a fraternity house. My daughter-in-law went to UCLA and she lived just, maybe, one year in a sorority house, which was all new to me. I was never exposed to that sort of living.

TC: When you went to Berkeley, what were your living circumstances there? Was it a dormitory or apartment?

LS: I lived in an apartment. In those days, you had old homes that were being taken over for living. I knew a woman whose son was in my class. They had moved up to Berkeley for him to finish at Berkeley. She took over, rented a two-story home, and so I had one room together with a roommate. I lived first on Derby Avenue and then later on College Avenue. It was a tremendous experience. We used to go outdoor swimming up at Strawberry Creek. They had unheated [swimming] pools, which they don't have today. Of course, Berkeley at that time didn't have all those buildings either.

TC: Yes, that's true.

LS: Berkeley campus living was not a bus stop like UCLA. It was altogether different and probably like you have back east in

the older schools. If you went to those schools, you were expected to live on campus or nearby.

TC: Yes. When you got out and you started working for Mr. Finkelstein, at the time, the Depression was still going on. You must have had a couple of thoughts there as you were getting ready to graduate as to where you would be working.

LS: It was very difficult to get jobs. My roommate went on to work for the Metropolitan Aqueduct [Metropolitan Water District Aqueduct], one of the very few big projects. Well, they were building the Golden Gate Bridge up north and the [Oakland] Bay Bridge, and the big project down here was the Metropolitan Aqueduct. So I tried hard to get on that and I wasn't selected.

TC: Was that a testing process that they did or was it just an application kind of process where they would select you?

LS: Yes, they had a written application and then an oral interview. So they made certain selections. I don't know what process they used.

TC: Yes.

LS: As I was working and doing library research at the main library downtown, I saw a civil service bulletin for structural draftsmen. And it was for that that I applied and took the examination. I was hired by the Department as a structural draftsman.

TC: Who was your immediate supervisor? And was that in the Design and Construction Department?

LS: Yes, I went to work for Design and Construction Division. They wanted young people to go out on the Boulder Transmission Line and be what we call saggers. They would actually have to climb steel towers. So Alfio Bissiri was my immediate boss in the Design and Construction Division of the Power System, and [Charles P.] Garman was head of the Design Section at the time. Alfio Bissiri is still alive. Let's see, he would be, I imagine, about eighty-seven years old by now.

TC: No kidding.

LS: I have seen him from time to time. He has little luncheon meetings with some of us people. He was an electrical engineer and was responsible for the location of the towers and the selecting of the conductor hardware. [William S.] Peterson was the transmission engineer at that time.

TC: Okay, yes.

LS: William S. Peterson, who went on to become General Manager.

TC: Yes. So you had to go out to the desert and live out there as a sagger?

LS: Yes. Let's see, in May of 1935, after spending two weeks in the office in a building on Hill Street in the Second Street-Broadway complex, I was taken out to a camp which they called Jean, Nevada, which was just across the state line in Nevada next to the dry lake, not too far from where Whiskey Pete's Casino is today.

TC: Oh, yes, right. I've seen that, yes.

LS: We had three other men, a team of four men, which would do the field calculations. We had to do all the calculations right there in the field. We used the sag method of setting the conductor for tension at the particular temperature.

TC: What was the sag method?

LS: Well, actually, what we did, we had the measurement from the cross-arms down and then we would use a surveyor's level and site the low point of sag.

TC: Okay.

LS: By calculation of the tension that was required, we would then have the workmen affix the wire. They were strung on shivs, or pulleys, if you will, specially manufactured for the HH conductor, and when you pull the conductor up a slope of ground, the suspending chains to the shivs would be plumb to the slope of the ground. But when you then transfer it to the insulators, which were some eleven or twelve feet in length, you had to position them in such a way that they would become plumb at the particular temperature. So all that had to be calculated and the information given to the field constructors, the linemen or tower line mechanics, as they were called.

TC: Yes.

LS: And we would do all the calculations and then actually climb the tower, set our surveyors level at that elevation, and then the wire was pulled into place. We would have field telephones. They weren't walkie-talkies in those days--we had

to have a conductor connecting the phones. We would go up a tower with the wire attached to us and we would speak to the mechanics at the pulling ends. Also, there were saggers in a mile pull, which we would coordinate so that we had two spans out of five in which we set the tension, the other three would assume correct positions.

TC: What is the general route of the transmission line? It comes out from Boulder, then it goes, I guess, due west directly or maybe a little bit northwest to Whiskey Pete's.

LS: It goes due west and crosses the highway just east of Whiskey Pete's. You can see it today, just east of Whiskey Pete's, and then it goes along and then heads west and crosses the highway just east of the agriculture inspection station near Yermo [east of Barstow].

TC: Before Barstow, yes.

LS: We had four or five camps working at the time and we were working from east to west on the first two Boulder lines. There are three Boulder lines, but we were doing two Boulder lines at the time, each single circuit.

TC: Okay.

LS: So, if you followed the Boulder lines--and now you have a DC line in the third Boulder line, so the Department has four tower lines that parallel each other--all four lines cross Highway 15 at or near the state line. Then they cross again at Yermo and they go to Victorville. And the two original Boulder lines then went through Cajon Pass, parallel to the

Pass, then along the foothills in a more or less northwesterly direction until eventually you wound up at 96th and Central Avenue in Los Angeles.

TC: And that was a big receiving station there?

LS: Yes, Receiving Station "B."

TC: Oh, Receiving Station "B," okay.

LS: Yes. It was the terminal of Boulders 1 and 2. The third line was built in 1939.

TC: Yes.

LS: And this line went to Victorville and then turned along the northern side of the San Bernardino Mountains, crossing them through Little Tujunga Canyon, winding up at Receiving Station "E" [RSE], which is near the Valley Steam Plant. Receiving Station "E" is the terminal for the third Boulder transmission line.

TC: Yes, the Valley Steam Plant, right, okay.

LS: Well, it's a little further than the Valley Steam Plant. You go a little further south-southwest, but RSE was the terminal. In those days of RSE, the San Fernando Valley was mostly agriculture. There weren't that many homes in the valley.

TC: How long did it take from the beginning of the transmission line construction to its final . . . ? I guess it was 1936 that it was completed.

LS: In 1936 it went into operation.

TC: So that would have been about a year?

LS: Probably footing construction was in 1932 or 1933. In those days, construction workers didn't have all these recreational vehicles or mobile homes, so they erected these camps at strategic locations, about twenty miles apart or so. So you started at Boulder, then you had the Jean Camp, Kingston, and then Harvard and Victorville. So you set up about twenty bunk tents, which had wooden floors and wooden bottoms, and then at wainscot high you had screen, and then you had the canvas flaps which would pull down in the wintertime, with a pot-belly oil stove. They had to develop their own drinking water. Each camp had a water well.

TC: Oh, really.

LS: Each camp had a water tank on a wooden tower. So, actually, the setup was like you have in the military. We had motor generator sets for our electricity, our own drinking water, we had a mess hall and a kitchen, and our bath houses all separate. The construction engineers did a very good job in those days.

TC: Well, there must have been an army of men out there.

LS: Well, you see, you had tower footings--they had specialized crews--and then you went to tower construction and then to stringing. Besides the conductor, you have overhead ground wires, which are half-inch strands of steel wire, for lightning arrestors. Having two lines, we only did a mile a day of stringing.

TC: That's what I was wondering.

LS: Today, you can maybe do three miles, or more. You didn't use the cranes like you do today, where you could hoist tower sub-assemblies up. Today you can preassemble towers and raise them up by crane. In those days, for tower erection we used a gin pole with pulley hoists. The digging equipment was developed special for the job. You had various types of augurs for ground or rock sites. The footings for Boulder Lines 1 and 2 were bell-shaped on the bottom, and a lot of the belling was done by hand. We lowered men into the hole, and by pick and shovel they excavated the base of these footings.

TC: How deep?

LS: Well, they could be about seven to nine foot deep, depending on the foundation material.

TC: Yes.

LS: You had to provide for uplift, for loads that come on the tower footings, so that the tower doesn't blow over or pull over from wind or tension from the conductors on the tower frames.

TC: Yes.

LS: The soils vary from sand, caliche and rock. Dynamite was used where required. The lines went through hills and valleys. Miners used mining techniques, including blasting. Of course, we wouldn't want holes that were fragmented, so the technique used for footings was pretty well tried and true. They had full-scale testing equipment, where they would cast a test

footing and then try to pull it out of the ground at designed loads. The engineering techniques were the best for the state of the art.

TC: Was Peterson on the site, usually? Or would he show up to oversee things?

LS: Just from time to time. He was primarily in the electrical part, not the structural. Mr. Lankovsky was the structural engineer, and a civil engineer, Mr. Butterfield. We had specialists in those days and they would visit from the city of L. A. But the civil would have a representative, a young man who would be trained in how the footing should look, and give his okay as to whether it was deep enough and done according to the plans and specifications. Concrete inspectors were on the job for all footings. For tower steel, there was a field engineer to see that the towers were erected properly, that it was vertical and not distorted with built-in extra strains. The engineering technique, testing and inspection methods were excellent.

TC: Well, there was nothing like it to compare it to. Isn't that true?

LS: Well, there were others. The Southern California Edison Company had developed certain techniques. The Department had built other lines. They had their Aqueduct Line [Los Angeles Aqueduct]. And then the Department had a line between Receiving Stations "A" and "B." When it came to prior experience, this is what the Department had. Most of the

workmen were boomers. Some worked for the Edison Company. Some became foremen. They had tremendous knowledge of tower line techniques. But on the Boulder Line, the fact that they used the hollow conductor, Bolser, Peterson, Bradley Cozzens, Floyd Goss and others conducted tests at Cal Tech and Stanford University's high voltage test laboratories. Considering the insulation, conductors and hardware, it was an excellent job.

TC: Liz Wimmer was telling me about Floyd Goss having developed a way to test the sag. He had some kind of glass or metal balls that would hang.

LS: Yes. Goss worked for Peterson and one of the questions they worked on had to do with vibration dampeners. The conductor vibrates from the prevailing winds. The Alcoa Company had patented devices for vibration dampeners. These had two weights with a sort of spring device from the suspended insulator. When the conductor vibrates, or gallops, these dampen the wind action so such resulting movements do not break the insulators, the conductor or the tower. Floyd Goss conducted field tests, living at the Kingston or Harvard Camp. He developed what he called the Goss Ball, which was a ball, which was split in two, with a hooking device which you could clamp on the conductor. The story goes that with the instrumentation and alarm system that went to his tent, at one time the wind was blowing gently and set off the alarm. It doesn't have to blow at tremendous gusts. Even with a gentle wind the conductor can start to gallop. But the conductor

wasn't galloping. Mr. Goss climbed the tower to the test platform and found that one of the experimental vibration dampening balls had come loose and swung off at an angle. This put a little torsion on the conductor besides the dead weight. Thus the technique was developed, so the line was strung with the so-called Goss Balls as vibration dampeners. Later on it was learned that the conductors were beginning to fail due to vibration stresses. They were removed and the Department resorted back to the patented Alcoa vibration dampener. That's the story of the Goss Balls.

TC: Okay.

LS: Goss was one of the transmission engineers that later came into the Transmission Design office. I worked in and out of the office, across the hall from Messrs. Peterson, Cozzens, Goss and [Henry J.] McCracken. Later on, [Edgar L.] Kanouse worked in this office under Mr. Peterson. E. L. Kanouse became general manager sometime later. In the art of lightning protection, two overhead ground wires were strung above the conductors. Messrs. Cozzens, Kanouse and Goss conducted the lightning protection studies. They used a spark gap at the base of the tower where the number of lightning strokes striking the overhead wires could be documented. Also, the interceptions preventing "hits" to the conductors and/or tower could be documented and demonstrated.

TC: Wow.

LS: Also, there was an engineer by the name of [Miles O.] Bolser who developed a great deal of the special hardware for splicing the conductor. The Power System had experienced problems with the pulling out of the splices, due to the difference in the cone size tolerances that would cinch the splice device. The mechanics also had problems assembling these first splices in the field. So new techniques were developed as we went along, until we developed a good splicing technique and connector, to the tension insulators. Mr. Bolser deserves a lot of credit for the splices, connector devices, arcing horns, and "shoes" that we developed for this project. Special "shoes" hold the conductor, sort of a cradle-rocking device, in deference to the simple clamping hardware which is used for the aluminum, steel-reinforced conductors. The latter merely clamp the conductor to the string of insulators. The two types of "clamps" are quite different due to the types of conductors involved.

TC: What was the camp life like? Did men have their wives along or was it strictly kind of a stag affair?

LS: Strictly stag. All men and no women in the camps. We would have maybe some Sunday visits.

Most of the employees didn't own cars. It was the Depression. You were usually delivered to the camp, like I was. I didn't have an automobile. I started field work only thirty miles from Las Vegas, (this was before the famous Strip). On payday, naturally, we went to Las Vegas. There

were about four blocks of Fremont Street which had the saloons and gaming halls. There was a lot of craps and poker. And in the camp, of course, in the wash houses, they had poker games for a modest amount at stake. We played horseshoes, chess and checkers. You were pretty well stuck when you were out in these camps, if you didn't have an automobile.

TC: Yes.

LS: We were only a mile or two from Whiskey Pete and, at that time, you could get yourself a "near" beer. We had no beer in camp. The small camp store sold such items as clothes. You had to buy your own gloves, socks and personal items. You could buy candy, soda pop or things like that. In most cases, you could buy on credit, because some of the people were down to their last pennies in those days.

TC: Yes.

LS: We were paid twice a month.

TC: Was the pay fairly good for that day and age?

LS: Well, I don't know about day and age. I went to work for $155 a month, including room and board. The meals were 30 cents each and the board was 10 cents a night. You had an iron cot and a couple of army blankets and just a pad mattress. The room and board allowance only applied to the engineers climbing the towers.

TC: Did it take a while to get the hang of sleeping in that circumstance?

LS: Yes. We had no air conditioning. When it came summertime, we would raise our cots with a length of pipe on the four legs. We'd be wainscot high, half the height high, up to the screen wire. You had an extra flap of canvas across the top, with air that would circulate underneath. Each man had his own water bag. You'd drink a lot of water and sweat. The desert cooler was developed later, about 1939. But if you were young, you got used to living and working without air coolers.

TC: What was the desert cooler?

LS: What you call the swamp or desert cooler, which they have even today out in the desert, is different from the refrigeration type of cooler. The desert cooler or evaporator cooler works on the cooling effect of water as it evaporates. The refrigerator cooler works on the principle of cooling as compressed gases or coolants are expanded.

TC: Oh, I see.

LS: The evaporative coolers use excelsior or similar material. You just dribble water down through the excelsior and blow air through it to the area to be cooled. Even today it's used economically out in the deserts, for those people that cannot afford the refrigeration type of air conditioning. In fact, I stay out at Palmdale today and all we have is a desert (evaporative) cooler.

TAPE NUMBER: 2, Side A

October 30, 1989

TC: I just wanted to touch on a couple of things that we skirted last time, just for the record. We didn't mention what affect the Depression had on you. You were in your teens at the time.

LS: Let's see, I graduated in 1934, so I would have been twenty-two years old. When I got out of the university, it was difficult to get a job. There weren't that many jobs around.

TC: Yes. Well, that was in the middle of the Depression. How about in 1929 and 1930? You were still in high school then?

LS: Well, I was fortunate that I had a dad that could take care of me and sponsor me through college.

TC: And the Depression didn't hurt your father's tailoring business?

LS: No, by that time, he was retired and was in real estate.

TC: Oh, I see.

LS: And being very conservative, he was able to weather that. So he did fairly well, not what you'd call good, but with everybody else being the way they were, things were inexpensive. You could get a meal for thirty-five cents. You could go to a restaurant and get a dinner for thirty-five cents--up to seventy-five, maybe. (chuckling)

TC: How about the Hollywood mystique? Did that have any kind of affect on you growing up? Was it anything you were particularly aware of?

LS: Very well aware of. It was nothing to see Harold Lloyd make movies on the street--it was the silent days--so I saw many companies doing silent films all around Los Angeles. Our Gang Comedy, as far as that goes. If you went toward Culver City, you had MGM, Hal Roach Studios and [David O.] Selznick. When I married, we moved to Beechwood Drive, which is above Hollywood, and we would then come down in the evening and go to the Paramount Theater. When we were out on the town, it was nothing to see stars cavorting around at the various cocktail lounges. I remember Betty Grable when she was running around with several other stars. There was the famous Sunset Strip, at the time, which was materially different than it is now. A number of movie stars went to the better nightclubs. We saw a lot of the movie stars during the late evening hours.

TC: Last time, we ended up discussing how the transmission line was brought across the desert from Boulder and I wanted to start this time talking about the frequency change from 50 cycles to 60, just to get into some of the background on that. First of all, what did that mean? Or why did it happen in the first place?

LS: Well, for some reason, the design of the L. A. Department of Water and Power system was on 50 cycles. Later on, the state of the art was 60 cycles. And when they took over the L. A. Gas and Electric [Company] in 1937, which was a very good load, they had a generating plant at Seal Beach. The Department didn't have any of their own generating plants. We had frequency changer equipment at RSB [Receiving Station "B"], which was a motor driven generator for 50 cycles from 60 cycles. In 1939 the Power System changed to 60 cycles. Gradually, they phased out the frequency changer and generators were converted to 60 cycles. The Department had a lot of equipment to change, both its own and the customers'. The simplest things, of course, were electric clocks, and the more expensive ones would have to be retrofitted from 50 to 60 cycles. For cheaper clocks, the Department would give those customers a new clock of 60 cycles. (The L. A. Gas and Electric had the generating plant at Seal Beach, which has now been torn down. The Department was going to rebuild a new plant there but never did get the permits to do so.) In any case, they set up a frequency change unit, and one of the fellows that I worked with in the field was in charge of the field surveys and crews to retrofit to the 60 cycles.

TC: Who was that?

LS: I'm trying to think of his name right now. I'll have to think a minute here. [Ted Wolford]

TC: Right, it'll come to you.

LS: But, anyway, I never did work directly with that organization; I remained with the Design and Construction Division. But one of the vice presidents [of L. A. Gas and Electric] was taken into the Power System and worked with Joe [Joseph F.] Mariscal. The Power System had to take a number of the former L. A. Gas and Electric distributing stations and convert them to the type of feeders of the Department of Water and Power. The stations were gradually integrated with the L. A. Power System. At the time, I was put from Transmission Engineering over to the Drafting Room, and then Mr. Mariscal would borrow me. I would go out to the various distributing stations and to the Seal Beach Steam Plant and change a lot of the name signs as systems were converted to our type of feeders.

TC: What name signs? You mean, on the generators?

LS: On the control and instrument boards.

TC: Yes, okay.

LS: I got into the frequency change to a certain degree, but not to the extent of changing motors and other electrically driven equipment that required the 60 cycle conversion.

TC: I see.

LS: Which was a big job. And, of course, later on the Edison Company had to do the same thing. They were in a lot of 50 cycle supply and generation that, later on, were converted to 60 cycle. We had to do change at the hydro plants, San

Francisquito [Numbers] 1 and 2, and the Owens Valley, and even at Hoover Power Plant. The newer plants were prepared so that they could convert. It was just a matter of speed, in the case of the generators.

TC: Yes. So they did it over a long period of time. Is that correct?

LS: Yes, it was staged. And with a frequency changer (50/60 cycle) which we had at RSB, it lent itself to converting it in an organized manner. The entire city was eventually changed over.

TC: Well, did this discrepancy [between 50 and 60 cycles] occur in a period before there were standards? Is that the case?

LS: The state of the art and standards had changed for the better, especially with regards to lighting. The industry tended to standardize. The electrical systems are now intertied, requiring a matching of frequency for economical reasons. But nevertheless, to this day, Southern California Edison has certain voltages that are different than the Department of Water and Power. For example, our loop system, was started out with the 110,000 volts and then it was converted to 230,000 volt lines, which "belt-line" around the city.

TC: Yes.

LS: The Edison Company has 220,000 volts for its transmission system. When two systems of different voltage are "tied"

together, transformers to fit the situation supply the intertieing link.

TC: Yes.

LS: And to this day, Edison has 220,000 volts and the L. A. Power System has 230,000 volts for their local transmission systems. We now have 500,000 volt lines, alternating current, of course, for long distance transmission, and so has the Edison Company. Therein, we're pretty well compatible. With the DC transmission the electrical energy is converted to AC. We do it to 230,000 volts. And the Edison Company would have to be intertied to the L. A. Power System at a switching station. The L. A. Power System has to conform to their 220,000 to 500,000 volt lines.

TC: This period of the frequency change was when, 1937, 1938 and 1939?

LS: About 1937 or 1939. Ted Wolford was the fellow I worked with. And at the time, when he was called for a supervising job, we were rooming together in an apartment house finishing up the Boulder line at Ontario or Upland, California. And Ted Wolford, who has passed away now, was given a field job doing the surveys and the retrofitting of a lot of equipment.

TC: So, in 1939, then, you were sent back out to the field for the third line. Is that right?

LS: In the earlier part of 1939, I was brought back out of the Drafting Room to work for Mr. Bissiri. I did paper location

of the Third Boulder transmission line. The Third Boulder line was the result of surplus energy at Hoover Power Plant; and also with an eye toward the fact that World War II was coming along. Mr. [Ezra F.] Scattergood was able to procure a contract for that surplus energy at a good price. The Third Boulder line was built. It might even have been built with government money, I don't know for sure. I was brought back from the Drafting Room to work for Mr. Bissiri. I did paper location of the Third Boulder line and later I went into the field with the surveyors to locate the tower centers, from the paper locations. We would then go out in the field to see if there was anything that the original data did not provide for: sideswing, particularly, or extra clearances over prominent points that the field notes didn't provide for.

TC: What's sideswing?

LS: Sideswing is when the wind hits the conductors and it swings these laterally. We had problems on Boulder 1 and 2, particularly at what they call Bottleneck Pass, which is east of the Nevada state line, at which it was recognized while they were building the line that the conductor would not have sufficient clearance, that it would have when it was under normal conditions, hanging vertically. The result was that a great amount of excavation, including blasting of the hillside, had to be done to provide proper clearances.

We had another problem that we recognized, as well. We had what you would call broken wire condition. When you break a wire in a suspension span, the suspension insulator of the first span fully conforms to the conductor catenary, and consequently puts more conductor into the span. The further spans take a certain amount of that swing out. Consequently, a critical span results which may not have the ground clearance required by code. We had little problems at a few locations, requiring increasing tensions to remedy the situation.

On the Third Boulder line, I did all the calculations of the broken wire conditions and sideswings. I spent appreciable time working in the office on this problem. From there, I was sent out in the filed as supervisor of the field saggers. We had three or four crews of saggers. We started on the west end of the line (at Receiving Station "E") and proceeded eastward to Hoover Power Plant.

The thing I didn't mention before was when we did the first two lines, we brought the lines to the government switchrack. And from the switchrack down to the power plant was about five spans, which were provided by the United States government, including the span that hangs from the leaning towers down to the roof of the power plant. The Department contracted for that segment. When I was on the first two lines, I worked on the conductors for the switchrack, of the

federal government, and the five spans, including the span that goes from the leaning towers down to the top of the power plants.

TC: You were still in the employ of the Department at that point?

LS: As an employee of the Department. The Department contracted for that work.

TC: Oh, I see. So, in building the third line, the motion was from west to east.

LS: West to east, yes. Well, first of all, the third line didn't go to RSB. The terminal was RSE [Receiving Station "E"] in the San Fernando Valley. It proceeded through Little Tujunga Pass and then along the foothills on the east side of the San Gabriel Mountains to the Victorville Switching Station where it then met the right of way of the first two Boulder lines, and then paralleled, more or less, the Hoover Power Plant. We used some of the construction camps that we had for Lines 1 and 2. We had a new camp at Adelanto, [California], where today they have a direct current terminal. We had a construction camp by Little Rock Dam, which could have been a CCC [Civilian Conservation Corps] camp, and we had one in Soledad Canyon, which was a CCC camp. I spent my time traveling back and forth, supervising field crews on the sagging of the third Boulder line.

TC: Did you have to drive overland, or were there roads enough to get you where you were going?

LS: It was always by automobile. In my case, I happened to have an old Buick that they turned over to me, which was quite a problem. Nothing like a small car. We didn't have four-wheel drive at that time. It was 1939, and so the Department built fairly good roads and they were maintained--dirt roads, with a little gravel here and there. You'd get stuck from time to time, so a little bit of caution was necessary. A big problem always was going from the main construction road off to the side roads to the tower sites, which were not that good. Of course, when we were there doing location, we didn't have the roads and we did drive over the natural ground with these two-wheel drive cars. We got stuck from time to time, but we worked our way out.

TC: Amazing. When we had our preliminary interview, you were talking about what it was like at the Department, just coming in there for the first couple of years or even for the first couple of months before heading out to work on the Boulder Transmission Line. I just wanted to get that on the record, too. There were three buildings downtown. Is that correct?

LS: Yes, we had the main building, the Broadway building, one on Second Street, about the middle of the block, between Hill Street and Broadway, and the Hill Street building. These three were tied together with passageways, so they were pretty well integrated.

TC: Oh, was it one building for water and one building for power and sort of joint, or was it all mixed up in the three buildings?

LS: They were all mixed. No, we never had any one building to a bureau or joint system. The main offices of the Department Head and System Heads or Bureau Heads were in the Broadway building. I was in the Hill Street building to start with, which had Transmission Design. And then when I went into the Drafting Room, after I came back in 1936 and the Boulder lines were in operation, the Drafting Room was in the Second Street building. So I spent time between the Second Street building and the Hill Street building. The Accounting Division had what was called the Washington Building, which was on Spring Street. It was south of Third Street, I think. And then later on, the Power Design and Construction Division took the Wright and Callendar Building at 4th and Hill Streets together with two floors for part of the Operating Division. Then the Power Design and Construction Division expanded, taking in the Black Building, which was at Fourth and Hill, on the northwest corner. Then sometime later the Design and Construction Division had a little expansion and took part of the Subway Terminal Building Annex. So the Power Design and Construction Division had problems with growth, until finally we moved into the new present Water and Power Building, which for awhile stopped that running around for space. It was very difficult

to coordinate efforts with the System Heads, the Legal Division, the Procurement Divisions and Accounting Divisions.

TC: You said that at one point there was a cafeteria in the Broadway building.

LS: No, the cafeteria was in the Hill Street building.

TC: Oh, the Hill Street building.

LS: And we had a very good cafeteria. I'm trying to remember whether it was in 1935 or 1936, but it was about 35 cents for a lunch from soup to dessert.

TC: And people like [Harvey A.] Van Norman and Scattergood would be seen there having lunch. Is that right?

LS: That's true. Van Norman and Scattergood frequented the cafeteria.

TC: Let's talk a little bit about the Department during wartime. Well, first of all, the third line was finished in what year?

LS: Let's see, about the first part of 1940.

TC: Okay, 1940.

LS: Yes.

TC: So, when war was declared, which would have been in 1941 . . .

LS: Yes.

TC: Was there a noticed sense of preparedness or a different sort of attitude going on?

LS: Yes. The Department had records of such a manner that they could coordinate with the federal defense effort to have an

inventory of the various machine tools that could be used for the war effort: drill presses, lathes and things like that. One of our shop superintendents left the Department and had quite a defense industry for himself. The L. A. city had shipbuilding at San Pedro, so the Department had to supply large amounts of power for such efforts.

TC: Yes.

LS: Then there was an aluminum reduction plant, which was built at 170th and Van Ness Streets, and the Department built a high voltage line to serve such, because that was an electrical process and the use of the power from the third Boulder line was very instrumental in providing electricity for that effort.

TC: Oh, I see.

LS: Harvey Aluminum at the time was quite an electrical load, which had an electrical process converting the ore to aluminum products, which were used in aircraft and other industries for the war effort. For shipbuilding, there were two or three plants that built "victory ships." You had Cal Ship and two or three others, so it was quite prominent. Aircraft also presented a large load.

TC: Yes, that's the other question.

LS: They had Douglas [Aircraft]. Douglas was primarily in Santa Monica and would be on the Edison system. I'm trying to think . . . Lockheed [Corporation], Burbank.

TC: Burbank. How about North American [Aviation]?

LS: North American would be on the L. A. system, which was at the airport at the time; that was at Imperial and Sepulveda.

TC: Yes. Did these big plants have their own sort of receiving stations?

LS: We built what we call industrial stations, and the higher voltage lines would supply them. But the 34.5 [kv], which was the Department system, would take care of these. But they in themselves would have a special line to feed those outdoor plants. The only high voltage line which took a tower line was the aluminum plant, to which the Power System built a 138,000 volt line. One of the lines came from RSB and one from RSC [Receiving Station "C"], which is in the Wilmington area. It did call for lines built out of RSB, and by that time we were building RSD [Receiving Station "D"], which is in the west part of L. A. I was connected with sagging the bus work at the stations and the lines that connected the receiving stations together.

TC: Were you involved in any of the Civil Defense operations going on within the Department itself?

LS: If I had a role with the Department, it was minor with regard to Civil Defense.

TC: Yes.

LS: I did have my hands full out in the neighborhood. In 1939, I bought my home in West Los Angeles and had one child at the

time, and then in 1941 we had our second child. We had civil defense units all around. Every neighborhood had their civil defense units for fire, blackout, first aid and other activities.

TC: Did the number of enlistments of engineers and other DWP personnel have much of an affect on the operation of the electrical system?

LS: It might have had a certain affect, but we were pretty well along by then. We lost a number of key people and some held some pretty good jobs in the Seabees and in the army engineering corps. They were very capable men.

TAPE NUMBER: 2, Side B

October 30, 1989

TC: How about yourself? Was there a deferment for the people that stayed back . . .

LS: Yes, I had a deferment. I applied for the Seabees and something didn't work out well there, so I thought at that time I'd let it stay the way it was. In the meantime then, we started to figure on hydroelectricity to insure the fact that we had adequate power. The Power System started to plan the Owens Gorge hydro plants. The Department applied for permission to build these, even to the extent of using wood poles for a transmission line. That didn't materialize. But later, after the war, the hydro plants were built and are an asset to the Department for reliable low-cost energy.

TC: So it was actually during wartime that the thought of building the Gorge plants actually came up. Is that true?

LS: No, they always had plans for the gorge plants. A planning unit, which later on I became in charge of it, Power Resources was charged with planning the Owens Gorge Hydro Power Project. We had civil engineers who were looking out for water rights. The Kings River, for example. In Inyo and Mono [Counties] there was a fight to procure certain water rights along the eastern Sierras which did delay the final plans for the Gorge plans. The Sierra Nevada Power Company had originally built

two plants in the Owens Gorge. The Department was not able to build because of that, until later on when they bought out that element. Having built the water system's Long Valley Dam and Lake Crowley, it made it so that it was a good setup to build the Gorge plants. The storage and the extra water rights, which came from the Mono tunnels and brought the Mono County waters to the Owens Valley, provided a complete project. In 1953, the Owens Gorge plants construction was begun.

TC: Yes, and is that a series of plants?

LS: A series of three hydro plants, with a total power drop of about 3500 feet. There are three major power plants with a lower holding dam, and a smaller power plant was added. Let's see, I'm trying to think of the name of the fourth plant. But that's a small unit. Basically, there are three identical type plants, two are controlled from the lower control plant, Power Plant 3. By that time, I had become Engineer of Cost Control and was involved with budgetary and cost control of the construction of the plants, taking a number of field trips up and down the Owens Valley. I was involved with the first planning of the Owens Gorge Project construction headquarters, the warehouses, shop buildings and dormitories needed to construct these plants. The tunnels were done by contract, and the penstocks by contract. The power plants, excavation, concrete and equipment installation was done by force account.

TC: Was that the usual breakdown?

LS: It was the first time to my knowledge that we ever did a tower line by contract. When we started, we were going to do it by force account--also the penstocks and the tunnels--but then management determined that it would be better to do it by contract. So what little effort was done by the Department forces was let out to be completed by contract. The Power System had certain experience in that work and had to finish some of the work by force account, regardless of the contract.

TC: Oh, yes. They figured it would be more economically efficient or something, to have it done by contract?

LS: Well, where you don't have the organized crew and supervisorial staff to do things like that, and you've got very qualified contractors, in general, it would be better to do it by the contractors.

TC: Yes.

LS: Of course, you have to do it with good inspection and specifications, and that's a problem.

TC: Yes. Actually, we've jumped ahead. This is more like in 1949 or 1950?

LS: Nineteen fifty-three, I think.

TC: The 1953 period, yes. But just to go back a little bit, still talking about generation, it was in 1941 or so that the Harbor Steam Plant was designed, I believe. Is that correct? It was during the war but it had to be curtailed.

LS: No, we built Unit 1 before the war. But prior to that, we had certain problems, I imagine. The Edison Company had legal hold on the Department, with respect to the fact that they could furnish surplus energy. After that was resolved, Unit 1 was started. Then along came World War Two and so certain materials were under control, namely welding rod and copper. I worked with some of the staff to demonstrate that the amounts involved were that critical. We made several visits to the War Production Control offices and demonstrated our requirements, with regard to the material, so we were given the go-ahead and went on to build Unit 2.

TC: Were these offices here in Los Angeles?

LS: Yes. If they weren't in Los Angeles, they were in outlying areas. It might have even been downtown. I can't remember right now, but it might have been downtown.

TC: Well, that was the Department's first steam plant, right?

LS: Yes, that was the Department's first steam plant. Let's see, in 1937, the Power System acquired Seal Beach Power Plant and Alameda Power Plant, so we bought two. The Harbor [Steam Plant] was the first one that was built from the ground up.

TC: Okay. And was that oil-fired or gas?

LS: It was oil-fired, with equipment to quick change to fuel gas. All the Department plant boilers are designed for either gas or oil, so where we can procure fuel gas at an economical price, such was preferred.

TC: No coal, then?

LS: No, they made provisions to store coal at the Harbor Steam Plant. Large acreage is required for storage in the event of a strike. That's one of the problems. We do have an oil tank farm at Harbor Steam Plant, so they're always prepared in case of an oil delivery strike.

TC: Yes, a cut-off from supply.

LS: So there is sufficient fuel for about two months.

TC: Yes.

LS: The Harbor Steam Plant was close to oil off-loading facilities and pipelines that supply the plant directly. The Power System went on to build a total of four units at Harbor Steam Plant. Then with the load growth after the war, in spite of the loss of the aluminum plant electrical load and certain shipbuilding electrical load, the growth was tremendous here in Los Angeles. So then the plans went on to build a new steam-electrical generating plant at Seal Beach. The Power System was unable to get the required permits, so they went to the San Fernando Valley for the next generating site.

TC: Oh, I see.

LS: And the Valley air quality is such that oil can be burned on a limited basis. In general, the permission to burn oil is pretty well restricted. So, when you can procure gas, the plant is so operated. The Power System tried to bring tank cars into the Valley Generating Station. Railroad provisions

and storage tanks have been built. Delivery of oil by truck is uneconomical.

TC: Yes.

LS: Trucks have to run day and night. Not much oil is used because of limits set. It's not the most efficient plant because of the cooling water provisions. Building near the ocean and using ocean water creates a more efficient plant. The next plant was Scattergood and then the Haynes Steam Plant. Scheduling was in accordance with the load requirements.

TC: So what kind of coolant is there in the Valley Steam Plant? It's not cooled, is that it?

LS: Cooling towers using potable water are used and adds appreciably to the generating costs.

TC: Yes, I can imagine.

LS: And that adds appreciably to the total cost of electricity. I must say one thing which I forgot to mention before, when we took over [L. A.] Gas and Electric, they had a unit in the general downtown area called the Alameda Steam Plant, which included antiquated Corliss engines, as opposed to turbines. They had a number of small boilers using fuel oil. I was involved in the cost control and dismantling of the plant. There were water cooling towers that had deteriorated and had to be rebuilt. Later on, all of the plant was dismantled.

TC: Yes.

LS: But from a capacity standpoint, this was small compared to today's plants. We're talking about units of about 5,000 kilowatts or so.

TC: So it wasn't worth keeping, then?

LS: It wasn't economical.

TC: Yes.

LS: But it fit into the system well during the frequency change. The Power System had some receiving stations using DC motor converters. The Alameda plant had DC underground lines to loads and distributing stations. The Power System had battery banks supplying DC to certain downtown buildings. There were elevators that worked on direct current. DC is good for that service.

TC: Why is that?

LS: Because of the ability to control and accelerate the direct current motor. But since then there have been improvements in the AC motors to the point where they can compete with the direct current motors. Most of the streetcars, if not all, were direct current motivated, in which there was good acceleration and deceleration. The feature was important to such services.

TC: But as I think we discussed last time, the streetcar system was not generated by the Department. Is that correct?

LS: The L. A. Gas and Electric had a certain load, together with the Southern California Edison Company. The streetcars had

stations along the lines for converting and voltage control. The red cars had lines out as far as San Bernardino and Ontario.

TC: Yes, that's true.

LS: There were even freight lines carrying fruit and other products and Southern California Edison had a lot of this electrical load. The Department didn't share this load.

TC: I've read about the way the Edison Company and the Department got along in the early days. They were in competition and there was a lot of animosity and antagonism, actually, between the two companies; but, as time went on, I think it sort of softened.

LS: It softened to a degree. The big breakthrough was later on when we joined the WEST Associates.

TC: Oh, okay.

LS: Which was set up to take the various states and have a common large generating facility. And then, later on, of course, with the government pushing for a direct current line from the Bonneville [Power Administration], cooperation developed into the building of the Pacific Intertie.

TC: Oh, yes, the Intertie.

LS: The Southern California Edison saw fit--and so did PG and E [Pacific Gas and Electric]--to buy into the Pacific Intertie, linking the Pacific Northwest with California.

TC: But in this period, say, in the late forties and early fifties, was there still that kind of animosity between the two?

LS: Yes, there was a certain animosity. We were vying for either's load and there was also the threat of takeover. So competition was such that an economical job resulted. Electric systems all over the United States can be compared through a uniform system of accounts, together with rates. This is a very good thing for the consuming public.

TC: Yes. Well, this gets into something on the controversy between municipal power and private power. When you were entering into service for the Department, were you a public power man? Did you see yourself that way?

LS: Yes, I guess, right away from high school. As a Boy Scout, I told you I had visited the Department facilities, both Water and Power, and read a great deal about it. And living in the city of Los Angeles, I became pretty well on the side of municipal ownership.

TC: Yes.

LS: Municipal operation is a good thing for large blocks of consumers centrally located. You have Burbank, Glendale and Pasadena. They also went municipal. With the state of the art today, you've got to have large generating plants. Smog control and other problems connected therewith must receive

prime consideration. Co-generation can also be used to advantage.

TC: Yes.

LS: Fortunately for Burbank, Glendale and Pasadena, they're tied to the city of Los Angeles. And while they built their own generating plants, they are very small. Of course, when they're on fuel gas, it's not always available to them. The Department had to eventually reach for coal generation for economical power, plus remove locations favorable to air quality control.

TC: Well, how does that work with Glendale, Burbank and Pasadena? I've been by some of their plants; particularly, in Glendale, I can picture where that is.

LS: Oh, yes. When you go off the freeway at Pasadena, there is the Pasadena Generating Plant. When you go on Interstate 5 out through Burbank, you can see the Burbank plant. So they have their small generating plants but they can't provide for the total load. Burbank, Glendale and Pasadena have a piece of the DC line. The Department has always wheeled the Hoover power for these municipalities.

TC: Oh, so they would sell . . .

LS: So, we are attached to them. At one time, we were attached at Receiving Station "A", then later on Receiving Station "E" and "G", so our lines between Burbank, Glendale and Pasadena are interconnected. They are members of WEST Associates, but

the Department still wheeled their shares. But now they've formed the Southern California [Public] Power [Authority] project and, consequently, if it comes to wheeling any of the power from the WEST Associates, they are able to receive their share of power by offsetting power or direct delivery.

TC: Yes.

LS: But, anyway, by offsetting deliveries through the Department lines an economical arrangement is provided.

TC: So that's the way they've been interconnected.

LS: Through interconnection, many utilities are insured an adequate supply of electricity, in their limited areas. L. A. is also limited, with regard to area, however we have a large area and respectable load.

TC: Yes.

LS: But on the other hand, we are losing certain industrial demand which takes large blocks of power. Commercial demand also takes tremendous blocks of power.

TC: Yes, that's true. So aluminum was lost right after the war.

LS: Yes, that was a tremendous loss, but the city was able to absorb that load. It worked out well by reason of a good load growth.

TC: I think Mr. Scattergood tried to keep that here in some capacity.

LS: They tried to keep it, but that's another economical reality. They could not compete with Norway or other foreign countries.

Also, there was the Bonneville Power Administration and Canada, which have abundant cheap hydro power, so they have aluminum plants in the state of Washington and in Canada. The plants were phased out later, becoming manufacturing plants for finished aluminum products.

TC: Yes. I read somewhere that in 1948 the Department made surplus power available to northern California facilities. It was during a particularly bad drought and I guess they weren't able up there to generate their electricity. Do you recall that? And if they did supply surplus power, how did they get it up there if there wasn't any intertie yet?

LS: In 1948? I'd have to think.

TC: Yes. I just saw a little reference to it somewhere.

LS: As far as power goes?

TC: Yes.

LS: I'm trying to think right now. Let's see. The only way, I would think, is if we had had some contract with the Southern California Edison company and we didn't avail ourselves of that part of that contract. The Southern California Edison being tied to PG and E through Bakersfield, they would offset certain power that they were supposed to get from PG and E, procuring this amount from the Power System through interties in the city.

TC: Oh, I see. That's probably it.

LS: So sometimes it's an offsetting sort of thing. The same way with water, we help the north tremendously. We have a contract today with the California Aqueduct.

TC: Yes.

LS: So if there's a drought up north, we don't take our share of the California Aqueduct and the north take it out of the Delta portion; and that's the way it's done. They are very lucky up north, they don't realize that southern California has really underwritten their ability to get water and electricity in time of need.

TC: Yes.

LS: But now we're intertied anyway. PG and E built the two 500,000 AC lines to Bonneville [Power] Administration, and then Bonneville has thirteen states within the northwestern United States plus Canada. There are contracts where we helped finance the two big dams in Canada that are now generating tremendous amounts of electricity.

TC: We've kind of gotten ahead of our story, although that's fine.

LS: I know we are but you've got to see the handwriting that really is on the wall.

TC: That's the point, yes.

LS: You've got to realize that we had people in the Department who were aware of these problems, and when it became economically proper, they saw that these facilities were constructed. Now, the Edison Company and PG and E also are big enough to

understand these things. So, at the right time, things fell into place, like the Pacific Intertie and power from different states. We don't have any coal-fired plants in California. And in order to do that, you've certainly got to get energy from someplace else. You're not going to generate the electricity in the Los Angeles basin on either fuel oil or fuel gas. Hydro is out. PG and E and Edison have much more hydro than the Department. However, it's probably not more than 10 percent or less of today's load. And out of this situation, from the standpoint of southern California, came the WEST Associates.

TC: Yes. What year would that have been that the WEST Associates were . . . ?

LS: About 1962. It was at that time that I was promoted from Staff Engineer in the Design and Construction Division, and Ralph Durke retiring, I became head of what they call Power Resources.

TC: Power Resources. Okay, before we get into that--and, in fact, maybe next time we could start with that because that seems to be the more modern period of the story here--for the rest of the fifties, you were more or less in the Cost Control area. Is that correct?

LS: Yes. I then went from the Third Boulder line to the Cost Control Unit, in the Power Design and Construction Division, then expanded from Cost Control to Budgetary Control.

TC: Yes.

LS: And then later on to Staff Engineer to Design and Construction Division.

TC: Well, in the Cost Control area, you had to more or less oversee what monies were being spent in the building of the steam plants then?

LS: Yes. I was involved with every facility through Cost Control, because force account was involved with almost every type of construction being built. So I went from generating plants, hydro and steam plants, transmission lines, distributing stations, commercial offices, general buildings. I was able to be involved with everything done by the Power System, and had quite an insight to all types of design and construction.

TC: Yes. Well, speaking just on that, then, in comparing the Harbor Plant to the Valley Plant and then to Haynes and Scattergood, are they pretty much the same design? I mean, other than the water cooling.

LS: Well, in the case of the Valley, of course, that's on potable water or well water for cooling and take-up water.

TC: Yes, well water, okay.

LS: And with the large cooling towers.

TC: But as far as being outdoor plants . . .

LS: The other ones were built along the ocean and have ocean cooling water, which is quite different. You have your heat balance, and the mechanical engineers calculate the

efficiencies with the heat exchangers and air pre-heaters to the boilers. But the state of the art was changing rapidly and the economy of scale was taking over. So we went from the Harbor Steam Plant, from units that were 65,000 kilowatt capacities to up into 110,000 [kilowatt] capacities which, as the units are developed, have to fit into the system, with respect to economics and also with respect to controls.

TC: Yes.

LS: So it's an engineering art to fit it into the particular system.

TC: Well, then each plant was a bigger plant than the one that preceded it. Is that correct?

LS: Yes, in general, when we started out Unit 1 was a certain size and we then increased the size of the units. I'd have to have the figures in front of me to recognize it.

TC: Yes, right.

LS: Then, as you went from Harbor Steam Plant to Valley Steam Plant, larger units were built. They're probably in the neighborhood of 85,000 kw or in the 100,000 kv to 110,000 kv units. So now when you go out in the modern-day plants, you're up into 200,000 kv range. Of course, we're combined with other utilities and you're up in above the 200,000 kv range.

TC: Yes, true, true.

LS: And you get what you call cross compound turbines, there are certain efficiencies attained. So it's really a complex machine when you look at it. While you call it one unit, you've got complex units with super-heated steam at high temperatures and high pressures for increased efficiencies. The art has been improving through the years.

TC: Okay. I guess we have just about another minute or two and I wanted to talk a little bit about some of the Department personalities, like Robertson. R. R. Robertson took over as Chief Electrical Engineer and he was only in for a couple of years, 1943 to 1945. And then [Charles P.] Garman was in from 1945 to 1951 and then Peterson. Did you work closely with any of these people?

LS: Yes, I was hired by Mr. Garman. But Robertson prior to that was Engineer of Construction and so figured materially on the Boulder lines. And Mr. Garman was involved, he was in charge of the station part of the Boulder lines. We had our switching station and our terminals, Receiving Station "B," and Mr. Garman was in charge of that. Mr. Garman actually hired me and then I went to work for Mr. Bissiri, which was on the construction part, the location of the towers and clearances. That work was under Mr. Garman's general direction, through Mr. Bissiri.

TC: That was under Garman. Oh, okay.

LS: So I was about two or three offices down the hall from Mr. Garman and Mr. Robertson. I used to talk to them all the time. Mr. Robertson was Engineer of Construction at the time.

TC: Did Robertson retire in 1945? He was only there for a few years.

LS: He had a son who, during the early part of the war with Japan, had come in to bomb a Japanese battleship. He was shot out of the sky. The book, The Queens Die Proudly mentions him as a Navy flier. So he was along in years and I guess he decided to retire at that time.

TAPE NUMBER: 3, Side A

November 21, 1989

TC: I want to begin with something that we mentioned last week, and it's a little bit back in time, but I wanted to see if we could clarify it. We talked a bit about Mr. Robertson, who was Chief of the Power System in 1943 to 1945. Garman came in 1945 and was in until 1951, then Mr. Peterson came in. You mentioned, I think, just as we were going off tape that, well, that was a transitional period there. And going back and looking again at some of my notes and at some of the records, I notice that there was the consolidation of the Water Bureau and the Power Bureau in 1943. I'm wondering, do you recall that consolidation and the politics behind it? Why it had taken place and why it was necessary to consolidate? I guess it was a reorganization.

LS: What date did you say?

TC: Nineteen forty-three.

LS: So I was there.

TC: Yes.

LS: I really don't know the politics of it, except that I could see that they are related in the fact that hydroelectricity really started the Power System.

TC: Yes.

LS: And it was a natural thing and a good, efficient step to combine under one commission and one general manager.

TC: Have the general managers been generally . . . I know that they have alternated, but it seems that they frequently came from the water side, and I was wondering if that was due to, say, [William] Mulholland's stature as the Chief Engineer?

LS: Well, maybe, but I don't think that was so. It could be from either system, and now they tend to alternate. I think the thing is that the most capable manager is essential, whoever he may be, to head the Department of Water and Power. I think it was a step in the right direction to become a Department of Water and Power. The customer billing is a joint billing. There are a lot of joint operations. And as time went on, they made joint shops and a joint fleet of cars and equipment. But billing in itself, you've got to realize that the Los Angeles [Department] of Water and Power became one of the foremost efficient, with regard to billing . . . In fact, IBM built a lot of their equipment around what was developed or sold to the Department. Let's put it that way. It was Frank Twohy that really was at the forefront of all this. Billing can be quite costly and, consequently, even today, there's a lot of billing that the city is "riding on the back of," including sewers, trash equipment and others.

TC: What was the story behind locating the GOB right there on Bunker Hill, a perfect spot that pretty much overlooks the

city and everything else? I know it was built in 1965, but the planning must have been going on for quite a while.

LS: Yes, they wanted the Department of Water and Power with its funds to be in the Civic Center, so there was a master plan for the Civic Center. You have to buy the property way out ahead--so they had property, apparently, that was as far as Second and Hill Street, and they had the Civic Center in mind. So slowly the Department would change property until, after about two or three moves, it came to the present location, in the master plan.

TC: Oh, I see.

LS: The Department of Water and Power is on one end, the western side, and the City Hall is on the eastern end of the Civic Center.

TC: City Hall, right.

LS: Since then they have extended the Civic Center eastward. The Department of Water and Power with its grand building, which they are capable of building, and the Music Center and all that. A great city has to have an architecturally integrated good plan. And while it's not fully apparent, if things went the way they should have, you would have one great civic center for a great city like the city of Los Angeles. Many other cities just grow, and, consequently, they lack a real architectural beauty as a Civic Center.

TC: Yes.

LS: Like Washington, D.C., Los Angeles has a master plan.

TC: Yes.

LS: And while it's plain, it's a beautiful city.

TC: Yes, that's true. You said Frank Twohy, now, was he out of the City Attorney's office or was that out of the Budget and then Accountant?

LS: No, no, he was Chief Accountant and Chief Controller.

TC: Okay. I knew I knew the name, but I was having a tough time locating him there in the scheme of things.

LS: Yes.

TC: So he was the one that was . . .

LS: Well, he was really the guiding force on the financial end.

TC: Had he been around for quite awhile?

LS: Yes, he was under Mr. Clyde Errett, before him.

TC: Yes, Clyde Errett, okay.

LS: And he was maybe a young man at the time, but gradually evolved to where he became head. But I think he was the guiding force, in back of what I call the billing system. You've got to realize they didn't have computers at that time.

TC: Right, yes, yes.

LS: But they had the IBM tabulating equipment. And we were able to use a lot of tabulating and other business parts. In fact, in the early years of Cost Control, I availed myself of the tabulating equipment to set up some good controls. Computers were not developed as yet.

TC: We mentioned some of your activities with the Cost Control Office there when we were talking about the development and construction of the steam plants in the fifties. Just to refine that a little bit, who did you report to in that situation?

LS: It was Clayton M. Allen, known as Mose Allen, who reported to the Engineer of Construction. So, when I started, we had Construction Cost Control, but gradually we became attached to the Engineer of Design and Construction. That included both Design and Construction and then later on I became Staff Engineer to the Design and Construction Division, including the Budgetary Controls. The Division does need good cost control, budgetary control, and it gradually evolved during the time I was there.

TC: Well, what would those controls consist of? Would it just be watching every part, basically, so that . . .

LS: Well, basically, every well managed enterprise should have, first of all, a budget and, next of all, a detailed estimate. And the estimate has to consist of details which then can be documented as the work is being done so you can exercise controls. So the basic things are, as reported later by Accounting Division, you have labor, material, transportation, equipment, engineering and indirect costs. And these are the basics of all costs, whether you're an airplane business or a mom and pop shop. I mean, besides just having a cash

register. The timely reporting is most important, so that controlling measures can be exercised before it's too late. The Accounting Division accounts for each penny, regardless how much time is involved. In the meantime you could miss the boat. So we, naturally, got our cost information as early as we could, so as to be controllable.

We would get reports direct from the field, with regard to field labor. We would get engineering reports from the design engineers, and transportation reports and equipment reports from the field offices. Material and contract costs sere taken from purchase orders. Many times you could have a job which is heavy on equipment, such as building the earth-filled dam at Pleasant Valley at the Owens Gorge. So these are the essential parts. When you put together a staff that can collect these, and also are capable of analyzing it, in the early stages you can begin to affect control to these costs. Also, the estimates must be evaluated for reliability as the job progresses. The main thing is be on top of the job at all times, so that you're really in total control.

TC: So it did happen that estimates were wrong. Was there a lot of red tape involved in upgrading the . . .

LS: No, we had a procedure in which we could supplement estimates that warranted such. Estimates and costs are reviewed all the way up to the Division office, and behind each job you would have the material to demonstrate exactly the reasons behind

any change in any estimates. This could be field inefficiencies, extra work, poor estimates, to name a few factors. You've got to realize that many of the jobs, the smaller jobs, you're designing and constructing concurrently. Consequently, engineers who make the estimates many time--of course, they may consult with the construction forces--but they are at a disadvantage because they really don't have all the details at the time of estimate. It's not like you do a spec[ification] and then hire a contractor. But even then when you have a contractor there are change orders galore, as far as that goes. I don't know of any large technical job that doesn't have a series of change orders and resulting increase in costs. There are some underruns, especially when the job is grossly overestimated.

TC: So you need that area of flexibility.

LS: Oh, yes, you've got to, otherwise you would never build anything. I have friends today that are building homes that could be unfinished for six months or more as a result of litigation.

TC: Well, you said sometimes the design was going on at the same time as the construction.

LS: Concurrently.

TC: Concurrently.

LS: Yes.

TC: So what would that mean? Would the design men . . .

LS: To give you an idea, the steam plant is a good example.

TC: Okay, sure.

LS: You may put out bids. You start with the boiler and the turb[ine] generators, the large long-time delivery of equipment. Then the supplier-erector may give you an outline so that you can proceed with designing the foundations. You may have designed the foundations and you start to build the foundations and the suppliers still haven't delivered. Let's say, the boiler supporting structure and then later on the piping, drums, et cetera are delivered and erected together with the accompanying essential drawings. Then the instrumentation takes place later on, after you obtain from the boiler manufacturer the details, so that the engineers can then do their design for the other essential parts to the boiler that may be furnished by others. With the turbine generator, you have certain instrumentation and controls. Some are furnished by the manufacturer. In order to coordinate with the other pieces of equipment, the design engineer, which in many cases was the Department of Water and Power. The Department Design Engineer would design those elements. Now, you may say, "Well, why don't you wait until everything is pretty well done before you turn a spade." By that time, it could be ten years. In fact, in visiting the water treatment plant [at Sylmar, California] the other day, they point out that it took ten years to plan and then three

years to build. Well, over thirteen years, the [state of the] art could change. But in the case of power, probably the demand was such that you'd have to have a plan out ahead of load growth.

TC: Was it necessary in the Cost Control office for you to go to the field a lot and to oversee things personally, or did you have enough reliable people reporting?

LS: Originally, I did everything personally. I had a staff as the workload became larger. This staff would go out in the field. It's very important that all managers go out in the field. First of all, to have a good understanding of what's going on, and also to demonstrate to the people doing the work that you're sincere and that you're capable. You develop the capability to demonstrate that you have control. Just your personal appearance on the job many times is a great moving force.

TC: Yes.

LS: I mean, you've also got to demonstrate to the people who are the superintendents and supervisors that you're interested in running a good house. And I think that's very important. As I look back, I can see it, and I feel very good about it, from the smallest job up to the largest. Of course, we're very careful; if you do a small job, you're not going to spend an inordinate amount of costs that do not pay off. If they're ongoing types of jobs and no problems usually come up, you do

it by combining a series of jobs. Budget items combining several jobs is an example of such. It's very important to be able to understand where you can exercise good control and thereby realize good cost benefits. Where the cost benefits are important, that's where the most effort is directed as a priority. I'm sure that all these big aircraft manufacturing companies have some pretty good cost control efforts. But it's important for the people that are working, down to the lowest person, to understand that you're capable of exercising control and you want them to know. Always keep them advised, because human nature is such that they'll cooperate where they see that it's worth it.

TC: From the Cost Control office, you moved into Power Resources. That was about 1964, I believe, or 1963.

LS: In 1962.

TC: And what was that office? Was that a new office at the time?

LS: No. We had an engineer by the name of Ralph Durke. At the time when the office was created, this office reported direct to the Chief Electrical Engineer, or his assistant. The Power System realized the need for a central place to control future generation in remote sites. There were water filings with the federal government and the state for power. These filings included the Sierra and mountains elsewhere, such as the Owens Gorge. Also with regard to power plant locations in and out of state, coal and cooling water had to be investigated and

filed for. A small office was created to oversee the future supply required for load growth.

TC: What? To oversee . . . ?

LS: I took over after Ralph Durke retired in 1962.

TC: Oh, okay. So this office would keep an eye on such things and in their report . . .

LS: We had all records of hydro. For example, one of the largest things was to build a dam above Hoover Dam. The city of Los Angeles had a real interest in seeing that they could share in that resource. That was a large project that could be shared by other state agencies having rights to same.

TC: That would be what, Glen Canyon?

LS: No. This was the Bridge Canyon Project, backing water a short distance into the Grand Canyon. The site is between Hoover Dam and Glen Canyon Dam. Up the Owens Gorge and other sites on the Sierras, there were filings by the Department that had to be maintained from time to time, so that the Power System could maintain their interest. Also, the hydro power permits that were operating had to be re-filed from time to time. This re-filing was very important, so that the Power System didn't lose their equity. And that's what this office primarily was charged with.

TC: Oh, I see.

LS: I'm glad to say that later on when the private utilities, spearheaded by the Edison Company and the states of Colorado,

Utah, Arizona and New Mexico, invited the Department of Water and Power to participate, the WEST Associates was formed.

TC: The WEST Associates, okay.

LS: And today, when you look at all these power plants that are built, including the Intermountain Power Project, it's the result of this organization.

TC: Okay. So WEST was in that same period of 1964 . . . ?

LS: It was organized in about 1963.

TC: I was reading something about WEST Associates and Howard King was telling me a little bit about it. It was mainly just a coming together. It didn't have a headquarters or it wasn't something like perhaps Metropolitan Water District. It wasn't an entity, in the sense of a permanent thing, was it?

LS: No, but there probably was a signing of an intent to cooperate, wherein it was of interest to one or more of the parties. I went to the first meetings in Phoenix, [Arizona], and early on it became apparent to me that they sent their vice presidents. I thought that it was essential, then, that we would follow with the Chief Electrical Engineer, and I did finally have Art Williams and Sam [Samuel] Nelson, then General Manager, attend. It happened that on the very plane that we were flying to this meeting, we had the Chairman of the Board of the Edison Company, who was very interested in seeing that the organization move ahead. Out of the meeting which we had at Phoenix, there was an agreement to participate

in hiring a consulting firm, I believe, the Bechtel Corporation.

TC: Yes.

LS: But, anyway, out of this meeting, the consulting firm was commissioned to make an engineering study as to where there were possible coal-fired sites in the various states involved. The study was to include the economics of building these power plants. It was our office that had staff and sufficient information for the consulting engineers, who paid us several visits. They were informed of the important element of water. We had records of a number of sites where the important element of water could be had, and this was incorporated in their final report. A report was made up and I attended the meeting in Phoenix, together with the associated members. The Edison company didn't like certain things in the report, so that those of us who had copies had to return such. It was a very good report; it had the various sites where later on several plants were built.

TC: That would have been sites like . . .

LS: The Mojave [Project], Navajo [Project], the Palo Verde Nuclear Plant in Arizona, Intermountain Power Project.

TC: What nuclear plant? San Onofre?

LS: In Arizona.

TC: In Arizona. Oh, Palo Verde [Power Project].

LS: Yes, Palo Verde. Then there's another coal-fired plant in Arizona. I can't remember the name right now. It would be in eastern Arizona. Then there was one east of Las Vegas that hasn't been built as yet. The Nevada Power Company has a vital interest in that because the Nevada Power Company has the right to a lot of coal.

TC: Yes.

LS: Then there was also one site near the national park east of Saint George, [Utah]. It became evident they'd never get a permit for that because of the air quality, which would affect Zion National Park. So I've named about six to eight sites.

TC: Yes, that's about six or eight, yes. They were all in that first report?

LS: All are built, except those in eastern Nevada, which were sponsored by the Nevada Power Company. The Department has an interest Nevada, where they have bought a piece of railroad for future coal hauling. This is the White Mountain Project.

TC: Yes.

LS: Well, Nevada still has a site that has possibilities. The plant will be coal-fired. Out of the WEST Associates came coal-fired plants and one nuclear plant.

TC: Well, in these meetings, who would take the role of chairman, for instance?

LS: The Southern California Edison Company spearheaded the organization and their men took the leading role. As the

projects developed, somebody from either Nevada or Arizona would take the lead for projects in their respective states.

TC: That would be the Salt River Project or . . .

LS: Yes, it would be the Salt River Project for the Navajo Project and Arizona Public Service for the Palo Verde Project.

TC: Oh, okay.

LS: Salt River was included in the WEST Associates because the Department of Water and Power insisted that we include them, and also Burbank, Glendale and Pasadena. So Burbank, Glendale and Pasadena have certain benefits, either in the Mojave or the Navajo Projects. The power is wheeled by the Department of Water and Power to the respective cities.

TC: When you say wheeled, I've seen that term and I think I know what that means.

LS: That is to transmit the power over the Department lines. The participating city takes its share at an interconnection with the Power System. For example, the Department's energy from the Mojave Plant, which is by Bullhead City, [Arizona], (near Laughlin, [Nevada]), is transmitted by the Edison Company to the Power System at convenient interconnections. Now everybody goes to Laughlin.

TC: Laughlin, yes. Right, that's near Las Vegas.

LS: The Edison Company takes the energy to a station just west of Boulder City, Nevada and then we have a receiving station or switching station--McCullough--in which we have a tie.

TC: Okay.

LS: And you account for the exchange of power. In a period of time, the power can go one way or another.

TC: So wheeling charges would be what it would cost to transmit that.

LS: Yes, they set wheeling charges by contract between the two parties.

TC: I'm just getting the terminology straight.

LS: Yes.

TC: So WEST Associates . . . It's interesting that the Department wanted to bring in some of the other non-investor owned entities into the whole picture.

LS: Yes, and governmental agencies also, which is reasonable so that you could not just point to the Department as having a selfish interest or selling public power "down the river," so to speak. That's my view.

TC: Yes.

LS: It was a good move because the opening was there and it has proven a huge success for all concerned.

TC: Well, did Edison at first balk at the idea or did they say, "Oh, no, that's fine. Bring them along, the more the merrier?"

LS: No, I think they recognized that it was wise to be that way. And business being what it is, it takes care of itself.

TC: Well, at this period, this is the same time that the whole matter of the [Pacific] Intertie is being discussed and planned. I wanted to start talking about how the Department got involved in that.

TAPE NUMBER: 3, Side B

November 21, 1989

TC: Let's talk about the background first. I know that an intertie or interconnected systems all up and down the coast had been talked about for some time. And it wasn't really until, I guess, the late fifties that any action, anybody started to move on that. How was it that the Department first heard about this or got into it?

LS: The federal government was interested in interties, both east and west, from a time zone that could take care of peaks. The other thing is they had a tremendous amount of surplus on the Columbia River. You realize that when that water starts to flow down the river, electricity is generated. And if you don't have the customers, then you just waste the energy because the water must move downstream.

TC: So you just let the water go? Is that the idea?

LS: Yes, otherwise it would go over the spillways, as the reservoirs are filled.

TC: Yes, okay.

LS: If the water didn't go through the water wheel generators, due to lack of customers, it would be just a waste of energy.

TC: Yes.

LS: But, anyway, there was a lot of talk of it and so the government "fished" around. I don't know the full story. I

know that [Edgar L.] Kanouse was involved with the negotiations and then Ivan Bateman, William S. Peterson and maybe others. There was a great deal of conversation and correspondence. And then, of course, the privates, Southern California Edison Company and PG and E, being the large users of electrical energy, thought that the best solution for southern California then would be a combination of the Edison Company and Department of Water and Power. The Department of Water and Power then brought in Burbank, Glendale and Pasadena. Northern California, PG and E, participated by constructing two 500 kv lines to northern California. This 500 kv system is built to Bakersfield. Here is an intertie with the Edison Company. So the big users of electrical energy have their interties, and then economically, they use all the surplus energies. It's very important to the economy of the west, California and the United States, that they avail themselves of these energies. Maybe the surpluses aren't there now, but later on it developed with Bonneville [Power Administration] on the northern end, and thirteen states and Canada can participate. The government took care of their interests through the Bonneville Power Administration system. We now, through interties, are connected to thirteen western states and Canada. And a deal was finally struck with Canada. With a lot of the water coming out of Canada and not having dams that could generate electricity, the United States

contributed to the construction of these dams. Deals were struck among the various participants. Consequently, the Department avails itself of energy out of Canada developed by hydro.

TC: Well, as the Power Resources office, were you assigned to look into the idea of the Intertie or what the Department's role could be?

LS: Some of the original work was probably done by Ralph Durke and I wasn't that familiar with it. I was asked to go to several meetings but I only had a minor part at those particular meetings.

TC: Would they be meetings of . . .

LS: These meetings would be of Bonneville, the Edison Company, PG and E and the Department of Water and Power. They were held in San Francisco, primarily, for the early planning. At that time, I think the government was pushing for a direct current line. The state of the art was a little questionable. I know Mr. Kanouse, together with the Edison Company's William Gould, made visits to England and to Sweden to see DC installations firsthand.

TC: Yes, I know Sweden had some demonstration projects.

LS: ASEA, yes. ASEA, at that time, had a line from England to Denmark. Sweden had a direct current line operating successfully. Mr. Kanouse and [William] Gould for the Edison Company, who later on went on to be president and chairman of

the board, visited these facilities and conducted and spearheaded a lot of the meetings that led to the selection of a direct current line for the southern end. PG and E being a shorter line, had two 500,000 volt AC lines into the Bay Area and as far south as Bakersfield.

TC: So they're the western part of the Intertie. I want to talk a little bit about the technology of direct current. Why was that not economically feasible? Wasn't direct current the original form that transmitting electrical power took?

LS: No, that goes back to the difference between Messrs. Edison and Westinghouse. When it became practical for lighting by direct current, this was the economical way to go. Street lighting became a practical reality in New York City. There were direct current motors and other direct current equipment. But Westinghouse was intelligent enough to know he could transmit AC electricity at high voltage, and with transformers practical, reduce the voltage to the consumer. Thereby the equipment could be run with alternating current, including lights and AC motors. Alternating current motors were developed which have different characteristics than the direct current motors. Through certain windings and commutators these motors became quite practical.

You asked a question about DC transmission lines. To be economical, DC systems are used on long distances. DC terminals are very expensive. The lower line losses offset

the terminal costs. Also, lower tower line costs offset terminal costs. The next question is: Are DC lines reliable? ASEA developed the system of mercury arc valves (rectifier-inverters) to the state where they were very reliable and economical.

TC: These valves are at the end of the DC transmission line.

LS: At the north and south terminals.

TC: At the terminals.

LS: So what you do is deliver the electricity, as alternating current, because that's the way it is generated.

TC: Yes, okay.

LS: Then you change electricity to direct current and transmit it as such. At the receiving end, it is then transferred back to the alternating current where it goes into the system of the utility at the prevailing system voltage.

TC: Yes, okay.

LS: In between the two terminals, an economical tower line can be built because you only have, technically, two conductors. You have a positive and a negative conductor. The higher voltage used, the more power and energy can be transmitted. The economics is such that it takes time, at least 600 miles or more before it . . . Otherwise, such transmission system competes with alternating current.

TC: I see.

LS: This DC line with DC/AC terminals would fit into the systems. So the balancing feature is the economical transmission line. There was a private company that offered to design and build a DC/AC system for the Pacific Intertie. It was the Foley Company, and they proposed a "guyed" tower structure. This structure would have been about three and one-half ton in weight, as opposed to a free-standing tower which would be about ten tons. The savings is not only in the tower but in the conductors, and the insulation, which is very expensive, including the construction thereof. So it was carried forward all the way to where the Pacific Intertie was built with, primarily, guyed towers. The Intermountain Power Project, which has a DC transmission line to Adelanto, has free-standing towers. These towers must weigh, I would say, seven to ten tons each, as contrasted to three and one-half tons for the guyed towers of the Pacific Intertie.

TC: How was ownership worked out? Who owns the Intertie?

LS: The original plan was the Edison Company would own 50 percent and get title thereof, the Department of Water and Power 40 percent, Burbank, Glendale and Pasadena, a total for the three of 10 percent. Now that they have constructed a parallel terminal facility, they've upped the DC line up to 3000 amps or more. I read that the Edison's entitlement is not the original 50 percent, and there is a new contract involved, which has altered the ownership shares. However, it's a good,

sound facility. There are problems at the northern end as to what you pay Bonneville for handling blocks of energy that are generated by other utilities in the thirteen western states and also Canada.

TC: What are the problems?

LS: From what I hear, they're always saying that the southern participants should build another line into the western states. In other words, not to be restricted, by the Bonneville Power Administration as keeper of the "gateway."

TC: What's the gateway? What is that?

LS: We only have one transmission line and Bonneville is at the other end.

TC: Yes. Well, in some of my reading I noticed that at one point there were two parallel DC lines planned. And because of cost or perhaps the desire to build one first, that idea was scrapped.

LS: I think originally, with the amount of energy that could be available, that at 800,000 volts the design plan was such that it could support two lines. In the preliminary plans, it showed two lines; but later, with the state of the art moving so, they upped the voltage to a million volts. And then later on, developed a paralleling of terminal facilities and that way took care that a second line wasn't necessary.

TC: Oh, I see.

LS: It's an awful lot of capacity to be on one line; but having several utilities takes care of a load drop problem, two tower lines would improve the reliability factor. It was the later state of the art which developed the way the Pacific Intertie is now built for increased capacity.

TC: Well, when you say that a million volts is a lot for one line, does that mean that it's too heavy a load sometimes for the line to carry?

LS: When you drop a load like that, you have to have systems on the ends that are capable of withstanding the shock to the system. You couldn't have a small town and suddenly drop the whole load from the town. The city of L. A., with all its loop circuits and generating equipment with quick pick-up, is able to withstand power interruptions of this magnitude. In any event, load interrupting studies support the planning of these facilities.

TC: It's hard, I think, if you haven't had an electrical engineering education, to visualize dropping such a load. Let me ask you, does that mean that the load is then dispersed into various places? Or is it grounded?

LS: No, when you drop the load at the generating end the facilities are designed to quickly by-pass water around to water turbines. It would be by-passed quickly within seconds, as far as that goes, so you can take the shock of that particular load to the generating end. And at the other end,

you drop the DC line. It's equivalent to dropping the electrical load of the whole city of L. A. The Edison Company being 50 percent, would help in absorbing this load drop. Having integrated circuits around the city, with each receiving station having its own generating source, including steam plants close by that can pick up these loads very quickly, as opposed to hydro which cannot do that quick a pick-up. You can't get water moving that fast. But by design, the steam generators of the Department of Water and Power and the Edison Company are very quick pick-up units.

TC: Oh, I see.

LS: These standby generators will feed into the systems. There would be just a dip that would be hardly noticeable, a flicker.

TC: Yes, I see.

LS: The problems are all calculated through simulators.

TC: Well, getting back to some of the earlier decisions that were made, the Department decided to actually be the one to build the DC line. Is that correct?

LS: It was agreed, I guess, with the Edison Company, that the Department had the engineering and supporting staff to design and construct these facilities. The procurement of right of way is important. Contracting for materials and equipment, together with administration of contracts, was also important. The Department was well suited. I was offered the job, from

the Power Resources, to Project Manager. To see to it that the designs were finalized and that the construction was accomplished. So, in 1964, I undertook the job of seeing to it that the designs and construction were finalized, which were completed in 1970. A contract was signed into a joint venture (City of Los Angeles, Southern California Edison Company, Burbank, Glendale and Pasadena). Bonneville was doing things simultaneously with the Department, each working their respective ends. A similar contract was struck, between Bonneville and the joint venture with ASEA and General Electric, for the respective terminal facilities.

TC: I see, okay.

LS: And that's a long-term deal because the equipment would have to be fabricated. Certain equipment, like the mercury arc valves and other controlling equipment, was done by ASEA in Sweden. The General Electric company had made a deal with ASEA that they would supply other equipment, such as AC/DC transformers, certain control and safety equipment. There were reactors and capacitors and an awful lot of detailed equipment that is essential to the art. That was provided and installed by the joint venture, ASEA-GE.

TC: Now, did DWP's part of it, did that money come out of DWP's pockets?

LS: No, a very good contract was struck, by which the Edison Company and Burbank, Glendale and Pasadena would be given a

bill monthly of what it would take to pay for the coming month's billing. It happened that I was very well-versed at that and I would see to it that we would have an estimate of what the billing would be. I turned these estimated billings over to the Accounting Division who then would forward a bill to the Edison Company, Burbank, Glendale, Pasadena. Later, the Accounting Division monitored actual costs to compare earlier billings. Naturally, the Southern California Edison Company audited the costs and billings very carefully. A deal was made by which there would be a two-man supervising committee of Floyd Goss and William Gould to oversee the design and construction and right-of-way progress. I think that I only met with them twice during the whole course of the design and construction. Their assistants carried on from there. Things went along very smoothly. It developed as the Accounting Division would check from time to time, or every month, that we were doing a pretty good job of billing. The Edison Company, who was the major participant, never complained once. They had two electrical engineers that were assigned to coordinate with us, and we had the best relations I've ever had. And, of course, the Edison Company had their legal staff and their accounting staff auditing at all times. There were certain questions raised. For example, we used some existing towers that we had revised to use on the line. We charged the project a certain amount of money for the use

of the towers. Then there were some joint roads that were used along the tower line up the Owens Valley as far as the Owens Gorge. Charges for such were made for the appropriate amounts. We had the best of relations.

TC: So the billing would be for each month ahead.

LS: Yes, for both design and construction, together with related costs, including indirect costs.

TC: Yes, construction in advance.

LS: That's right. The Department did not have to then finance, technically, the design and construction for the Edison Company's, Burbank's, Glendale's or Pasadena's respective shares.

TC: Okay.

LS: We did not have to do extra financing.

TC: Yes, that's interesting. Now, as far as the contracts went, the first set of contracts dealt with, as you said, the equipment and, I guess, the work breakdown, as it were.

LS: Yes. There was one spec, I can't remember it now, but it had several items which it detailed, the furnishing of certain equipment and the erection thereof, and also the testing and the guarantees and warranties for a period of time. In fact, when the earthquake came, ASEA-GE still were responsible for that equipment, fortunately. There was about $10 million of earthquake damage on the ASEA-GE contract involved there. Of course, that was covered by insurance. The Department, on

the other hand, delineated in the contract that they would do certain services, to wit, the switchracks, the bus work, certain cable for instrument and controls and certain foundation work. The Department was responsible for this earthquake damage, also about $10 million.

TC: It was spelled out.

LS: The Department had a certain amount of "force account" work. It worked out very well. There were certain questions raised because there was a time element involved, and also the state of the art on the controls as specified was quite a question. And as General Electric went way out to try and do it with certain computers, it cost them a great deal of money. They did ask if they could receive certain extras and these were resolved.

TC: Well, was it up to you, as part of your job, to say, "Hey, wait a minute, what is this?"

LS: Yes, it wasn't my final decision, but it was up to me to make the recommendation. Of course, on the other end of the transmission system was the federal government. We both came to a very good understanding of exactly what ASEA-GE had to supply and what we would pay for. The final word for the Department is, always, the Board of Water and Power Commissioners. You realize that any contract you make and any change order thereof has to be approved by the Board of Water and Power [Commissioners].

TC: Right.

LS: The City of Los Angeles, the Department of Water and Power, has a very good managing element, with regard to conduct of business, from where I sit.

TC: Yes, I'd say so. But, of course, the Board not being so technically educated would probably take the advice of the presenters.

LS: Yes, we'd have to develop and have a whole staff in back of it. You have your Chief Electrical Engineer who was well-versed with the conduct of such enterprise. The Chief Electrical Engineer and the heads of the divisions are very competent men, with regard to the conduct of the business described above. They are tops in their field, including the whole United States, with respect to an electric utility. I'm not saying with regard to the research and development of certain equipment. But on the other hand, we're not in the business of going out and constructing facilities where we're not certain that these will be practical.

There's an element, also, with regard to earthquakes. Unfortunately, while all these were specified and we had the Sylmar quake, there were certain things that failed. Nevertheless, the major part held together and was restored, 50 percent within one year, and the total facilities within eighteen months.

TC: That was in 1971, I think, February of 1971.

LS: Right.

TC: That was quite a jolt. Where were you at the time? Were you here?

LS: I was at home, in west Los Angeles.

TC: You were here in this house, huh?

LS: I was in the kitchen. I was just getting up. I realized that I was twenty miles from Sylmar, the epicenter, or where the shock surfaced.

TC: Yes.

LS: And I recognized that that was quite a disaster. We did have power. The Department was able to furnish the electrical load. I made certain phone calls and then took off for the downtown L. A. headquarters. The Pacific Intertie had been turned over to the Operating Division upon completion in 1970. I was called back to rebuild the facilities several months after the earthquake.

TC: Was anybody hurt out at the facility?

LS: The suspended ceiling came down on the operator's head. He was just cut but still moving around. One engineer was driving on his way to the Castaic [Power] Project and the highway was buckled right near the facility. That was Jim Sakamoto. He did pull in and there was the operator and all that. Of course, the facilities were lost. It happened that our communication facility was still going.

TC: You still had the communication facility.

LS: We had our microwave that goes direct to Bonneville.

TC: Yes.

LS: So I could even call Portland, Oregon. We have several communication channels besides the instrumentation and controls circuits. But later on the battery facilities did wear out, went dead, and that was the end of that facility. But the tower line held up beautifully.

TAPE NUMBER: 4, Side A

January 23, 1990

TC: We've been away from this for a little while and I would like to get back talking about the power projects that you were associated with. Last time, we really went into the Intertie in pretty much detail.

LS: Yes.

TC: And I'd like today to talk about a couple of the other projects, starting with Castaic.

LS: Yes.

TC: That was a particularly innovative project, I know, as a pumped-storage kind of project. Whose idea was that to begin with?

LS: Well, I was in charge of the Power Resources and we had Phil Hoffman who worked for us as a civil engineer. He transferred over to city hall from the Power System. He wanted to get back. We had known that he had contacts with the [California] State [Department of] Water Resources, which was planning the California Aqueduct to southern California. Phil had done a masters degree at SC [University of Southern California] on pumped-storage and he was quite intrigued with it. It was a question whether we would hire him here under the Power Resources as a civil engineer. Which we did.

The state was planning to build the power drop to the Castaic Reservoir and they tried to get certain utilities interested in such, including the Department of Water and Power. But none of the electrical utilities would have anything where the state would have full control of the power plant. Phil concocted a deal with his contacts whereby the Department would design and build the power plant and pay the state in energy which they would have generated with the passing of the water from the one reservoir to the other. This was a good deal to both parties. We hired Phil and proceeded with his ideas. Under my direction, then, it resulted in the Castaic Power Project.

To begin with, the state's route was such that they would come down the San Francisquito Canyon. Phil was bent on building a power plant regardless of where it was. The San Francisquito route was not a very good layout. The tunneling and the penstock arrangement would have been very costly and not that efficient. Later on, the state highway department rerouted the ridge route and the result was that it made available a very good reservoir site at the Pyramid Reservoir. This was built, together with a seven-mile tunnel from Pyramid Reservoir to Castaic Reservoir. This resulted in a good penstock location, which the Power System laid out. We proceeded, in difference to the state, to locate a power plant, penstocks and size the tunnel for peaking

characteristics tied to the Power System's need. The state would have built a seventeen-foot diameter tunnel, which would take care of the water requirements. The Power System calculated a thirty [foot diameter tunnel] for peaking with pump storage features, still provided for the state's water needs.

All of the preliminary planning and the economic justification of the plant to fit in with the Power System was done in our office and under my direction. Phil did not have the best of the economic and engineering experience required. He recognized that. Together, we were able to plan and justify a project of value to both parties. We had an office staff of two associate engineers, and Phil, an engineer and myself. We were able to develop a plan which was acceptable to the state. The contract was based upon a seventy-year life and rights to an option after seventy years of operations to renew the contract for another seventy-year period.

TC: I see.

LS: Drawing up a report, which demonstrated the economic justification to both the Power System and the state, the Power System had several meetings with the state presenting such plan. One meeting included Samuel Nelson and the head of the California Water Resources, who was William Warne at the time, together with his staff. We concluded that we could draw up a letter of agreement that later on resulted in the

finalized contract. I then, in 1962, assumed the job as project manager of the Pacific Intertie. The work of the contract for the Castaic Project was completed by the Division that was formed, the System Development Division.

TC: I see.

LS: After signing letters of intent, the Power System proceeded with the design and construction of the Castaic Project. The details that were done in the Design and Construction Division followed very closely to those of the original planning. The Power System sized the tunnel and the plan called for the state to do the detailed design and contract for the tunnel. The Department then would take over at the penstock, including the surge chamber. The Department designed the penstocks and the power plant with transmission of the power to the Department's system. Construction was started in about 1965 or thereabouts. It was completed in 1971 and resulted in what I think is a very successful addition to the power system.

TC: That's the California Aqueduct.

LS: The California Aqueduct divides as it's pumped up the Tehachapis to a point, Quail Lake. There the aqueduct divides into an eastern and western branch.

TC: Is that Quail Lake?

LS: Quail Lake.

TC: Okay.

LS: One branch of the California Aqueduct goes on the north side of the mountains to the Silver Lake Reservoir near Lake Arrowhead. There a power drop is made onto Perris Reservoir, which is the terminal of that leg of the aqueduct. The other leg comes from Quail Lake to Pyramid Reservoir through the seven-mile tunnel, the power drop through the Castaic Power Project onto the Castaic Reservoir. Then it's taken along the western foothills to, I believe, the Morris Dam. This is the terminal of the western leg of the California Aqueduct.

TC: Who manages the power drop on the eastern side there?

LS: There are some small power drops on the eastern side, and maybe some pumping. That's taken care of by the California Water Resources. We considered the economics to the power drop from Silver Lake Reservoir, which would go toward Riverside and terminate at Perris Lake. Under my direction, I determined that it wasn't economical for the city of Los Angeles to handle that power drop. That was the larger power drop. The other power drops are small power drops and it wouldn't be economical for the city of Los Angeles.

TC: Had there been any other pumped-storage projects that you knew of or was Hoffman onto a new thing? Is that what got him going on that?

LS: It was a new development and there was one in St. Louis, [Missouri]. This is the Tom Sauk Power Project. There was also one out of Denver, [Colorado]. I visited both of the

projects, studying the type and feasibility for these pumped-storage projects. Both were very cheaply constructed pumped-storage projects, including reservoir and plant. The one in St. Louis is owned by the Union Power Company, a private company, and the one out of Denver, also cheaply constructed, is owned by a private company.

When I say cheaply constructed, in the case of the one in Missouri, they just shaved off the top of a little mountain peak and then took the rock material and placed it around to form a reservoir. This was concrete lined. There were a lot of problems with leaking after that because it was pretty cheaply constructed. Also, the power plant was an outdoor type, which was designed by the Bechtel Corporation; and the type which I thought would be good for Castaic. But later on, our Design Engineers determined that we wanted an indoor plant and designed such. Also, the plant in Colorado was outdoor, at a very high elevation. They built an earth-filled dam, which provided the upper reservoir, and was very cheaply constructed. A lot of leakage could result, together with other problems.

I may say here that after Phil's retirement, he was hired by the Southern California Edison Company and he did consult on a pump-storage plant. The Pacific Gas and Electric built the Haas Pumped Storage Project, which includes an underground plant, built in the mountains above Fresno. The Southern

California Edison Company built a pumped storage project in the mountains above Bakersfield.

So, since the Castaic Project, two pumped storage power plants have been built in California. I believe they're very successful plants. The Department of Water and Power was the first, to my knowledge, to build a pumped-storage plant in California, but not the first in the United States. There are some in New York. My feeling today is that the Castaic Power Project is one of the most successful pumped-storage plants here in the west, if not the whole United States.

TC: The principle of pumped-storage is that, first of all, it's not used all the time? It's for peaking periods?

LS: It's for daily peaking with due consideration for water delivery. There is a question on stand-by, because of the slow pick-up and characteristics, as compared with a steam generated plant. It is not for emergency pick-ups. So it's a peaking plant with potential economy of use. When we did the original studies, the Department was considering nuclear generation in Tulare. However, other sources of energy were considered and found to be economical.

TC: Yes.

LS: When the Power System has economical energies available within its supplies or for purchase, it would figure into the economics of pump-back operations. The Power System could take advantage of running the operating generators at large

load factors when the rest of the system could not take this electricity. It developed with the Intertie from the Columbia River, which has to flow at times when the north cannot take all this capacity, that there would be energy available to the Castaic Power Project to the economics of the Castaic Plant and to the benefit of the Bonneville System. It later developed, also, that contracts had been made with Canada, with respect to the hydro projects that they have built. With Bonneville, the Department has thirteen states plus Canada, from which energy can be made available.

TC: Yes, right.

LS: And later on, even the Edison Company could use some of this power for peaking. In our Power Resources report we got information from the Operating Division with respect to the daily load curve. And it's very obvious, especially with air conditioning during the summer periods, that a peaking plant of that nature would fit into the system very well. Since then, I've heard that the Edison Company has availed itself of this system and contracts that are valuable to the City of Los Angeles have been made. The economics of this Castaic Plant are such that, when you've got large power requirements such as we have in southern California, that a pumped-storage works out very well economically. Pumped-storage, you've got to realize, as you pump back, that a loss of about 33 to 40 percent is realized.

TC: Yes.

LS: However, there are a lot of people who don't understand the economics. It's such that when you're picking up energy that would be lost otherwise, like the Columbia River, or that you can generate economical off-peak from plants which would be otherwise a problem run at low efficiencies, the benefits are realized. The 40 percent loss at Castaic can be accounted for economically by such as described above. The Castaic Project becomes a tool in the economics of energy for the entire system or those who choose to deal.

TC: But the mechanics of it, the water is stored below, pumped back up, and then dropped down through the penstocks?

LS: The water is dropped for power generation. As an aqueduct, you've got to have two large reservoirs, one for holding it back when the water requirements down below are not needed. The primary consideration is the water conveyance.

TC: Right.

LS: The number one user is the water for water supply. Without two reservoirs, you cannot have pumped-storage. It developed that we were able to size the Pyramid Reservoir and the Castaic Reservoir for both water and electrical power. You've got to recognize it is also a tremendous asset to the state of California for recreation. There is boating and fishing on both these lakes. These were all discussed as the project was planned. I sat in on a number of meetings with the state

engineers and the State Assembly as they discussed these features.

From our standpoint, you've got to realize that when we draw down the water from Pyramid Reservoir, we have a thirty-foot tunnel, as opposed to where the state would have had a seventeen-foot tunnel. When running full bore through these generating stations, we're really drawing down the reservoir at Pyramid at a good clip. Now, when you draw this reservoir, you've got boats out there that are tied up, so there are certain studies that had to be made with respect to the draw-down and their effect on such. You also have supply of the aqueduct, so it's quite a coordinated deal between California Water Resources as they supply this water to the Pyramid Reservoir, and also the conveyance to the Castaic Reservoir.

There is a 1,000 foot head drop between the two reservoirs, all requiring a well-coordinated plan. It's not a simple hydro plant, nor is it a simple steam plant, as far as that go. A steam plant you are able to fire up; you have high-speed pick-ups like we had at Harbor Steam Plant, which is now on cold stand-by. But as the system grew, all features were designed in a manner that would fit into our system. All these features are taken under consideration with respect to the detailed designs.

Now, Phil always wanted to consider going to very large hydro units, 400 megawatt units. The only one in the world

that ever had such size of generators was the Soviet Union. And from my standpoint, I indicated that 200 megawatts was a practical machine for that size plant; we'd have six units. The state insisted upon the seventh smaller unit so they could have bypass features if there was trouble with the larger units. Consequently, there are now six units with a small bypass unit, I believe about 50 megawatts.

All these detailed designs were done by the Department of Water and Power, the Power System, Design and Construction Division, and the state, of course, approved all the plans. With respect to their tunnel, the Power System sized the tunnel, the state did the detailed designs. The tunnel has steel lining in places where they felt it was necessary. There is a curve in the tunnel. The state didn't think they could do that. The Power System influenced the routing of the tunnel, and, consequently, I feel that we have a very good design.

TC: Now, Castaic Lake and Pyramid Lake had been there prior to this?

LS: No, no.

TC: They hadn't been there?

LS: No, no, by the state abandoning that part of the ridge route, it opened up a very good reservoir site. There is a peak there, which is like a pyramid; that's how it got the name of the lake. The state designed a rock-fill dam at that location

and formed the Pyramid Lake. That was all planned and designed and constructed.

TC: I see.

LS: The same at Castaic. Castaic Reservoir site was picked by the state. A very long and expensive earth-filled dam was constructed there. This reservoir has the capacities that integrate with the Castaic Project. The size of the reservoirs and the resulting dams had to be planned and built. There was nothing there at the time of initial planning.

TC: I see.

LS: Castaic Lake is not the best dam location. It has a very long earth-filled dam and it was a very costly project.

TC: Yes.

LS: However, it fits the system very well. Now, it's been operating since about 1971 or 1972, in that area, and here we are in the nineties. That's eighteen years. Not bad.

TC: That's not bad. Well, what comes next? Was it Navajo [Power Plant] or IPP [Intermountain Power Project]?

LS: Well, after I finished as Project Manager of the Intertie, I was appointed Engineer of Construction. I was given the additional duties of the McCullough-Navajo [Transmission Line] and coordinating parts of the Navajo Power Generating Project. This project was managed by the Salt River Project Authority headquartered in Phoenix, Arizona. The Power System built a

transmission line from McCullough switching station to the Navajo Power Plant. I was made Project Manager.

We had two partners, the Nevada Power Company and the United States Bureau of Reclamation. Both partners have a small percentage interest; however, their contract was such that after it was designed and constructed by the Power System, the Nevada Power Company took over the operation and maintenance of the line. They now operate and maintain a 500,000 kv transmission line, designed and constructed by the Department of Water and Power. Progress payments were made by the partners so that the Department does not have to finance or put out for the design and construction of this project. It worked out very well.

TC: Well, the Navajo Plant is at Lake Powell. Is that right?

LS: Lake Powell, yes. The lake provides for the cooling water. With every thermal power plant you have to have cooling water. The site was selected with that in mind. The fuel, coal, was hauled in economically by unit train. The design and construction was managed by the Salt River Power Project, which is a public entity out of Phoenix, Arizona.

TC: Yes. Out of Phoenix, right.

LS: Yes. They hired a consultant engineering staff to design and manage the construction. The Salt River Project worked with a committee from the participants, Arizona Public Service, L. A. Water and Power, Nevada Power Company and U. S. Bureau of

Reclamation. There's two lines that go to Arizona. They were built by Arizona Public Service Company, a private organization, into the Phoenix area. So they're the three major transmission lines transmitting power from the Navajo Power Plant, one to Nevada, the McCullough switching station, and the two others to Phoenix, Arizona. The Navajo tribe also receives power from the Navajo Plant, and transmit such to their customers.

TC: Now, do Salt River and Arizona Public Service compete for the same customers?

LS: They usually have separate service areas. You could say they compete. The nature of electrical distribution to individual customers is such that you do not have two service lines. Each utility has its own service area. Duplicate lines are neither economical nor practical.

TC: So they break it up into areas.

LS: Yes, they break it up into areas.

TC: What they can agree on.

LS: By agreement or by the state's or governing body's direction. In the process of getting right of way, the Power System went across Indian reservations, U.S. government lands, the State of Arizona lands and private lands. It's quite a job of right-of-way procurement. One of my jobs on this project was meeting with the Bureau of Land Management to get their permission; the U. S. Bureau of Indian Affairs, trips to

Washington, [D.C.], meetings with the state of Arizona, together with their legislature, certain Indians and their attorneys. This in itself is quite a job, just the right of way alone. Meeting with private citizens for the procurement of their lands or endorsement to public lands is a job in itself.

TC: Yes. I have here a paper that you gave at Las Vegas in November of 1970 at the State Multiple Use Advisory Board Meeting on rights of way.

LS: Yes. I'd forgotten about that.

TC: What are some of the issues? I'm sure it gets pretty complicated because you have . . .

LS: With these vast so-called desert lands, government lands, the transmission lines become quite a factor to be reckoned with. And then, of course, if you have power plants, such as the Four Corners, with its effluent gases making people complain here and there, this presents more and more problems to the government with respect to siting of power plants. And I'm sure as they did for the Intermountain Power Project, the site had to be moved to several locations because it was argued that the plume would affect certain national parks. So this meeting at Las Vegas was designed not only for transmission lines, but at the time, for bikers and off-road vehicles that were tearing across the desert. Today they have that big race from Barstow to Las Vegas for bikers and off-road vehicles.

TC: Yes.

LS: The bikers and off-road vehicle riders wanted to have their say with respect to their rights to the government lands. The government had to also look out for the environmentalists as to the effect on the deserts. Now, when we built the transmission line to the Navajo Plant, we hired experts, out of the University of Arizona, on Indian life so that we didn't desecrate any of the Indian items that were in the ground, whether it be graves or extinct village ruins. We didn't have any of these problems when I did the Intertie. It becomes increasingly difficult as we go across the country with lines, with respect to environmental concerns.

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TC: Well, the difficulty then has to do with being sensitive to whose property it is. It sounds like it's a balancing act.

LS: Yes, you have to mitigate anything of their concern. I could go on indefinitely with regard to private people who want to make sure that they get their just dues. And also, we do not take such direction that would diminish the value of the rest of their property.

TC: Well, these rights of way agreements, are they a pretty standard thing that they just sign, or do you have to sit and negotiate with each party?

LS: We have our right of way and land agents that are very familiar with problems connected to the particular parcel. These agents have the usual papers. Then, of course, hanging over the landowner's head is eminent domain, where such is appropriate.

TC: Yes.

LS: The Power System has the power of eminent domain in Nevada. I met with the Nevada state legislature on the Pacific Intertie, together with our Legal Division, to establish that we had these rights. We also hired legal counsel out of Reno, [Nevada], who would see to the problems of eminent domain,

including court processing. Each case is contested on its merits. It's not a simple matter.

TC: Oh, yes.

LS: Our right of way agents probably have a simple form, but they negotiate each parcel on its own merits. Then, of course, once the appraisal consultants have set the price, the Department can pay so much above such. If the private owners want more than such, then you have a problem. We have to go to court to settle such matters.

TC: Oh, I see.

LS: The management of right of way procurement is quite an art. It's also quite an art to see to it that your team understands that there are other costs besides just simple dirt. There are economic and intrinsic values to both parties.

TC: Yes.

LS: So I will say this, I spent a lot of time out on the desert, on the road past Reno onto the Oregon border. Also on the Navajo line, I met with some private parties concerned that during the construction that they had suffered damages to their cattle, with respect to the birth of calves, where the contractor had broken the fences and range bulls had taken over their cows. I had a little background with respect to the cattle business, and I was able to meet with these people and to settle certain understandings as to rights and costs.

TC: That's great.

LS: But it takes a good staff, all the way from right of way of land, legal and transmission line design engineers to locate and build a transmission line. It takes a lot of organization, well-experienced.

TC: Well, getting back to the plant itself. It's coal-fired. Why was it chosen to be coal-fired? It's close to Glen Canyon, why wasn't hydro put into effect there?

LS: The government has the hydro there generated by Lake Powell, so there's no more hydro available. I have to take us back to where I've made statements that I was in charge of a Power Resources unit attached to the Power Executive Office when we formed the WEST Associates.

TC: Yes.

LS: In there, the Power System had plans for a number of power generating sites to use coal-fired plants. Together with coal, you have to have cooling water and potable water, with regard to steam generation. So WEST Associates hired the Bechtel Corporation and they made a report. And in that report they determined what was available at these sites, and one of these sites was the Navajo plant. The coal would come from the Black Mesa, [Arizona]. It's the same mining site which has the coal that is delivered with slurry to the Mojave Power Plant. It was determined by the Edison Company, who designed the project together with their consultants, that the slurry method would be good for the Mojave Plant. In the case

of the Navajo Project, the designers determined they would have their own railroad system which would provide trains that would deliver coal from the Black Mesa site and be used purely for the plant. That figures into the economics of the project. So you have to have the availability of the coal, the availability of the cooling water, and then also the transmission lines. All that has to figure into the economics of plant siting. Then, of course, where you have several partners, this all figures into the economic feasibility of the plant sites. So this how the site was selected. It happens to be on the Navajo Indian reservation, which created certain problems because the contract with them stated that a certain number of Indians would be hired. We hassled all through the project, with respect that the participants didn't live up to that particular segment of the contract.

TC: Was that because of the level of training?

LS: It was the level of training. They contended that there was bias and things like that. So it's the training and then you've got unions and availability. The housing for workers was there, but they did have to supplement the housing. Part of building a large plant like that is that you have a segment for the construction crew that will come in and has to be taken care of. Then, after the construction, the construction crews disappear and you just have an operating crew.

TC: Yes. So the idea for Navajo originated within WEST Associates then?

LS: WEST Associates more or less crystallized it, but you could say that the Department of Water and Power, the Nevada Power Company, the Salt River, the Arizona Public Service and the Salt River Project were all looking at those sites prior to the actual construction thereof.

TC: Okay.

LS: Studies are being made all the time as to plant siting.

TC: Right. Well, who first approached you about it, about getting involved in the Navajo Project? I mean, who came to you and said, "Hey, wait a minute, why don't you guys come in with us on this Navajo Project?"

LS: Well, the Edison Company was more or less pressing for the WEST Associates.

TC: Yes, okay. We've talked about that.

LS: And so I went to a number of meetings and it developed that I thought that they were dealing at a higher level than I was. On one of the flights to the meeting with the participants, there was the Chairman of the Board of the Edison Company.

TC: Yes.

LS: So I determined that it would, at a certain point, take a very high level to finally sit down and make an agreement.

TC: I see, yes.

LS: So then we took Sam Nelson who was General Manager of the Department of Water and Power, and Arthur Williams, the head of the Power System, and we determined at the meetings in Phoenix that we would participate in forming WEST Associates. This would include participants from Utah, Colorado, Salt River Project, Edison Company and Nevada Power and Light. The Department insisted upon also including Glendale, Pasadena and Burbank.

TC: Yes.

LS: So out of those meetings WEST Associates was developed. Then they set up the terms and hired the consultant, the Bechtel Company.

TC: Did you have anything to do with the Western Systems Coordinating Council?

LS: I never was connected with that.

TC: I know that has to do with electrical reliability council.

LS: Yes, I think the reliability council formed three areas in the United States to manage the problems of reliability for such areas of concern.

TC: Yes.

LS: It all springs from the proposal by the United States that, due to the time zones, they could take over and then transmit energy and work out efficiently the entire United States.

TC: Yes.

LS: Naturally, most utilities are opposed to the federal government taking over the direction of the power systems. And I think it resulted in the formation of dividing the United States into three areas. The one you're talking about is the West[ern] System.

TC: Yes, the Western Systems . . . Okay.

LS: And it includes the private and public utilities. There are much more private utilities.

TC: Yes.

LS: The blackout which they had in New York City in itself would call for some coordination among the utilities, with respect to reliability.

TC: Yes. When you read about that--you, being you or your associates in the Department--how was that taken? Was it kind of an unbelievable thing? Had anything to the extent of the Northeast Blackout happened before? Or were people not surprised?

LS: Our colleagues who were familiar with the layout of the New York system, its radial system instead of loop system, they were not surprised at what happened. Our belt system allows for more flexibility, hence more reliability. Through a belt system, problem areas can be dropped and remaining loads can be handled by the generators available, owned or inter-tied to utilities so contracted. The Power System has one or more generating systems to each one of our receiving stations and,

consequently, the city of L. A. has a much better system for reliability than New York. Our interties with the Edison Company and Pacific Northwest leaves us in a very good position with respect to reliability for generated power. New York learned a lot with that blackout and, consequently, I'm sure they rectified certain things.

TC: Well, did the Department have to reassure the public right after that, that it wouldn't happen here? Were you flooded with phone calls?

LS: Yes. When there's a problem in any part of the United States, with the news media as it is, you have to assure the public and the politicians that you understand what took place there and what the Department must do to see to it that we're in a better position. The Department did present to its customers and others an analysis of our differences.

TC: Yes.

LS: The same goes for earthquakes. As soon as you have an earthquake, you have to explain that the City of L. A. with its designs and construction will not be subjected to the degree of damage in other areas where earthquake factors re not considered to a large extent. The degree of earthquake consideration is good for the reliability of the systems.

TC: Getting back now to Navajo, there was a period when you were, at one and the same time, Project Manager for Navajo and

Project Manager for the Intertie. Did that overlap for a period? I have a note here that in 1970 . . .

LS: It might have overlapped for a short period, but then I was finally relieved of the Intertie. You've got to remember, we had an earthquake and I had to go back to the job of rebuilding the Sylmar switching station.

TC: That's right.

LS: We were probably in operation at Sylmar with a small part to be completed. So I probably was relieved of the duties of the Intertie for a short period until the final closure of the Pacific Intertie Project, including the Sylmar station.

TC: I see. So when you returned to the Intertie, that was in the aftermath of the earthquake.

LS: Yes. The tower line and everything was operating when the earthquake hit in 1971. I was relieved before that because we turned the facilities over to Operating Division. I merely was brought back for the reconstruction of the Sylmar earthquake damage. That assignment was by letter from Floyd Goss. Now that I think about it, Goss was one of the first ones in the formulation of the Western System Coordinating Council. Goss was instrumental, together with the Edison Company, in forming this council.

TC: Yes. What was your connection with the Intermountain Power Project? Were you closely associated with that?

LS: No, I don't think I had anything ever to do with IPP, outside of the fact that as they started to form their project offices we were able to assist in how you set up project procedures, including the accounting and billing to the various partners. We also assisted the Castaic Project. The Intermountain Power Project wound up with some of the top personnel.

TC: I'd like to talk a little bit about what you know about it. I guess the idea originated with the Utah companies and then the Department was approached to participate.

LS: Yes. When you go into different states, you've got powers that will insist that they're the ones that are going to set up the terms in which you come into their states. Utah Power and Light, naturally, is a big supplier of most of Utah, if not all Utah, and they had these various power sites and plans for such. They also have ties to certain coal supplies.

TC: Yes.

LS: As the negotiation began, it finally boiled down to Utah Power and Light and several municipal or public utilities. That relationship probably wasn't palatable to the Utah Power and Light; so, with the shakedown, it finally wound up that Utah Power and Light pulled out. The city of L. A. became the major player. The L. A. Power System finally took over the project management. This includes procurement of all these permits. Included was how the coal would be supplied. A railroad was built to the main existing track so that the

project was not a captive of a certain coal field. The governor of Utah entered into the picture, insisting that the coal come from Utah. It becomes a program for the state when you do that.

TC: Yes.

LS: I wasn't involved with any of these plans or negotiations. I am just pointing out the problems which must be resolved in any large project such as the IPP.

TC: Well, you were close enough that you knew what was happening.

LS: I was close enough to know. There were a number of engineers that came out of the Castaic Project, such as Mr. Erickson. Then James H. Anthony finalized the project.

TC: Right. Now there's direct current, is that correct, from the Intermountain Power Project?

LS: Yes. They finally determined on DC transmission, to my surprise. I was consulted by some of the engineers from System Development as to the economics and practicability of whether it should be a DC line or an AC line, also how it would connect into our system. I felt that a DC line could go to the Victorville area. And it resulted in that. Finally, our engineers from System Development, together with Transmission Line and the Project Engineers, figured a DC line from the Intermountain Power Project to Adelanto, in the neighborhood of Victorville. I may note also, with the experience we had in the Intertie, they determined that it

would be more economical or practical to have free-standing towers of a higher height. The standard tower is probably more than 110 feet to the bridge. The Power System has built a tower line which I feel is economical and effective, as opposed to the guyed towers on the Intertie Project. The Pacific Intertie towers are still the most economical towers you could ever build, believe me.

TC: Why is that? What's the difference?

LS: The difference in weight of tower and ability to erect such inexpensively.

TC: Yes, weight.

LS: A guyed tower on the Intertie weighs about three and one-half tons, the IPP line probably weighs anywhere from seven and one-half to ten tons. So there's a difference in the steel and the construction thereof. Also, the four footings cost more than the four guys. It's quite a job not only of designing, but locating a line across the country before all the individual tower sites are finalized. You're locating sites as you're building part of the line. You have to have flexible designs that will be finalized as you start the excavation for the footings.

TC: Yes.

LS: The location and the design and construction of a long transmission line is quite an art.

TC: Well, do you have to go out beforehand and decide on the route that the line will follow. Then do you, at that point, say, "Well, okay, here we will have a tower," and then you mark that off somehow and then proceed?

LS: No, between the engineers and the surveyors, you survey several routes and then ascertain the most practical, and then also whether you can receive the rights of way and the permissions from the governing bodies. And you then do a paper location of the tower sites, with respect to the profile of the land including the conductor sideswings. Starting with the line to the Navajo Plant, the paper location is now done by computer. The Bonneville Power Administration set up a program by which they can do it by computer, so we were able to get that program. Our Design and Construction engineers modified this program to fit our specifications. The type of tower and location is done with feeding the surveying material into the computer program. The computer then plots the location of towers and a ground profile. You have a center line profile with appropriate profiles where needed. As the line crosses highways or any other obstructions, the program is so set to allow for such.

The next thing is sideswing. The experience we had in the Boulder lines comes in here. As the line passes through certain hilly terrain, the conductor must be allowed to swing out thirty degrees from plumb and still maintain required

ground clearance. This includes variables of temperature, ice and wind.

So these are the things that the locating engineer has to take into consideration. The computer has saved a lot of money. The final location is determined after the surveyor "flags" out the site and the transmission engineer agrees or makes adjustment. The transmission engineer should be versed in footing engineering, including soils engineering. It's quite an art is all I can tell you. There are very few people that are qualified all around.

TC: Well, how many men did you have working under you on this?

LS: Well, out of the Design and Construction Division, is the Surveying, Civil Engineers, Geologists, Structural and Transmission Design Groups. There could be thirty men.

TC: You can call on quite a pool.

LS: They were very well coordinated. It happens that our organization has built up to a highly qualified group, but they do need management, as any other organization needs. I'll tell you that.

TC: Yes.

LS: And, uniquely, I happen to have had experience in all the engineering and construction areas required. It was a nice job, as far as I'm concerned, coordinating all this talent.

TC: Well, by the time the Navajo Project was finished and, I guess, you went back to the Intertie to repair it and then . . .

LS: The Navajo was not completed until I got the Sylmar back in operation.

TC: Okay, yes.

LS: I continued the Navajo Project while the Sylmar station was put back in operation, turned over to the Operating Division. I then completed the Navajo Project.

TC: Oh, I see.

LS: I was Engineer of Construction and then was assigned to Assistant Engineer of the Design and Construction Division before the McCullough-Navajo Transmission Line was completed. The completion was assigned to the Engineer of Construction. The line was at least 90 percent complete at the time.

TC: I see, okay.

LS: I know we were behind schedule and Howard King would call me and berate me for not getting the contractors finished on time. I tried to tell him that the contractor would pay for any energy that we had to buy as a result of not being completed on time. And it's true, we were able to buy energy from the Edison Company and the contractor paid for what it cost us for that energy, as per the terms of the contract. This was taken out of his progress payment withhold.

TC: Well, what were some of the projects that you were involved with in those last few years after the Navajo Line was finished? You became, what, Engineer of Design and Construction?

LS: I became Assistant Engineer of Design and Construction.

TC: Assistant, right.

LS: [K. O.] Cartwright was the Engineer of Design and Construction. We were completing the third unit to the Scattergood [Steam] Plant and then Cartwright asked me to see to it that that project was closed. It's quite an art to see that the Design and Construction Division completes the final end of a power project and also that you then disband the construction groups, the material warehouse and the tool warehouse connected with the project. That's just a small job, but I did little duties like that, in addition to the regular duties.

The Castaic Project had problems with respect to the braking of the unit to a shutdown. The project suffered a million dollar damage on the water wheel's braking surfaces. In fact, the original water wheel turbine is at the project. This was supplied by the Japanese, the Hitachi Group. I saw to the coordination of the solving of the problem, which originally was thought of as a lube oil deal. It turned out to be that the steel plate segments that are forced up by the oil into the braking surface were oversized, and consequently

went into bending. With the consultant engineer, we finally, after much looking around found the problem and the solution.

TAPE NUMBER: 5, Side A

January 31, 1990

TC: Last time we were talking about your having been called back to Castaic to solve a problem there with some of the equipment and I just wanted to go over that again so that we didn't lose that particular incident.

LS: We had problems with "the burning up" of the braking system to the water wheel. The braking system involves a series of steel pads that are then pressed against the water wheel to stop the rotating of the machine before any damage is done.

TC: I see.

LS: And this mechanism failed. The Power System Design Engineers retained consulting engineers, in addition to the manufacturer's engineers. All had difficulties determining whether it was in the oil pressure system or not. A lot of time and money was spent on that assumption. I then entered into study, conducting the meetings with the consultant engineers and the various engineers of the Department and the manufacturer, to try and ascertain as to why they weren't making any progress. At the time, I was Engineer of Design and Construction.

Finally, the consultant engineer determined it was in the sizing of the braking pads. The manufacturer had never made this large of a machine. The generator company, ASEA of

Sweden, just extrapolated the size of the braking plates; consequently, the plates went into bending, which the company didn't realize at first. The consultant engineer was able to finally put his finger on this, so that solved the problem by reducing plate size. In the meantime, to replace that turbine rotor for the water wheel, the price was one million [dollars]. Today it would be much costlier.

It just shows that in the coordination of a Design and Construction Division, you still have to have management enter into the picture to settle problems as they arise in the design and construction. I'm sure that this takes place even in the maintenance of the Department of Water and Power facilities.

TC: Yes. What was the company that manufactured that piece of equipment?

LS: ASEA of Sweden manufactured the generator, with these questionable plates.

TC: Oh, was it?

LS: Hitachi was the Japanese company that supplied the water turbine.

TC: Also, last time you just mentioned that you were called on to the Scattergood Unit 3.

LS: Yes, when I was Assistant Engineer of Design and Construction Division. In constructing a large project, there's always a problem with completing the project. Little odds and ends

come up and it's a question as to when you get off the construction phase, even though the plant is under operation and maintenance. There's odds and ends that have to be completed. That can go on forever if you don't have somebody well-acquainted with how to close out these immense projects. I'm sure that other utilities have the same problem. So I was called in to close down Scattergood 3 plant construction.

It's a question of getting the design engineers to finalize their little changes. Also, the construction, to coordinate and get their work done, to close down the warehouse with its surpluses. The sale of surplus material or certain material that can be turned over to the Operating Division for their warehouse supplies must be determined. This may involve some very large equipment. You can wind up with millions of dollars worth of surplus on a single power plant. Also, there's the tools and equipment use by force account. We have a certain amount of force account, and so we have an appreciable tool inventory. It takes a person well familiar and qualified to disperse such. I've had this experience. We had certain problems on Scattergood 3 to proceed with dispersement. I entered into the management and closed down the tool room and warehouse facilities.

TC: Scattergood 3 had a troubled existence, I guess. It was constructed in what, the late sixties? But you weren't able to use it until sometime after that.

LS: No, no, the problem was that the permit by the Air Quality [Management District] was only for gas-fired. Fuel gas was not available at all this time. While the boilers are designed for both oil and gas, when operating on oil, the plant was required to operate at very reduced rates. The Power System always had contact with the EPA [Environmental Protection Agency], the federal agency for air quality control. The Power System tried to get so that we could burn fuel oil, because of fuel gas not being available. The plant itself is very good. There are no problems with Scattergood 3 that I know of. I understand today that they finally have the permission to operate up to full capacity. On that they have the cooperation of the gas company to have a fuel gas.

The Edison Company has the same problem in this air quality basin. Eventually, you'll find that most of these fuel-oil-burning plants will be taken out of the L. A. basin, due to smog controls.

TC: You think so?

LS: Oh, yes.

TC: So you mean that the plants in existence now will eventually be decommissioned?

LS: Yes, they'll be decommissioned. So far, the only one I know is, of course, the Harbor Steam Plant that is on cold standby. I don't know if it's ever been run for a number of years. The only one we actually demolished and removed was the Seal

Beach Steam Plant, which was acquired from the L. A. Gas and Electric Company, which has long since gone out of the electrical utility business. The gas operation has been taken over by the Southern California Gas Company.

TC: Yes.

LS: We also had a power plant in the downtown area, the Alameda Steam Plant, which had small generating units and probably about twenty-eight or so boilers. These were dismantled a number of years ago. The plant was procured in the takeover of the L. A. Gas and Electric electrical facilities.

TC: Well, from your vantage point of having been involved in the planning of not only the steam generation plants but also some of the coal-fired, and you were close, at least, to the Nuclear Projects Office, at least aware of what was going on there . . .

LS: Oh, yes.

TC: Where do you see it going in the next, say, ten or twenty years, if they have to decommission the steam plants in the basin? What's the alternative?

LS: Well, if you're talking ten to twenty years, there'll be deals made with the Pacific Northwest. They have the resources to build coal- or gas-fired plants. There is a lot of fuel gas still in Wyoming. In fact, they're building a pipeline right now from Wyoming to California. There'll be deals made. There are no problems with transmission. We'll be able to

build DC lines great distances, so we can tap the eleven western states. Wyoming, Montana, they could build plants there, and use any of their surpluses. We can even take energy surpluses from Canada. I imagine we're buying a certain amount of energy from Canada as it is; but we have to have transmission via the Bonneville Power Administration over the Pacific Intertie line.

TC: Yes.

LS: I understand they're planning future arrangements to have our own transmission lines into the Northwest, outside of the Bonneville's control. I see a good area of the Northwest, with respect to their fuel and ability to burn in smogless or smog-free areas.

In the great distant future, I still think there's a future for nuclear. I think with the experience at Chernobyl, a lot of information will come out that will demonstrate that we can still have nuclear plants in certain locations. Now, we have the nuclear plant in Arizona, west of Phoenix, in which the Department has a certain equity. I think the experience that that plant will develop will demonstrate to the powers that be and to the public that there's still a role for nuclear plants. There has to be a trade-off, due to the smog and other contaminants that are emitted by these coal-fired plants. I'm sure that the Intermountain Power Project is one of the finest ever built from the effluent standpoint.

This plant has electrostatic precipitators; and also they've gone to bag houses. When you go to bag house, you've gone to the ultimate.

TC: What's that?

LS: Well, they have fiberglass bags which actually filter out the particulate matter from the stack.

TC: I see.

LS: This is a tremendous expense because you have to constantly clean these bags. There is a certain amount of sulfur that has to be dealt with. Sulfur is probably one of the biggest culprits in the coal-fired contaminants. The residue has to be dealt with. Special dump pits, with special leakproof linings are used for disposal of sulfur. It's an ever ongoing thing for the contaminants. When it comes to nuclear, you're talking about the spent fuel. But, yet, the spent fuel of all the power plants in the whole United States, not counting weapons supply, could probably be put in an area as large as ten football fields. We're not talking about a great thing. I'm talking about spent fuel. You still have to decommission the power plant if you ever put one out of business. But on the other hand, we're still talking about maybe fifty acres. It would have to stay for hundreds of years. But after all, our mountains are there for millions of years, eons.

TC: Yes, yes, right.

LS: So I think the public is going to have to finally reckon with nuclear, and the government, too. I think we can learn a lot from France. We don't hear too much about it, but France has got a number of nuclear plants.

TC: Yes.

LS: And the Russians haven't given up on nuclear. Chernobyl was quite a disaster, especially when you move out a whole city of thousands of people, and that city will just stay there forever.

TC: Yes.

LS: Southern California, with the density of population and the automobiles, has quite an air quality problem.

TC: We were up in Canyon Country over the weekend, on Sunday, and that place is just mushrooming.

LS: Yes.

TC: With the incredible demand on water and power up there, when you start to think about it, it's overwhelming.

LS: I followed that Canyon Country all the way when it used to be just truck farming, and the Newhall family controlled large areas. I used to run up to the San Francisquito power plants in the early days and pass all these fields. Now they're covered with homes. I'm well-acquainted with the changes. I have friends in the Canyon Country. I see the growth at Valencia. The residents formed the city of Canyon Country, which takes in Saugus, Newhall, Valencia and even goes out

over as far as Sand Canyon to the east and Magic Mountain in the north. I'm very familiar with that. The population growth is going on from Santa Barbara all the way down to San Diego.

TC: Yes.

LS: With the amount of people that have moved in here, the problems connected with water and power are going to be a tremendous challenge in the future.

TC: Yes.

LS: And it wouldn't surprise me that eventually the so-called Snake River-[Samuel] Nelson Plan to bring water to the Colorado [River] will take place. Of course, you would generate power to pump it up the elevation required, but then on the drop you can generate electricity, a certain recovery. There probably would be about a 40 to 50 percent loss of energy in the process.

TC: Yes.

LS: But that could take place because we're not going be making water from sea water for a long time. That's a very expensive process. And when they talk about wind power and solar power, that's a very small percentage of the requirement. I think in the future that we'll have to tap the Northwest with its fossil fuel and then we'll have to have nuclear at some time.

TC: I do want to talk a bit about some of the alternative energy options and problems with the environment, but I wanted to

hold off on that for a minute, just to finish some of the more chronological issues just prior to your retirement. One of these, there was a changing of the guard around 1975. I guess, [Robert] Bob Phillips retired.

LS: Yes.

TC: And Carl Tamaki came in as interim GM [General Manager]. I just wanted to get a sense of why . . . Did Tamaki not want to remain as General Manager on a permanent basis? Do you recall or were you at all involved in any of that deliberation?

LS: I wasn't really involved, but I sensed that the Board [of Water and Power Commissioners] was set upon bringing in an outsider, so-called outsider, and Tamaki didn't care one way or another. So he was willing to take on interim General Manager, and he handled it very well.

TC: Yes.

LS: And then, of course, we brought in [Louis] Winnard.

TC: Winnard, yes, Louis Winnard.

LS: It's always a problem when you bring in outsiders--I use the term loosely--because it takes a lot of experience and talent to move into a large organization. There's a certain amount of politics and public relations. A knowledge of the general area and its problems is important. The plant facility must be understood. The Department has an efficient, ongoing organization in both the Water and Power.

TC: Yes.

LS: And it can be managed through the very qualified employees. The Department has a good promotional system and well-built plant facilities.

TC: Why did the Board want to go outside either the Water System or Power System in the first place?

LS: Oh, I think from time to time that it is felt by, say, the Board or others that that's good for the organization, to turn it over, so that you don't get a "crony" system.

TC: Yes, like a new blood sort of thing.

LS: Which is maybe all right, it's true, and from that standpoint, from where I sit, that seems all right. It's a demonstration that the organization in itself is well-organized and can stand tests from time to time and demonstrate that it's nicely constructed. On the other hand, if you become too lax and aggrandized with yourself, it's true, you'd go off in an area of organization and management that would not be the most cost effective.

TC: Yes.

LS: And also, we have to serve the public here. We have a public responsibility.

TC: Well, I want to also talk a little bit about the relations of the Power System to other levels of government, starting with the Board. Sometimes the plans, the strategy of the Power System, ran up against opposition right within the Board. For

instance, on San Joaquin, the nuclear projects, some of the Board people weren't as enthusiastic about that. Did you find this to be the case along the line?

LS: Yes, there may be some of that. But you can see in a developing area like greater Los Angeles, southern California, the problems of water and power call for constant planning. Now, which brings up the environmental impact reports. Millions of dollars can be spent on reports. Some degree of intelligence should be exercised in this area for the good of all concerned.

TC: Yes.

LS: The San Joaquin Nuclear Plant, there probably was ten volumes from consultant engineers galore. It's not a simple matter. In the old days, we'd ascertain that this was it. In fact, for Castaic, the state did the impact report. All we did was demonstrate the economics, cost effectiveness of a pumped-storage plant, and we didn't have to go into these environmental impact reports in a never-ending situation.

TC: Yes.

LS: Certain members of the Board are naturally environmentally oriented, as opposed to career people who have to supply the water and energy. There's a time frame that has to be met. When you consider spending ten years to develop these major projects, and the lifetime career of a person being about forty years, you're spending 25 percent of your time just

planning. If the planning goes down the drain, you've got an appreciable loss. Planning is an ongoing problem. It is no simple matter to furnish this community or all of southern California. It's not that simple!

TC: Yes. How about relations with City Council? Did you generally see that to be a smooth process?

LS: The Mayor has personnel that sit in on the Board meetings and is privy to talk with anybody, the General Manager or anybody within the Department of Water and Power. They review the ongoing business from time to time, so good relations are developed. It takes more personnel, but there are checks and balances that take place. The Mayor appoints the Board members, with the Council's approval, and that's a good procedure.

I understand now, in reading the newspaper today, that there's going to be a measure put on the ballot by which the Council wants to approve certain contracts for construction and maintenance and things of that nature. I believe that the Board system as set up is the best plan there is for governing the Department of Water and Power for the benefit of the people of L. A. I have been a citizen of L. A. for over seventy-seven years and I think it's one of the finest arrangements there is. When you put too much bureaucracy, a chain of approvals is a very costly thing. The inefficiencies are immense. The burden is borne by the rate-payer. The

rate-payer, together with the environment, is very important in this area.

TC: Yes. This gets to sort of a final point about these alternate energy sources. They're just not economical, I'm beginning to understand. If you drive up towards Tehachapi or towards Palm Springs and you see the huge windmills up on the ridge there . . .

LS: Yes.

TC: First of all, who owns those? Are they privately owned?

LS: Well, those are privately owned by companies selling share bonds. It's common knowledge, you know, everybody knows the government encouraged that with certain tax benefits. The number of tax benefits are such that it encouraged manipulators to solely benefit. A great deal of shareholders took appreciable losses in this enterprise.

TC: Yes.

LS: So it's more than a measure to get these fringe areas of energy. You also now have a situation where other private suppliers can supply energies. Some are economical and others are not economical. The price of energy has gone up. Before I retired, we talked of 3 mil energy, 5 mil at the most.

TC: Yes.

LS: Now you're talking about three and five cents a kilowatt hour for generation. That's a big difference.

TC: Yes, right.

LS: And we're just talking about the energy. Then you've got transmission, distribution and the commercial enterprise. The costs of these items have gone up. We're still in the low-cost end of the business, but you have to be constantly vigilant. You get into some of these fringe areas and you start providing some of these benefits and pretty soon the costs are going to go up too high.

TC: Well, I guess, let's take the solar plant out by Barstow or Daggett.

LS: Barstow or Daggett, they're practically the same area. One was set up as a partnership. It was run by Edison Company. The Department of Water and Power was involved, and also the federal government. It's now on coal standby, shut down. It's not economical. Then you have two private suppliers out there. One made the newspaper the other day. It has oil standby, in which when you aren't supplying the energy by solar, they're running an oil-fired steam plant. It caught fire the other day, sustaining an appreciable loss.

TC: Yes, yes, I read about that.

LS: We are getting a number of suppliers that are entering the utility field and there is going to become a point then when we have to maybe shut off a number of these because they're not that reliable. We're not putting enough premium on reliability. Reliability is one of the things that the public

utilities, private or public, are furnishing the citizens of L. A.

There was one time we used to have a red dot on clocks. We don't have them anymore. When we had the red dots on clocks, you didn't see a red dot in a year sometimes, and that's how reliable a system L. A. had.

TC: I don't understand. What's the red dot? What is that?

LS: These clocks would have a red dot, so if you lost the energy, the electrical clock would show a red dot even though the clock started up when power was renewed.

TC: Yes, right.

LS: If it stopped, then you were on notice. If it started again, of course, you could read the time, which was not correct.

TC: Yes.

LS: By seeing the red dot, you knew that the power supply went out. Today they don't even use it.

TC: That's right.

LS: But that's one indication of the reliability of the system. I've been here umpteen years and I've had clocks all around here with red dots--no more. I've been in one house for fifty years and I don't think I've been out of electricity more than five occasions. That is tremendous.

TC: Yes, that's tremendous reliability.

LS: And if you were to go to some of these other suppliers, you would be out for hours, a number of times a year.

TAPE NUMBER: 5, Side B

January 31, 1990

TC: Well, we have covered a lot of topics over these last five interviews and I don't really have anything else I need to cover, as far as my information goes. I'm wondering if you have any . . . Have I missed anything, in your estimation?

LS: No, we've covered quite a field. I was thinking in comparison to others, I don't know of anybody that has covered as much as I have, all the way from generation, to transmission, to distribution and general facilities.

TC: Yes.

LS: I've been involved with every facet of the Power System. It just fell that way, starting with my cost control efforts.

TC: Yes.

LS: I worked out in the field as a sagger on transmission lines; I lived in construction camps; I've gone over most of the states of California, Utah, Nevada and Arizona, belonging to the different committees. I've been all over the system, I've covered the field very thoroughly.

TC: Well, yes. I think your vantage point is very valuable and I think that that's why this interview will be a very valuable historical resource for what's happened and also to begin to anticipate what's going to happen to the future needs. So I

just wanted to, on tape here, thank you for the time you've put into this. So, thank you very much.

LS: Thank you for the opportunity and confidence.

END OF INTERVIEW