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Los Angeles Department of Water and Power

POWER SYSTEM ORAL HISTORY PROJECT

MEMOIRS OF A NUCLEAR ENGINEER:

AN INTERVIEW WITH EUGEN KOFFMANN

Interviewed by Thomas Connors
The Bancroft Group

Dates: October 13, 1989; October 20, 1989;
November 3, 1989; December 1, 1989;
December, 15, 1989

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BIOGRAPHICAL SUMMARY

PERSONAL HISTORY:

Born: January 15, 1916

Education: Early Education Dnepropetrovsk, USSR; Russian High School, Berlin 1934; Berlin Institute of Technology (Diplom Ingenieur), 1938; Oak Ridge School of Reactor Technology, 1956.

CAREER:

1939-1941	Machinery Designer, EIMCO Corp.
1941-1944	Power Plant Designer, Utah Copper Co.
1944-1946	Equipment Designer, Westinghouse Electric
1946-1952	Mechanical Engineering Associate, LADWP
1952-1953	Assistant Piping Design Engineer, LADWP
1954-1955	Heat Cycle Piping Engineer, LADWP
1955-1956	Assistant Engineer, Steam Plant Piping, LADWP
1957-1960	Nuclear Engineer, Nuclear Design, LADWP
1961-1962	Engineer, Nuclear Engineering, LADWP
1962-1963	Nuclear and Staff Engineer, LADWP
1963-1966	Senior Engineer, Nuclear Engineering, LADWP
1967-1974	Nuclear Projects Manager, LADWP
1974-1978	Consultant to Nuclear Regulatory Commission
1975-1988	Lecturer in Engineering, University of California, Santa Barbara
1986-1988	Consultant to Pacific Gas and Electric

MEMBERSHIPS:

Seismic Design Committee of the Nuclear Utilities
American Nuclear Society
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Tape Number: 1, Side A

October 13, 1989

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

EK: On my birth certificate it says January 2, 1916, but the birth certificate is based on the Old Style calendar which is Julian. It has changed now to the Gregorian calendar, so my true birthday is January 15, 1916. I was born in a city that had a number of names. The original name was Ekaterinoslav, then it was changed after the Revolution to Dnepropetrovsk, then to Brezhnev, and now it's changed back to Dnepropetrovsk. I don't know what it will be in the next ten years, but that was essentially my birthplace.

My father was Russian-born, my mother was German-born. I was born a year before the revolution. The revolution came in 1917 and, of course, after the revolution, you had civil war, mass terror and famine, between 1918 and 1922. My father, who belonged to a privileged class--fairly well-to-do--was killed in 1919. I was only three years old, so I didn't know him to speak of. Because of my background, I was discriminated against. My father was wealthy, my grandfather was a banker. I had limited educational opportunities. I was not permitted to go to college and, essentially, I was scheduled to be sent to the Gulag. The Soviet government set up a series of classifications of people who were going to go to the Gulag: if you belonged to a former class, if you had relatives in a foreign

country, et cetera.

TC: If we could jump back a minute, the town that you were born in, did you grow up in that town as well?

EK: Yes. I lived in that town for seventeen years.

TC: Seventeen years. And where was it in relation to Moscow?

EK: It was in the Ukraine.

TC: In the Ukraine.

EK: It was on the River Dneiper where a large hydropower station was built, Dneprostroy, one of the first large hydro projects of the Soviet Union.

Between 1922 and 1929, living was relatively peaceful. Of course, the living conditions were very bad. My mother, my brother, and my former governess lived in a seven-room apartment, which we shared with five other families. There was no running water, and privies were outdoors. And outdoor privies in Russia in the winter were very cold. (chuckling) You have to do it real quick.

Then, of course, came the collectivization, which was 1929.

TC: You said that your father was from a privileged group. What was his occupation?

EK: He had a degree in law, but my grandfather was a banker and my father was a factory manager. He owned part of the factory and he was managing it. He belonged to the capitalistic class, if you will.

TC: Yes. And what was the factory? What did it produce?

EK: The factory was a paper factory, essentially. They produced envelopes, they produced a variety of paper products. It was a fairly large factory.

TC: And that was immediately taken over, no doubt, with the revolution.

EK: That was taken over. So was my grandfather's bank. And my grandfather had to spend about half of his life after the revolution in jail. The Soviet government was run by people who had no economic background, and one of the things that they knew was that my grandfather's bank had assets of--I forget the number--let's say $100 million. But the actual money that was found there was only $5 or $6 million, which was standard. Well, they didn't know that you didn't have to have all the money in assets. They suspected my grandfather was hiding the gold either in some underground caverns or he was transferring it to some Swiss bank or French banks. So my grandfather had to sit in jail and write checks to French and Swiss banks in order to recoup the alleged assets, which he didn't have. He finally died when he was eighty-four. He died in jail.

The basic problem with the Soviet government was that the people who came to power were people without much education, that became successful in the Civil War, and believed that most of the problems could be solved with a gun. And that, of course, ruins a country economically. The country was run by nincompoops who were successful

revolutionary politicians but otherwise didn't know much about society.

TC: Well, with the education that you did get . . .

EK: I graduated from a seven-grade high school, which was the intermediate school, and I started working when I was about fourteen years old.

It was during the collectivization in Russia, which was 1929 to 1932, when the government tried to reform the agriculture. And their idea of reforming the agriculture was sending all the efficient peasants to the Gulag and really starving the country. It was a horrible time. In the Ukraine, which has about 30 million people, about 5 million people died from starvation. That's one in six. You had bodies lying on the streets, indiscriminate shootings, mass starvation, and it was very rough. That was essentially my Russian background.

TC: Yes.

EK: I was lucky because my mother was a former German citizen and, through the German government efforts, she, I, and my brother went to Germany in 1933. We arrived in Germany about two weeks before Hitler came to power. But Germany was a considerable improvement for me, in spite of the fact that I was again discriminated [against] because of my racial background, being Jewish, and was also scheduled for the Holocaust.

I went to a Russian-German high school to pick up

German. I graduated in 1934. It was very hard work, but I managed. And then I went to the Berlin Institute of Technology and graduated in mechanical engineering in 1938. The Berlin Institute of Technology at that time was one of Europe's leading engineering schools. It was equivalent to MIT [Massachusetts Institute of Technology] or better. The German high school graduate is more advanced than the American. An average German high school student graduates about eighteen or nineteen years old, and the average German college degree is obtained about twenty-four or twenty-six, so you have a couple of years more training than you have in American schools. It's equivalent to our masters degree. I left Germany in 1938. Things were getting hot.

TC: Can we back up a minute here?

EK: Sure.

TC: So you had German and Russian, as far as your language was concerned.

EK: Right. I can speak equally well. I visit Europe every two or three years and I'm usually taken for a German because my German is fluent.

TC: In growing up back in the Soviet Union, as a Jew, you weren't able to practice the religion to any degree, I would imagine.

EK: No, neither did I have much interest. I come from an unreligious family.

TC: Oh, I see.

EK: My grandfather had no use for the religion and there was a lot of intermarriage with non-Jews. By and large, the Jewish upper class was fairly advanced and religion wasn't much of an issue. Also, religion, after the revolution, was persecuted.

TC: You know, there were a number of Jews that became active in the revolution.

EK: Very much so.

TC: For instance, Leon Trotsky.

EK: Yes.

TC: Was there, in the Jewish nonreligious social circles, some push to get you more supportive of the revolution, or not so much you but maybe your family?

EK: No. The Jews who became prominent in the revolution rejected their Jewishness. As you go back all the way to Karl Marx, who was a baptized Jew, you find a great deal of anti-Semitic sentiment in Karl Marx, and it was always felt that if you became a communist revolutionary, you had to be anti-religious and anti-business. That was part of your dogma: religion was for fools and was used by the exploiters. The Jewish community in Russia was split. The Jews that became communist revolutionaries, by and large, became very strong proponents of anti-religion, and anti-business. There was business and upper class solidarity. If you belonged to an upper class, as was my family, those people stuck together with upper classes, and opposed the

communists.

TC: Yes. It must have been pretty tough for a young boy, to know that, because of your background, there was just no hope of any kind of a reasonable social life where you would prosper and advance. In another situation you might be able to, if you were in the West or something.

EK: I had a special problem. Part of my problem was my mother was German born and a very strong German nationalist. When she married my father she didn't know what she was getting into. She developed a profound hate towards Russia and everything connected with Russia, and the revolution, of course. And her attitude always was to pull me out, to get me to Germany. She instilled in me a dislike for Russia, which was not very difficult considering the revolution. So, by and large, my general idea was to get out of Russia, to go to Europe. As a matter of fact, I have an older brother, and when my mother got pregnant she insisted that he was born in Germany. She went back to Germany. She wanted me also to be born in Germany but, of course, the war came and she couldn't do it. But her general idea was to get out of Russia. She never could really learn good Russian as such. So that was the background.

TC: How many other brothers and sisters did you have?

EK: Just one brother.

TC: One brother.

EK: An older brother. He just died recently.

TC: Now, getting back to, or moving forward to Germany as you left off a little while ago. What was it that brought you to engineering? What was it that helped you to choose the Berlin Technical Institute?

EK: Well, the experience of the Russian refugees. When I went to the Russian-German high school, I found out that most of the professions cannot be transferred, moving from one country to another. If you were a Russian lawyer going to Germany or to America, you'd usually wind up as a doorman or a taxi driver or God knows what. So I wanted to get a profession that was transferable. I also believed that engineering was probably the way of the future and that was the essential reason.

TC: When you were growing up, you said there was a big hydro project there.

EK: I worked on it as a translator. That was another one of those strange deals. Ukraine had the Ukrainian language which was somewhat different from Russian. I went to a Ukrainian school, and learned Ukrainian, and I had to help the Russian engineers to talk to the workers. Also, I knew a little bit of German because of my mother and my former governess, so I was helping the German engineers. I was a translator, in effect.

TC: So the Soviet government got German engineers to come in and manage that project.

EK: Right. The major work was done by General Electric. The

turbines were General Electric. The guy who ran the project was an American, Colonel Cooper. But there were a lot of German, French and English engineers, and all kinds of subcontractors. The concrete, I think, was done by the Germans. Some of the other stuff was done by the British. It's overall management was by the Americans.

TC: That's odd because, by this time, that would be in the thirties, I suppose.

EK: Nineteen twenty-nine.

TC: Was it 1929?

EK: Nineteen twenty-nine.

TC: Oh. Because I know that for a long time there was a boycott of the Soviet Union as a legitimate country. For instance, the labor movement in this country would have nothing to do with sending delegations to the Soviet Union or receiving delegations from there. But you show that General Electric and various other enterprises . . .

EK: Bechtel.

TC: Bechtel was there?

EK: Oh, yes. As a matter of fact, Steve Bechtel died in Moscow. Steve Bechtel was going to get a huge contract in Russia. That was 1932. He was a diabetic and he went there and the Russian medical facilities were such [that] he couldn't get treatment. He died in Moscow.

TC: Oh, he did.

EK: But there were a lot of foreign engineers. Going a little

bit back into history, one-third to one-half of the Russian industry was foreign concessions. The English had a very large share. So did the French, so did the Germans. So there was a long tradition of foreign industrial involvement, and that continued through the Bolshevik Revolution. Armand Hammer was one who had done quite well in Russia.

TC: Yes, that's true. With the foreign engineers, were they supervised by, say, Party people that were making sure that there was not too much mixing of the groups?

EK: Right. There was mixing but it was broken up through the famous Shakhty Process. That was in 1928. That was the first show process [trial] where a group of British engineers--Metropolitan Vickers, to be specific--was accused of conspiring with Russian engineers of trying to sabotage the industry. That became a normal practice. The mismanagement of the country was so bad that the government was always trying to find scapegoats, and the scapegoats were the engineers, the agronomists or the doctors. The first large process, the Shakhty Process, which was a mining engineering process, there were Metropolitan Vickers engineers and a bunch of Russian engineers. The Russians confessed to everything and the Metro Vickers engineers did not and were released. The Russians were, of course, shot. There was a continuous pressure to split the Russian engineers from the foreign engineers. The Russian engineers

had a very rough time, generally, because the government, the Party, always set impossible goals. If those goals were not met the engineers were at fault. If they tried to meet the goal, and wrecked the machinery, then the engineers were at fault again. I can tell of all kinds of horrors.

TC: I suppose that in Russian education you would get a strong dose of Marxism-Leninism.

EK: Well, yes, they had a lot of it. The peculiar aspect of the Russian education was that they wanted everything modern and they used a great deal of John Dewey's ideas, in which you had self-government of the students, et cetera. Later they found out it didn't work and they came back to a very strict, conservative education. But in my time, there were a great deal of experiments; and, because of that, we didn't do too well. Of course, we didn't do too well with the other system as well. But the Dewey system was that you had one group prepare a subject, another group criticize it, and then you switch around. I don't know whether it is still practiced, but that was very popular in those days.

TC: Well, when you finally got to Germany and you were in school there, it must have been quite a culture shock, as far as what you were studying and how you were studying went?

EK: Right. Of course, I went to a Russian-German school, which was a mix of mostly Russian refugees, the upper classes and nobility. But I found that I managed and actually I jumped one class. I did a great deal of self-study. You see,

before I even could get into a Ukrainian school, I had done a great deal of home-study because I couldn't get into school for awhile because of my background. My entire schooling was really short. I had only a year and one-half in Ukrainian school, a year in German-Russian school, and four years at the Institute of Technology. I made it out by studying around the clock, with practically no social activity of any sort, just study, study, study.

TC: And your degree was in mechanical engineering?

EK: I'm a mechanical engineer. I have a German diploma-degree. I could show you my certificate, with a nice big swastika on top of it.

TC: In the mechanical engineering program, was it strictly mechanical engineering or did you take introductory . . .

EK: No, no. Okay, first, the German high school, which I had an equivalent in, has a high degree of math. We had algebra . . . Let me go back a little bit.

TC: Sure.

EK: In Europe, after you graduate from elementary school, from grade school, you are separated. Some would go to liberal arts, others would go to technical school. If you went to general high school you could study religion, law, history, literature. That was the standard university. The ones that go to a technical school [Realschule] would get a great deal of math and science. So by the time you graduate from a technical high school, which I had, you are well-prepared.

It's roughly equivalent to at least one and possibly two years of American college. After that you get into your technical university and you get two years of basic science, and then the last two years you specialize. My specialty was power generation and turbine design.

TC: Oh, I see.

EK: But that is the basic European approach: Whoever wants to go liberal arts gets a general education; if you go technical, you get special training.

TC: When you were studying this material--in my own reading of the history of nuclear experimentation 1938 was when [Fritz] Strassmann and . . .

EK: [Otto] Hahn, yes.

TC: . . . published some of their work. Were you aware of that at that time?

EK: No. In 1938, my major effort was to get out of Germany because that was during the Czech crisis, as you might remember, when Neville Chamberlain came to Berchtesgaden.

TC: Yes.

EK: And there was a very serious threat of war--it was touch and go--and I was trying to get out. I got my degree working around the clock, and got out.

TC: You said that when you got to Germany you felt some discrimination.

EK: Well, there was anti-Semitic discrimination but, still and all, as far as living conditions were concerned it was a

vast improvement for me. Peculiar. At that time, nobody took Hitler seriously but 1934 was the turning point when it became clear that Hitler was going to stay. That was the killing of Ernst Roehm.

TC: Oh, yes, that was in the purge of the storm troopers.

EK: Right, the "Night of the Long Knives," or whatever it was called.

TC: And so, by 1938, you were looking to get to the U. S. or to France or England?

EK: No, I had a job offer from Australia. I was going to go to Australia but before going to Australia I thought I'd visit the U.S. At that time, it was very easy for me to get in the United States because I was on the Russian quota. The Russian quota at that time had about 30,000 people, but very few could leave Russia so it was easy to get in. And I liked the U.S. and I'm still here.

TC: And you're still here, yes. (chuckling)

EK: Yes, I had a job offer in Canberra, actually, a commitment.

TC: Was it a private company?

EK: No, it was government. Canberra is the capital of Australia and strictly government. It's like Washington, D.C.

TC: What was the job? Was it engineering?

EK: Engineering. They were expanding. It was essentially construction of the enlarged city.

TC: Oh, yes. The same thing was happening in Washington, D.C. at the time.

EK: Right.

TC: In your thinking of coming to the U.S., or of leaving Germany anyway, and in your engineering education, did you read much or think much about what was happening in some of the big hydro projects here? Like, the Boulder Canyon Project.

EK: I heard about it but I wasn't particularly interested. My specialty was steam. My hydro activity was essentially just as a translator. I was not involved in the technical end.

TC: I see.

EK: But my interest was power plants and that's what I've been in ever since.

TC: So it was specifically steam at that point that you were studying?

EK: Right. Coal, essentially coal. That was, at that time, it. Gas or oil were not considered much of a fuel as was coal.

TC: Just to jump ahead from that, when did it come in that oil and gas began to be used for steam generation?

EK: Well, it was only in California to any large degree. Most of the others were coal. Even in California they were talking coal. But because of air pollution, oil and gas were used here. I think we used most of the power plant fuel . . . oil and gas in California. There was a little bit in New England. Most of the rest of the country was coal. Well, no, I'm sorry, there's Florida. Florida, New England, and California used oil and gas but the bulk

was California.

TC: Again, we're jumping ahead a bit, but that's okay, we can come back and pick up the story.

EK: Right.

TC: I just wanted to follow this thought. So the first steam plants here were coal?

EK: Yes.

TC: The Harbor [Steam Plant] had been one of the earlier . . .

EK: No, I'm sorry, when you say "here," I thought America. No, in California, the first plants were hydro.

TC: Yes.

EK: We started in hydro and then we went to oil and gas.

TC: Oh, so there was never a coal period for steam generation in the L. A. basin?

EK: Not in the L. A. basin, no. The L. A. basin always was oil and gas.

TC: Okay. Getting back to the story, you came to the United States. Did you enter in New York?

EK: Right. I came here in September. It was during the height of the war scare and the ship went halfway through the Atlantic, then it was called, back twice. We were running out of food before we finally made it. We landed in Halifax. That's Nova Scotia, Canada.

TC: Yes.

EK: There we refueled and resupplied and then came to New York.

TC: What was the point of departure?

EK: The point of departure was Hamburg. We went to Ireland-through Galway. Hamburg, Galway, back and forth, Halifax, New York.

TC: So as the boat was steaming across the Atlantic, it got called back?

EK: Right.

TC: And you had to turn around? What was the reason?

EK: Well, there was a war scare. That was September.

TC: Oh, yes.

EK: And as you know, it was touch and go, whether there was going to be war or not. The British practically mobilized, digging trenches in Hyde Park and finally Chamberlain caved in, which was the wrong thing to do because if he didn't Hitler probably would have been overthrown. You probably know that the German army was ready to ditch him if he would declare war in 1938.

TC: Oh, really?

EK: Oh, yes. This is a fairly well established historical fact.

TC: Oh, I wasn't aware of that. When you got to Halifax, then you went to the United States?

EK: I arrived in New York, right, in September.

TC: And at this time, were you still thinking of going to Australia, or by this time had you decided that you'd stay in the U.S?

EK: It was still wide open. I wasn't sure I could get a job here. That was one of my problems.

TC: So you had no contacts here?

EK: I had some distant relatives who provided an affidavit. In those days, you had to have an affidavit that you would not become a public charge.

TC: Yes.

EK: And through some of my kissing cousins, if you will, I received such an affidavit. So I had some contacts, but I still was uncertain whether I could get a job. My English was very poor. But being an engineer, I found out it wasn't all that bad.

TC: Did you study some English in Germany?

EK: Yes, I had the usual English high school course at the Russian-German high school, which was about a year, so I had a little bit of English but not much.

Tape Number: 1, Side B

October 13, 1989

TC: When you got to New York then, and you were, as you said, open, how did it develop that you found work or you decided then to...

EK: I went to an employment agency and they offered me a job at $25 a week, which I accepted. I came to the office and they told me, well, since my English was miserable, they'd pay me $15 a week. So I accepted it, but I really wasn't going to live on that kind of an income.

TC: That was in New York City?

EK: That was in Brooklyn. It was a company that manufactured the metal box or street receptacle where you dump garbage--you see them all around.

TC: Oh, yes, sure.

EK: I was a draftsman. I was there for about six months and I figured I wasn't going to get anywhere. So I went to another employment agency and I got a job in Salt Lake City with EIMCO Corporation. By that time, I was not too enthusiastic about New York, anyway. So I went to Salt Lake City in February of 1939. I worked for EIMCO. It was a small company, manufacturing mining equipment-filters, drums, loaders--and I was with them for about two years. I was a designing draftsman, which means that I was designing components. And again, that was not my line, and I kept looking around and then I got a job with the Utah Copper

Company in 1941. The Utah Copper Company at that time was building a power plant, a 110-megawatt coal power plant, and that was my specialty and that's where I started working. I worked there from 1941 to 1943. I also volunteered for the Army but the Army deferred me if I would teach officer candidates, which I did. I taught at the University of Utah. I taught in the Army Specialized Training Program, ASTP, in which they took graduate students in engineering and made officers out of them, I taught there for awhile.

TC: What was it that you taught, mechanical engineering?

EK: Mechanical engineering and stress analysis. I was helping run a laboratory where you test and calculate the strength of material, simple mechanics of material. The course was called "Mechanical Stress Analysis." Later, in 1944, the Army told me to go to Westinghouse Electric Company in Pittsburgh, Pennsylvania. I was assigned to the transportation department. At that time, they were trying to develop a Navy catapult. If an airplane is to take off from a deck of a ship, you have to have a long runway. They thought they could accelerate it and have a very short runway with a catapult. It's like a slingshot. I was with Westinghouse from 1944 to 1946.

TC: Okay. So you went back to Pittsburgh for this?

EK: Yes. I was in Pittsburgh with Westinghouse. Again, it wasn't quite my line. Also, at that time, 1946, we had a series of strikes and it began to look like we were going to

be out of work. Westinghouse moved us into a hotel. We were in a small hotel room, with tables and we were supposed to do engineering. Every couple of weeks, the union would find out where we were and would throw pickets and Westinghouse would move us into another hotel.

TC: That would have been . . .

EK: Nineteen forty-six.

TC: Was that the Steelworkers Union [United Steelworkers of America]?

EK: It was the Steelworkers. That was the big steel strike. So I decided I'd leave and try to get either a consulting job or start working for somebody. And my old boss from Utah Copper Company, E. J. Franklin, was here and I went to him and I told him, "I'm looking for a job." And he said, "I know Harvey Van Norman, he owes me a big favor." I asked him what was the story on it--and the story might be of some interest.

TC: Yes.

EK: They might not want to put it in the Department history. E. J. Franklin came from Kentucky and so did Van Norman. Their two families were great friends. Van Norman had a rough time. He used to drink a great deal and he used to lose one job after another. The parents of Van Norman came to Franklin and asked whether he could help him, and Franklin said, "I'll straighten him out." He hired Van Norman, I think, as a truck driver. And then, one of those days when

Van Norman got drunk again and sassed Franklin, Franklin said, "Under normal conditions, I would have fired him, but he was a friend of the family and I was going to teach him a lesson. I beat the hell out of him." (laughter) He put him in a hospital. He ripped out his ear with a two-by-four.

TC: Oh, my!

EK: Broke a number of his ribs. In the hospital, Van Norman met his future wife who was a nurse. And between Franklin and his future wife, he straightened out. He became the General Manager of the Department of Water and Power.

TC: Yes.

EK: So when I was sent to Van Norman, Van Norman said, "Well, I'll take care of you, for my old friend Franklin." And that's how I got into the Department.

TC: That's a great story. (laughter) That's a wonderful story.

EK: Van Norman showed me his torn ear. Franklin took a two-by-four, I guess, and hit him real hard. Both of them were huge men. Franklin was about six foot three and built accordingly and so was Van Norman. But Franklin told me he had an advantage because Van Norman was drunk.

TC: So Franklin was here in California at that time?

EK: He retired. He had a beautiful estate at Encino. I don't know whether you know some of the story of Utah Copper.

TC: No.

EK: Okay. Utah Copper really became famous because of the

President of Utah Copper, C. J. Jacklin, who was an electrical engineer. At that time, copper companies used ores with very high copper content, about 2 percent, and the rich ore was running out. Jacklin developed a method where you could use ore with very low copper content. A quarter of a percent could be commercially mined. Jacklin also went to Cyprus, in the Mediterranean off the coast of Greece, which had a lot of copper ore. Between the copper of Cyprus and the mining of low-grade ore, he made Utah Copper great. Jacklin was a friend of Franklin, so Franklin was not just the chief engineer of Utah Copper but also was a large stockholder, and a very rich man. He took a liking to me, and he had been my patron at Utah Copper. I got promoted very rapidly. And also when I was in California, I kept in touch with him. He died a number of years ago. He is buried at Forest Lawn.

TC: So he connected you to Van Norman?

EK: Yes and Van Norman started me at DWP.

TC: You started working then at the Department of Water and Power, at that point.

EK: Right, and I could specify where I wanted to go. I wanted to work in Power Design and Construction, and I started as a Mechanical Engineering Associate.

TC: So Van Norman, at that point, had the power or ability just to plug you in.

EK: Well, a couple of telephone calls. You know how it is. He

was the General Manager.

TC: Who was head of the Power System then, was that Charles P. Garman at that point?

EK: Probably.

TC: So what were your duties as an Associate Engineer?

EK: Well, when I was at Utah Copper, I was in charge of the piping design.

TC: Yes.

EK: When I came to the Department, I was put in charge of the high-pressure piping, the steam piping, which at that time was at the Harbor Steam Plant and then I began to work on the Valley Steam Plant.

TC: On the Valley.

EK: Harbor was fairly well underway.

TC: Harbor was underway but not up and running yet. Is that right?

EK: Well, Harbor had a number of units. Some units, I think, were operating. One might have been operating and I don't know about two.

TC: That's true. I think, in fact, one of those units the Department may have picked up from one of the other companies.

EK: The Los Angeles Gas and Electric Company.

TC: I think so, yes.

EK: Yes, right. There was quite a hassle. The Gas Company went to court and tried to prevent it.

TC: Yes, through condemnation, the Department was able to get hold of the LAG&E's electrical system and, I guess, that included their generating plant.

EK: Right. They also picked up Seal Beach [Steam Plant], but that was a stand-by.

TC: That wasn't used that much, Seal Beach, at that point?

EK: As a stand-by, as a part-time unit, if you will. It was not run full-time, but they were using it.

TC: When there was a need.

EK: Yes. When I got there, Unit 1 was just about finished on Harbor. I think I got in on Unit 2.

TC: So you were actually involved in the designing of the . . .

EK: Piping.

TC: At what point did they start talking about a Valley Steam Plant? Were they talking about it at that point?

EK: I think so. I'm not sure now anymore. I wasn't that high up. I was pretty low.

TC: I was talking recently, just the other day actually, to Laurence Schneider and he was telling me about the atmosphere in the Department in those early days--how there were three buildings downtown and that the Business Agent's and the Sales Departments were over in one place . . .

EK: Second and Broadway. I was in Wright and Callender.

TC: Wright and Callender.

EK: We had to run back and forth. It was very inefficient.

TC: Yes. And he was saying though that there was a lot of

esprit de corps. He said that you had one cafeteria and that Van Norman and E. F. Scattergood would show up for lunch and there wasn't any big separation between the higher-ups and the ranks.

EK: That was fairly normal in those days. (chuckling) Yes, I think, Larry was before me, as I remember. He was also more socially involved than I was.

TC: Yes, he came in, I think, in 1935.

EK: Right.

TC: So he'd been there a good ten years before you. At the time, were you aware or interested particularly in the whole municipal versus private dichotomy that went on in the electric utility business?

EK: Not right away. I would say I got involved in 1949 and 1950. I joined the Speakers' Club and I got involved. I read a great deal about it. I read the Department history to familiarize myself. But I'd just got married in 1947, we had a kid in 1950, so I had my hands full.

TC: Talking for a minute about the engineering teaching that you did during the war . . .

EK: Right.

TC: Did you find a great difference between how engineering was taught in Europe and how it was being taught in the United States, or was it fairly standard? There was more time involved, as you pointed out, in the European educational system.

EK: Well, the Army Specialized Training Program was a very special deal. The Army drafted a lot of people. Some of those people had doctors' degrees in physics, doctors' degrees in mathematics, so you had an elite group, and that elite group I had for three months. They were called "The 90-Day Wonders."

TC: "The 90-Day Wonders," right.

EK: To make them into officers. And some of those people--that was during the Battle of the Bulge--were not too crazy about it. So you had a guy who, let's say, had a Ph.D. in physics come in and say he wants to become a tank officer. So you give him a 90-day course in basics and then after he's just ready to graduate, he flunks deliberately and he says, "Now I want to go into the Air Force." But after the beginning of the Battle of the Bulge, they were all thrown into battle as infantrymen. It was not possible to compare it to any standard teaching. It was an extremely tough course, very fast. You dealt, of course, with very bright people, and you concentrated on a few fields. It was tough on the student, and it was also very tough on the teacher, because you dealt with very bright people who tried to derail you, to delay your presentation. They asked all kinds of questions, they'd give you arguments. My knowledge of English wasn't that good, it was very rough, and very few people liked it for any length of time.

TC: So it was a great deal of stress on you.

EK: A great deal of stress and a great deal of stress on the students. It was wartime.

TC: When you got to the Department, when you started to know the other engineers and see what they were doing, how did their engineering stack up to engineering that you had known and studied? Because the Department had quite a name nationally in power engineering.

EK: Well, the Department was a leader, as you probably know, in high-voltage transmission. They were pretty good on steam power plants, but that was just the start of the operation. And I would say they did quite well, by the standards of the time. They were very thorough and rather conservative. We had two problems, as far as I could see. One of them was that the buying of equipment was rather cumbersome, and getting rid of incompetents was a problem. Usually, you shifted the incompetents around. But as far as engineering was concerned, if anything, it was more safe than private utilities. There was no tendency to cut corners. By and large, the Department's power plants were probably a little bit more expensive than private utilities. Most of the private utilities, as you know at that time, were not doing their own engineering. Edison, for instance, had all of their engineering done by Bechtel.

TC: Oh, so they would subcontract their engineering.

EK: Most of the utilities subcontracted their engineering. The actual utilities that did their own engineering were

Tennessee Valley Authority, Bonneville Power Administration. The Pacific Gas & Electric Company was doing their own engineering but mostly on hydro. We joked: Edison was run by mechanical engineers and lawyers; the Department was run by electrical engineers and lawyers; and PG&E was run by civil engineers and lawyers. Each utility started with a group that tried to keep control of the future operation. PG&E started in hydro with civil engineers, they tried to be on top of the organization and they succeeded. The Department's engineers were electrical, Southern California Edison's were mechanical. The Department's electrical engineering was superb. The mechanical design was less advanced but the mechanical achieved high reliability. That was one of the major goals of the design and operation. We were trying to achieve a competitive cost operation, not only with the cost of the power plant but in total cost.

TC: You said that buying equipment was very cumbersome. In what way was this? Was it just because of the bids and the spec[ification]s that got passed around?

EK: Well, you didn't have much leeway. One of the problems was, for instance, let's say I want to buy a car: I can write a spec where I'll only permit to bid General Motors, Ford and Chrysler, and maybe Toyota. I could write a spec where I would, let's say, write out Yugo. Yugo might not be acceptable or Hyundai might not be acceptable. With the Department, you couldn't do it, because Yugo and Hyundai

would come in and raise the roof, and say that we wrote the strictest specifications, we were discriminating against them, and then we would try to write the spec in such a way that at least we have a standard that Yugo or Hyundai would have to meet. But that was difficult because we would have to write a very liberal spec and, of course, Yugo will come low. And then we have to evaluate it. It's very difficult sometimes to prove that what, let's say, Ford offers, might be a little bit more expensive but, in terms of maintenance, in terms of reliability, you save a hell of a lot of money. You might wind up with a cheaper piece of equipment originally, but over the life cycle it will cost you a hell of a lot more.

TC: Yes, I see, yes.

EK: That was one of the problems. Private utilities don't have to do that. They can just call in General Electric and Westinghouse and say, "What are you offering?" and they negotiate. We couldn't do that. So that was one problem. Of course, on the other hand, in the private utilities, you get in a lot of graft and a lot of corruption. The classical case was the affair with General Electric and Westinghouse. There was a collusion between General Electric and Westinghouse and utilities paid very high prices for turbines. When we bought from English Electric there was a very large saving. So, by and large, I believe in competitive bidding, but I believe in more flexibility.

We used to have a saying that "The best award is to the second lowest bidder," not the lowest bidder, but the second lowest bidder.

TC: You also mentioned about one of the other problems being what to do with incompetent people.

EK: Right.

TC: Was it the civil service connection that created that situation?

EK: Right. It was very difficult, to fire incompetents. We usually had to shove them into dead-end jobs.

TC: So that they would not be let go, but they would be put in a situation where they didn't do any harm?

EK: Right. They were put in some jobs that still were useful but they didn't have responsibilities, they were not crucial.

TC: Well, that really pretty much does it for that early employment period that we were talking about. And I think that we could actually go into some of the 1953 to 1955 period here and just end on that point.

EK: Okay.

TC: . . . We have this situation that you're a piping design engineer and you're still involved in steam plant design.

EK: Right.

TC: Are you at this point thinking about nuclear? This would be a good topic to end on in order to prepare for the next one. For instance, the Atoms for Peace Program was being

announced, in the early fifties, or at least being formulated in the early fifties.

EK: I think it was 1954 or 1955.

TC: How was it that you got turned on, as it were, to working in the nuclear field?

EK: Well, the Department was interested at that time, and they were offered an opportunity to train one engineer, and the Department submitted three names and I was asked whether I was interested. I was interested because by then I had enough piping design, I'd seen enough of general power plant design, that I'd like to do something else. By and large, I tried to move every five years or less because, after all, it becomes routine and becomes boring. So it was a change of pace and I was offered that opportunity and my name was submitted. Three names were submitted, I was selected.

TC: This was for the Oak Ridge School of Reactor Technology.

EK: For Oak Ridge.

TC: Which is about 1954.

EK: It was 1954.

TC: Well, prior to that, were you involved much in thinking about nuclear energy?

EK: No, not very much. I was interested but it was a general interest, just trying to keep up with the latest developments.

TC: You were certainly aware of, probably during the war, talk about the atomic bomb or the possibility of it.

EK: Right.

TC: And I know that, even though it was top secret, there was a lot of hearsay discussion that went around in engineering circles about what was going on and what the possibilities might be. What did you think of the possibility, say, of nuclear fission?

EK: Well, the atomic bomb was dropped on Japan in 1945. In 1946, Henry D. Smyth, wrote a book explaining the basic bomb. I read the book.

TC: Yes.

EK: I also was at that time interested in Russia. I was at one time a consultant to the Office of Strategic Services which was the forerunner of the Central Intelligence Agency.

TC: Yes.

EK: And I discussed Russian industry. At that time, the great interest was whether Russia would have the know-how and the material resources to build an atomic bomb. So I had some discussion on that. At that time, the general feeling was they were going to have a rough time doing it. We found out that was not the case. I was involved a little bit in the Robert Oppenheimer affair. I had a pretty good idea of the nuclear military development. We had it at Oak Ridge, as well.

TC: What was this?

EK: My major interest was military and Russia. I knew of Otto Hahn, Lise Meitner, and Fritz Strassmann. I didn't

think that power development would come as soon as it did. We didn't anticipate Admiral Hyman Rickover. There was a lot of talk that was mostly military talk about submarines, but my major interest was in the future, and it was an interesting subject.

TC: And so, in the early fifties there, 1953, 1954, when it became a possibility, you . . .

EK: I was interested.

TC: You were interested.

EK: Right.

TC: Just before that, the Valley Steam Plant was being planned at that point.

EK: Right, and designed. Yes, I worked on that.

TC: You worked on that?

EK: Right.

TC: Just tell me about that quickly. That was a fairly innovative steam plant, as I understand. It was outdoors, for one thing.

EK: Yes, that was correct. It was outdoors. It used cooling towers which was, of course, not all that different. It was high-pressure, high-temperature. They were large units but, otherwise, it wasn't all that remarkable. . . . There were some other outdoor plants in Texas, as I remember. It was not the first outdoor plant. . . . Some of the refineries, of course, are outdoors.

TC: How about size-wise? Was it particularly large?

EK: No, it was not the biggest. It was fairly big but not the biggest.

Tape Number: 2, Side A

October 20, 1989

TC: I wanted to first go back and clarify a few points from last week's conversation and elaborate a little on a couple of things. One thing is you mentioned that your father died in 1919. What were the circumstances of that?

EK: He was killed by an armed band. Those were the days when the Communist Party under Lenin took the position: "Rob the robbers," expropriate property. Our house was invaded by a group of armed partisans, as they were called. Partisans were a group of people who sometimes robbed on their own, they sometimes became Communists, i.e. Bolsheviks, and they got very rough. My father, who was an athlete, with a great deal of physical courage, wasn't going to put up with it, tried to prevent it, and was put against the wall and shot in the presence of my mother and the family.

TC: Oh, my God. Now you were three at the time, so you really don't have any recollection of that actual event?

EK: I was three. I don't have any recollection. My older brother, who was five years older, did.

TC: You mentioned also that your father traveled quite a bit. In fact, he had come to the United States.

EK: That is correct. He was interested in boxing and he attended the match between Jack Johnson and Jim Jeffries about 1910.

TC: It was quite a long trip for a boxing match.

EK: Well, we were very wealthy. Also, quite a bit of our house furnishings came from America. We had rosewood furniture, we had a Steinway grand piano, we were very well-off.

TC: You mentioned that you did a little stint with the OSS. Was towards the end of the war, World War Two?

EK: Well, I did three things. In the beginning of World War Two, I helped the Air Force to spot the bombing of Berlin. I knew Berlin and, by coincidence, I had a book of photographs of Berlin from the air, which I brought with me, which helped them a great deal.

TC: I can imagine.

EK: Also, I looked at the maps, and spotted industrial installations. That was one thing. The second thing was my lectures on Russian industry, and the OSS wanted a copy of those lectures. And then an OSS lady came over and asked me some questions about Russian industry.

TC: Where were you at this time?

EK: Salt Lake City. I was in Salt Lake from February of 1939 to April of 1944.

TC: Okay. You also mentioned, just in passing, something about the Oppenheimer matter. I was wondering if you could elaborate a little bit on that. From my memory of my reading of it, I know Oppenheimer had some left wing connections. Was that prior to his activity in developing the bomb, and he was sort of called on it afterwards? Is that correct?

EK: Well, the Oppenheimer case was complex. Basically, it is this: Oppenheimer had Communist connections and was probably writing some of their pamphlets. That was not really the issue because General Leslie R. Groves, who was in charge of atom bomb project, more or less ignored it. Oppenheimer was a very gifted man, and an excellent organizer. By the end of the war, his past was more or less out of the picture. The thing that got Oppenheimer into trouble was the hydrogen bomb.

You might recall the debate about the atomic bomb, which Oppenheimer developed. There was a large group of scientists led by Edward Teller who thought we should not drop the bomb on Japan, we should drop it in the Pacific as a demonstration. Oppenheimer objected and he told Teller in effect that, "You're getting into politics. Scientists shouldn't do that. You should leave it to the politicians." Well, the politicians were not sure.

It was partly Oppenheimer's influence that forced the dropping of the atomic bomb on Japan. Oppenheimer took the position in the General Advisory Committee: "We don't really know whether the bomb will work. So if we try a demonstration, and announce that we have an atomic bomb, and drop it in the ocean and nothing happens, this is going to be very, very embarrassing." That influenced the decisive vote on the Advisory Committee to drop the bomb.

After Oppenheimer saw the pictures of what happened in Hiroshima, he got revolted, and he didn't want to use any more nuclear weapons. When Teller was pushing for the hydrogen bomb, Oppenheimer was very much against it. Oppenheimer now turned around and said that the politicians might want the hydrogen bomb but we as scientists should not permit it. And that, of course, got Teller very unhappy. Teller started to campaign for getting the hydrogen bomb, but because of Oppenheimer's influence few wanted to work on it and the federal government was prevented from developing it. This changed when the British discovered that Klaus Fuchs, who worked on the hydrogen bomb, went to Russia and the Russians were working and were very close to getting it. Oppenheimer was overruled but most scientists still backed Oppenheimer. Teller had to start a new laboratory in Los Alamos to work on the hydrogen bomb. Oppenheimer kept agitating against the hydrogen bomb. He said, first, you can't make it; secondly, if you make it, you might start a chain reaction that destroys the world; and this is when his old Communist connection was used against him to get him out of the government.

TC: Oh, I see.

EK: And Teller was mostly instrumental in getting him out. He was called to testify and he said, "I wouldn't trust him." That was the basic story on Oppenheimer.

TC: That's the basic story, yes. But you mentioned you had a small role in that.

EK: I didn't have much of a role. The guy that nailed Oppenheimer in World War Two, was a Russian refugee who was a security officer. During World War Two, Oppenheimer was approached by a Communist fellow traveler or spy trying to get for Russia the information on the atomic bomb, which Oppenheimer refused, but he didn't report it. The refugee colonel [Boris Pash] whom I knew from Pittsburgh interviewed Oppenheimer and, without Oppenheimer's knowledge, recorded the interview. Oppenheimer told a number of lies to protect the Communist sympathizer who approached him [Hakon Chevalier]. Later, when Oppenheimer was called before the security board, he told a different story, without realizing that there were tapes that were contradicting his story. And that is what sank him. Now, I knew this colonel in Pittsburgh and, he more or less indicated that Oppenheimer was shifty. He told that to Groves, but Groves overruled him. Groves took the position that if we kick him out he could be more harm to us. So I know a little bit of Oppenheimer's story through the Russian refugee security officer.

TC: I see.

EK: That's about the only role I had.

TC: Before we get back into the discussion of nuclear power. We left it off last week at about 1954 or 1955, but this was a

period when you were more involved in steam generation design [than nuclear power]. I just wanted to get at some of the problems with steam generation in the Los Angeles Basin. I know that air pollution came up as an issue, a serious issue, in the 1960s with the Department of Water and Power.

EK: Right.

TC: And I'm wondering if in that early 1950s period this was a concern yet, because you were burning gas and oil.

EK: Well, that was the beginning of the air pollution control.

TC: Yes.

EK: (chuckling) It was not taken too seriously. At that time, it was believed that most of it was from automobiles.

TC: Yes.

EK: There were some objections to power plants, but some of the objections were misleading. One of the stories was funny. The first director of the Air Pollution Control District was a retired Marine colonel. He got into a helicopter and he flew over the city and, of course, the first thing he spotted was this steam vapor coming out of the cooling towers. And he said, "That is the major source of air pollution, shut it down." It was believed that discharge from plants could be handled by high stacks and it was believed that the major problem was automobiles.

TC: Okay. Let's start talking now about how you got involved in the Oak Ridge School of Reactor Technology. I know that in

1946 the Board of Water and Power Commissioners authorized the Department to start looking into atomic energy and there was a committee formed. William S. Peterson was on it, Edgar L. Kanouse, Sidney Weiss and Henry L. Transtrom, were on it and they also had a position, an undesignated position for a physicist. First off, this group was supposed to make a report. Did this group ever, to your knowledge, make a report?

EK: I was too low. I didn't know anything about it.

TC: Who was Sidney Weiss, by the way? I know William S. Peterson was at the time, the Chief Electrical Engineer.

EK: I worked with Sid Weiss who was a Mechanical Engineering Associate in the Steam Design Section. He had some physics background but he was essentially working as an engineer.

TC: How about Henry Transtrom? Do you know him?

EK: I don't know him.

TC: And did they ever assign a theoretical physicist for this, do you know?

EK: No. Sidney was probably the only guy that was connected with it. He attended the meetings but his role was mostly as an observer.

TC: Okay.

EK: Samuel Morris was very much interested in nuclear power.

TC: Sam Morris was?

EK: He went to the Geneva Atoms For Peace Conference.

TC: Oh, did he?

EK: He made a speech pointing out that if there was a utility that would be interested it was the Department, because we were big, we had low fixed charges, and we were using oil and gas--we couldn't use coal. So he put the Department on the map, as far as a possible user of nuclear power.

TC: Oh, so he was at the Geneva Conference itself?

EK: He was at Geneva, right.

TC: And then he made this speech there?

EK: Yes.

TC: So you were aware of what was being said at the Geneva Conference?

EK: Yes.

TC: Well, that was fairly significant, I think, because this was a time when just prior to that the consideration of atomic energy was top secret.

EK: Well, not really. You had the Henry Smyth report that described it fairly well. The details were secret but the overall picture was reasonably clear.

TC: As far as what the reaction is there?

EK: Right.

TC: I know it's a complicated matter but, in simple terms, could we just state what that reaction is, because I know that you have a fuel that is fissionable . . .

EK: Right.

TC: And the breaking open of that atom is what creates the energy, the heat, I understand.

EK: That's right.

TC: But to try to get a picture of this in my head is very difficult. What breaks that uranium atom in the first place? Is it breaking apart by itself or is it helped along somehow?

EK: The atom consists of two types of particles, the core of the atom: neutrons and protons. The protons are electrically charged so that they're repulsed from one another. But there is a nuclear glue that keeps the parts together. The smaller the atom is, for instance hydrogen or oxygen, the more glue there is that overrides the repulsive forces. The bigger the atom becomes, as you go from oxygen to beryllium and ultimately to uranium, the more protons you have, the more is the repulsive force there, and not enough glue. So a uranium atom which has ninety-two to ninety-five protons is very unstable.

TC: Okay.

EK: It takes just a little impetus and then the thing breaks open. And if it breaks open, the remnants become separate elements and a number of neutrons become loose and they're converted to energy. So you have a very large release of energy when you split a uranium atom. Now there are two types of uranium. There is abundant uranium, uranium^{238} and rare uranium^{235}. And uranium^{235} is the one that can do it. Uranium^{238} is fairly stable.

TC: Okay.

EK: So most of the uranium is uranium^{238}. Only less than one percent, seven-tenths of a percent of uranium, is uranium^{235}. So first we get uranium^{238}, which is fairly abundant, then we separate the uranium^{235}, which is radioactive and emits neutrons. If there are enough neutrons emitted, you have a chain reaction. You split uranium^{235}, usually in lanthanum and beryllium which are smaller elements, and the loose neutrons are converted into energy.

TC: Okay. What starts the reaction to begin with? I know in a reactor there are control rods and the actual fuel.

EK: Those are poison. You have a lot of loose neutrons available, but if you put in those poison rods, the poison absorbs the loose neutrons so there aren't enough neutrons to sustain a chain reaction. Then if you pull out the poison rods, there are plenty of neutrons now and the chain reaction commences.

TC: It commences. Okay. It was in 1954 that the Department, Sam Morris and Ivan L. Bateman were starting to talk about sending somebody to the Oak Ridge School of Reactor Technology.

EK: Right.

TC: And several names were proposed in April of 1954.

EK: Right.

TC: Now you weren't one of those names that were mentioned first. I don't know if you knew that.

EK: No, I didn't know that. I got in by a fluke. I'll tell you later about it.

TC: Well, you can tell me now. They had picked or pinpointed Grayson Arnold as being the possible candidate.

EK: Right.

TC: But his application was late in going in so sending somebody to Oak Ridge was put off for one year. Now, one of the upshots of that was that F. C. Vonder Lage, is that how you pronounce his name?

EK: Yes, Vonder Lage, he was the director.

TC: He was the director. He noted in a letter back to Morris that, "Well, your man Arnold there doesn't have the mathematics and science background, so he might not be the best choice." So then they started the whole thing again. But at what point were you approached or when did you get into the consideration of that?

EK: Well, I got into the consideration in 1955 practically.

TC: Yes.

EK: There were three names submitted. I was put in just to fill in the names. The basic idea was because nuclear power is way off, you wanted somebody young. I was at that time, in 1954, thirty-eight. I was put in to get three names. They didn't figure that I would make it because of my foreign background, that my security clearance would take too long. But they didn't know that I had connections with the OSS, I taught at the Army Specialized Training Program, et cetera.

I got in. I was selected because I got an immediate security clearance. It was automatic. Also because of my European background. Rickover and his crowd had a hand in selection and Rickover was a violent critic of American education and he always held up European education and European engineering education, as an ideal. All he had to look at was my European degree, plus the security clearance, and I got in.

TC: That's very, very interesting. Rickover was quite a remarkable man, I think.

EK: Yes.

TC: And maybe we could talk about him for a minute here.

EK: Sure.

TC: Because he, at this point, was developing the Nautilus, I believe.

EK: That is correct.

TC: But the engine that he developed for the Nautilus, that was a pressurized water reactor, is that right?

EK: Yes, right.

TC: And was that the first practical demonstration of what this can do, as far as power generating potential goes?

EK: Right. Now Rickover worked, actually, on two things. He worked on a naval power reactor. And the first prototype reactor that was tested was a land reactor. A couple of years later in 1957, he built the Shippingport, Pennsylvania, power reactor. That was operating in 1957.

TC: And that's still operating, I believe, isn't it?

EK: I believe they have a second unit. The first unit is dismantled.

TC: Did you ever get to meet Rickover in any capacity?

EK: A couple of times. As a matter of fact, he was in Santa Barbara just before he died. He came down here about four years ago, made a speech and antagonized everybody in the audience.

TC: What was his speech?

EK: He was talking on nuclear power. A little old lady got up and said she can't sleep because she worries about all this waste that is going to last 250,000 years. And he said, "What are you worried about? You won't be around very long." (chuckling) And similar remarks.

TC: Oh, lord. So, in any case, you were chosen to go to Oak Ridge.

EK: Right.

TC: Okay. One thing that I noticed in the file that we have among the historic records on this period is that there was an agreement that you had to sign.

EK: That is correct.

TC: What was the content of that agreement?

EK: That, basically, after I graduate I stay with the Department, seven years, I think.

TC: Seven years, I believe it was, yes.

EK: Seven years after I graduate, I'll stay with the Department. I don't think it was enforceable but it was a moral commitment.

TC: Yes, it was a moral commitment and, I guess they were investing something so that they wanted to see a return.

EK: Right.

TC: Now the Department paid for your tuition. Is that right?

EK: Right, and the rent.

TC: And you stayed on salary, too.

EK: I stayed on salary, right.

TC: Okay. And so you moved out there with your wife and son.

EK: Right.

TC: And that was for one year.

EK: Correct.

TC: Now there were close to 100 students there. Is that correct?

EK: Ninety-four.

TC: Ninety-four. Where did they come from? What was the general breakdown of their backgrounds?

EK: It was a mix. . . . Originally, it was a Navy operation under Rickover, and Rickover still controlled most of it. So there was a large number of people that were building nuclear reactors and nuclear submarines. There were a number of people from shipyards. There were a number of people from reactor manufacturers: Westinghouse, General Electric, et cetera. There were a number of people from the

utilities, and then there were a number of people that were Navy personnel that would be operating the nuclear submarines. So it was a mixture of Navy people, and personnel from manufacturers of nuclear reactors and utilities. That was basically it.

TC: What was the age range of the students there?

EK: I would say twenty-two to thirty-five. They had a group of what they called "A students," which were students on grants, usually, very gifted students--"A students" usually meant they had a 3.5 to 4.0 average--that were just out of college and then received a grant. Most of them were graduates with advanced degrees.

TC: And their degrees would have been in physics or engineering?

EK: Physics or engineering.

TC: So that they would have been actually studying nuclear energy or atomic physics or that kind of area prior to going in.

EK: Right.

TC: So it wouldn't have been such a new field for them.

EK: There were engineering graduates, the preference was mechanical and electrical engineers. A number of physicists, but the majority were engineers.

TC: How about the instructors? How many instructors were there?

EK: We had about a half a dozen instructors. We had an instructor in physics, an instructor in thermodynamics, stress design and what have you.

TC: Well, did they break up those ninety students into different classes?

EK: No, it was one class.

TC: One class, then. You would be together.

EK: One class, right. There were separate groups in labs but basically the lectures were one class.

TC: Would the instructor gear the lecture to the most advanced or to a middle portion?

EK: A middle portion. But we had to hustle.

TC: Yes, I can imagine.

EK: They were a bunch of very competitive people and I had to keep up.

TC: You'd go to class all day long and then go home and study, no doubt.

EK: Right. There were large assignments. You usually had to work over the weekend. It was, I would say, a sixty hours per week grind.

TC: Okay, so there were several courses that you had to take. Was it a set course?

EK: It was a set course. Absolutely. There were no options whatsoever.

TC: Why don't we talk a little bit about what the courses themselves were? Reactor design, I suspect, would be the main one.

EK: First, you had the basic physics. Then you had the heat transfer. If you look at the boiler on a power plant, it's

a very huge thing. You're talking about a hundred feet high, about forty feet square. That's where you extract your heat. A reactor core, which produces the same amount of heat, may be only about ten feet square and ten feet high. So your heat intensity was very high and you were at the technological frontier, that you had to design from scratch. There were no precedents.

Tape Number: 2, Side B

October 20, 1989

TC: And this also goes for the materials used, I suppose.

EK: Very much so. Not only that, but the materials were bombarded by neutrons and that changes the characteristics of the material. You had to know how the strength of the material is influenced by the high radiation field. That was part of the problem. We were on the technological frontier.

TC: So, in some sense, you probably had to unlearn certain things you had learned before, like characteristics of metals, because you're dealing with a different set of . . .

EK: Well, not so much unlearn, but learn new things, something brand-new. Some of your habits you had to drop. You had to think differently.

TC: You mentioned in one of the reports . . . I happened to go through some of the reports that you sent back. Each month, you sent to [Ivan L.] Bateman a report which was a fairly thorough report, in a summary fashion, as to what was going on there.

EK: Yes.

TC: And you at one point set up the . . . it's kind of a dichotomy between physicists and engineers, maybe we can talk a little bit about that, that initially in nuclear research it was physicists doing that research.

EK: Right.

TC: And then the next generation of engineers came in. Was there an antagonism there?

EK: Well, yes, in a way. Physicists usually develop the concept, the theoretical concept. They set some general ideas. But if the same physicists tried to do the engineering, that was usually a failure. The classical case was the Oak Ridge National Laboratory, which was run by physicists. Another case was General Atomic in San Diego, California. They were run by physicists. They tried to build a number of reactors that didn't work because they simply didn't have the know-how of how to handle the hardware.

They tried to develop the homogeneous reactor which, engineering-wise, was a monstrosity. They tried to develop a nuclear airplane that was ridiculous. They tried to develop a gas-cooled reactor that never worked. They just didn't have the engineering know-how, how to develop a concept into practical application. They were good in the theoretical end, but once they went into practical application it really didn't work.

TC: You may be familiar with this book, I'm not sure. It's called <u>The Cult of the Atom</u> by Daniel Ford.

EK: I know Ford. I know what he writes.

TC: And it's an anti-nuclear . . .

EK: Right. He's an economist. He was a Harvard economist.

TC: And it's mainly about the Atomic Energy Commission, but he makes an odd statement, which got me to thinking, having to do with just what the utilities were thinking when they got into the nuclear industry. He said, "Utilities got into trouble because senior management found itself far removed and unfamiliar with the details of nuclear technology."

EK: That's true.

TC: The implication being, though, that the people involved, the engineers from the utilities, were somehow, you know, behind the times as far as what was going on. He says, "Utility companies lacked experience with the kind of stringent quality control practices that were required in building nuclear plants." And when he's speaking, he kind of lumps time together, so he's not saying that early on this was the case. But he's saying throughout the whole period of the attempt to develop nuclear power in this country, this was a problem. Did you find that to be the case?

EK: Well, not being behind times, but if you are building conventional power plants you develop certain habits, okay? Here you were in a new field. And if you are in a new field, you have to develop new habits and the learning process involves a number of mistakes. The best teacher of engineering over the years has always been to learn from mistakes. You cannot just move from an existing technology into an entirely brand-new technology and not make mistakes.

TC: Yes.

EK: You can't do that. The utility management moved into new technology that was completely unfamiliar to anybody, you couldn't just say that, well, some people did it, all you have to do is how they do it. There was no precedent. Yes, we made mistakes.

TC: The mentality of that is very interesting. Here you are at Oak Ridge and you're with a group of very bright young engineers and others. Were you aware of the newness of this technology?

EK: Right.

TC: Did that translate into a kind of spirit and a kind of high morale maybe?

EK: It was exciting. It was the belief that you were a trail-breaker, that there were all kinds of possibilities. But as you read my letters, I was rather careful of not over-promise too much. I felt that there was maybe ten or fifteen years of development needed. Part of the nuclear problem then was that there was too much enthusiasm by the federal government. It was pushed too hard, and it was also maybe picked up too fast by the utilities.

I will blame some of it on United States Geological Survey. The USGS kept predicting that we were running out of oil. There was always the story that in ten years we would run out of oil. So there was this urgency that we must develop new sources of energy. World War Two introduced a whole series of new technologies, by and large,

successfully so. So there was this heady optimism that we could do anything, and maybe we went too fast. I don't know.

TC: You make another interesting dichotomy in one of your reports. I guess this is related also to the summer project that you had. You had almost two semesters or so of theoretical lecture type courses and labs.

EK: Right.

TC: And then in the summertime, you had a project, a practical project that you had to undertake.

EK: Right.

TC: And your project was what?

EK: A reactor. We were going to build a power reactor or something like that.

TC: Did you actually build it there?

EK: No, we just made a report.

TC: You just conceived of it and it was a report.

EK: We just had a design concept, how to work it out.

TC: But I think you make a distinction between sort of academic reactors and practical reactors.

EK: Right, correct.

TC: What was that? What was the difference?

EK: Well, you can design a beautiful reactor on paper, but transferring it into hardware is usually much more expensive, much more complicated, many more headaches, and some of the things do not work. Paper can stand anything,

but when you start dealing with actual hardware, you run into all kinds of problems that you didn't anticipate.

TC: Just in summation of that period at Oak Ridge, in one of your letters you mentioned that it was an opportunity of a lifetime.

EK: That's correct.

TC: And that was something you felt honestly? I mean, I don't think you would have put it if you didn't.

EK: No, very much so. It was very interesting.

TC: But you were aware that this was a cutting edge kind of thing. How did you stack up grade-wise with the others? Were you given grades, first of all?

EK: Well, you were given a standing. I was number sixty-eight in a class of ninety-four. I may be trying to rationalize myself, but if you take it by age, I was probably number three in terms of age and people over thirty-five.

TC: I see, yes.

EK: Also I didn't have the American habit of taking examinations once a week. In Europe, when you go to college, in four years you get only two exams.

TC: Oh.

EK: And here you had to take one once a week. So it was rough on me. But overall, adjusted for my age, I had done fairly well. Otherwise, I was sixty-eight out of ninety-four.

TC: What were the social activities at the school? Most of the students had wives and families, too, I would guess.

EK: Right. Very little, very little.

TC: Very little.

EK: Very little. It was a grind.

TC: So there weren't weekend parties or that kind of thing there?

EK: No, you get together, usually work in groups. You compare notes and you work on problems. The family gets a rough deal.

TC: How about things like vacation or any of that, time off?

EK: Well, we had time off at the end of the course, two weeks. I went down to Florida.

TC: How did Oak Ridge stack up against the other atomic schools at that point? I know that the Argonne Laboratory

EK: It was considered the top one.

TC: It was the top one.

EK: The top one, I think. Oak Ridge was fifty weeks. The other ones were shorter.

TC: That was the Argonne Labs?

EK: Yes, Argonne, up near Chicago.

TC: In Chicago, yes. Why was there not simply just, you know, one school? Why were there several? Were there different approaches and different funding sources, et cetera?

EK: Well, originally, Oak Ridge was strictly for Rickover. Later on when there were openings they let in other people but it was mostly still directed for the Navy, as you can see by the people there.

TC: Oh, yes.

EK: Argonne was more for power reactors. It was not considered as good.

TC: The other major school was . . . Is it Knolls?

EK: Knolls Laboratory. That was General Electric at Schenectady, New York.

TC: That was General Electric.

EK: Right. That was run with General Electric bias for their reactors. At that time, there was quite a competition. General Electric originally wanted to build a sodium reactor for the Navy and Rickover wouldn't go for it. And they were still trying to prove that you could have a sodium reactor. They actually built a sodium submarine, the Sea Wolf.

TC: What is the difference there? What's the sodium reactor?

EK: You have a very high heat content, and you use water for cooling, and water hasn't got the heat capacity that sodium has. So the idea was, by physicists again, if you use sodium as a coolant medium, you can get a more efficient reactor. But as Rickover pointed out, he is going only to use a sodium reactor, if the ocean was made out of sodium. Rickover was right, the sodium reactor is too tricky.

TC: Is it liquid sodium?

EK: Liquid sodium.

TC: Oh, so the manufacture of that must be in itself a rather expensive process.

EK: Yes. The major problem is that if you cool, the sodium solidifies. So if you shut down your whole system, you have to heat it up, and as you heat it up, you run into all kinds of problems.

TC: Oh.

EK: There is nothing that beats water.

TC: Well, let's talk a little bit more about the other kinds of reactors that you studied. I know there was a breeder reactor . . .

EK: I did not study it.

TC: At that time, were breeder reactors being considered?

EK: Oh, yes. Detroit Edison built one, the Fermi Reactor near Detroit, Michigan.

TC: That was Fermi, yes.

EK: That required sodium and they had problems with that. Again, it was a physicists' reactor as we used to call it.

TC: What does that mean?

EK: It means that this was an elegant concept, as long as you don't get into the practical problems. The practical problem with sodium first, of course, is that if you shut it down and it cools, it solidifies, so you have solid metal in your whole system and you have to heat everything up to start. Secondly, it has to be absolutely leak-proof, because if oxygen gets into the sodium you get all kinds of unpleasant reactions.

TC: Yes.

EK: Also, you have to have special pumps, you have to have special valves. It's just that the technology isn't there. The concept is nice but, you know, we've been handling water for a couple of hundred years. We haven't been handling sodium.

TC: So, the pressurized water reactor and the boiling water reactor.

EK: They're water reactors.

TC: And they're related, as far as the technology?

EK: There are differences. Essentially, the big difference is that in a pressurized water reactor you have a closed circulating loop through the reactor. There is no radioactivity that goes into the turbine. In the boiling water reactor, you generate the steam in the reactor and that steam goes directly into the turbine.

TC: Oh, I see.

EK: It's a little bit more radioactivity.

TC: Okay. So the radioactivity can be right there within the turbine, as the turbine is moving.

EK: Right. But it can be handled. It isn't all that much of a problem.

TC: Well, how about the homogeneous reactor?

EK: Well, that was the stuff they developed at Oak Ridge. That was another physicists' reactor where you use a thorium sludge and you have to have two shells, one within another. Engineering-wise, it was a nightmare, it just didn't work.

TC: Oh, so they actually could build one. They did have a demonstration?

EK: They built one and it operated a short time, but was nothing but trouble.

TC: Well, how many different reactors did they actually have there? And could you just go and watch how they work, or were you called in to work on these things?

EK: They had a variety of reactors. They had a swimming pool reactor, which was essentially a swimming pool, and the core was underwater. It was a test reactor. They had a graphite reactor that was part of the nuclear bomb project. When they went into the nuclear bomb production, because they didn't know what would work they approached it three different ways, of which this graphite reactor was one. Then another one was up at Hanford, Washington another one at Savannah, Georgia. They placed their bets on a number of horses and some of them worked out, some of them didn't.

And the one at Hanford was the one that really produced. But there was the homogeneous reactor, which was an experimental reactor. Oak Ridge, was run by physicists . . . Alvin M. Weinberg was a very gifted man, very gifted propagandist, a very gifted writer and all that, but his engineering ability was very limited.

TC: What was his background?

EK: He was a physicist.

TC: How about Vonder Lage? Was he a scientist, as well?

EK: No. Vonder Lage came from the Navy, from not West Point but--

TC: Annapolis.

EK: Annapolis. He was a physics teacher at Annapolis and Rickover picked him up and moved him. There were a number of people from Annapolis. The whole thing was Navy dominated.

TC: Now as far as the application, your particular concern was: okay, I'm learning all of this reactor technology, but what I have to do is show the people back home that at some point we can apply this to power generation.

EK: Right.

TC: Were the lectures geared in any practical way to your particular problem? When they talked about reactor design or metals or those kinds of things, did they say, "This is the problem you're going to run into if you start generating electricity"?

EK: No, not so much, no. The basic thing was the reactor. Once you get the steam out of the reactor, that didn't interest them. Economics didn't interest them too much. The idea was that if you were in the utilities, you buy your reactor and you ought to know how a reactor operates, how much it costs, and how to write a specification. That was my basic interest. Also, I wanted to know about radioactivity. I wanted to know about safety aspects. I wanted to know about operating problems.

TC: So they didn't talk much about the economics?

EK: No, there was no discussion of economics whatsoever.

TC: Was, or is, the fuel expensive?

EK: No. The fuel is quite cheap. Your biggest expense is the reactor. The fuel is cheap, there's no question about that, but the reactor is expensive. And the biggest question is capacity factor, how often you have to shut it down, what problems do you have. But, by and large, once you build it, your fuel costs are quite low.

TC: Well, at the time, who were the leading people in the electrical industry that were actually putting up new plants? Shippingport was up and running.

EK: At that time, Rickover was running it. He didn't want anybody to stick his nose in it. There were two operations going on. One was the Dresden plant in Chicago. That was a General Electric. The other one, which was unfortunate, was the Fermi plant, the first breeder, if you will. Again, they were pushing technology way out.

TC: Yes.

EK: The first breeder of Detroit Edison near Detroit. That was Walker M. Cisler, and that, of course, didn't work out too well. Those were the two. The utilities, private utilities, were worried that the federal government would preempt them and they were trying to move in to show that they could handle it. There was always the fear, of the private utilities, that if nuclear power is developed by the federal government, the federal government will build

nuclear power plants just like they built Tennessee Valley Authority, and Bonneville Power Administration, and there was a reaction against it.

TC: And I suppose the Eisenhower administration was somewhat more amenable to allowing the private groups in to have their say then, than the former administration?

EK: Yes, Eisenhower at one time was making noises about selling TVA. The private utilities took the position that as long as they could get the transmission from a federal hydro plant, that was okay, but nothing else. They were scared to death of the federal government building steam plants. Hydro, well, they had to live with it, but not steam plants.

TC: Yes.

EK: And nuclear they thought was an opening.

TC: When you returned, or I should say, meanwhile, while you're at Oak Ridge and, it's June or July, you're working on your summer project. Back at the Department of Water and Power, there was also consideration going on as to what the nuclear future was going to be for the Department. Were you in correspondence with the people back in L. A. about that?

EK: Not much.

TC: Because they formed a nuclear study group. Was that your group, or was that formed before [you returned]?

EK: I think it was my group. I'm not sure now. My memory of it is that I came back and I reported to the Department management, Edgar L. Kanouse and Ivan Bateman. Bateman laid

down the law. He said, "It's all very interesting, but, for at least five years, we're not going to do anything about it."

That was the basic position. There were some people in the Department, I think it was Peterson, who were more optimistic but as far as Bateman was concerned, he had enough headaches without getting involved in nuclear. And based on my letters, he felt that for another five years we really should lay low.

TC: Did you agree with that?

EK: Well, at that time, I knew that there was talk about the atomic power demonstration projects. I felt that if we could get a project going, a small project, where the federal government guaranteed you that you wouldn't spend more money than it cost you to generate power, we should have tried. But I wasn't going to argue with Bateman. He was a very decisive character.

TC: Yes.

EK: And eventually this is what happened.

TC: That's what happened. So, when you got back, there was a group . . .

EK: There were some people but I think it was mostly a paper group. I don't think they'd done anything.

TC: Oh, a paper group. Okay.

EK: Bateman didn't want to get seriously involved. That was his basic position.

TC: There was another person I just wanted to mention, and to get some background on him, was it Rubenstein?

EK: Yes, Herb Rubenstein.

TC: Yes, and he, after you came back, he went off to Knolls, I guess, to do a . . .

EK: He was sent, right. Yes, they were considering further training. Herb went to Knolls.

TC: So that if they were considering and actually sending people, they were serious about nuclear power, even though they didn't want to jump into studies.

EK: Right. There were some studies. Then after Knolls, after Herb went there, we sent Louis Weidner to Argonne. Right, yes. There was no question about it, the Department was seriously considering, but the question of timing was something else.

TC: Timing, I see. Okay. I also saw in the file relating to your time at Oak Ridge that, at the end, there was a problem with reimbursement and some problems having to do with finances. And I'm just wondering if that left a bitter taste or was that just a simple snafu that got taken care?

EK: No, I had no problem there.

TC: No problem.

EK: I had a problem with the Internal Revenue Service. The Department paid for my rent and also for my salary. And the IRS felt the rent had to be taxed. I was getting more than my salary, and they felt that I had to pay taxes on it, and

I had quite a hassle with them. Finally, one of the Department lawyers, Lawson, came over there and pounded the table and they left me alone. That was the only problem I had.

TC: That was the only problem.

EK: I think there was some question about moving furniture, but that was all resolved. The Department was very generous. I had no complaints.

TC: Let's talk a little bit now about this demonstration project.

EK: Right.

TC: Was it a government or industry idea? Was it the government that initiated this possibility?

EK: The government initiated it and they asked for proposals. They said, "Here is what we're willing to do. You build the plant and we, in effect, guarantee you whatever costs are above your normal power costs." Which, in essence, was they would buy the reactor, pay for installation, pay for some of the parts. They really would handle the nuclear end. And the utilities would have to furnish the turbo generating end, they'd be buying steam from the government and pay a little bit for it, not to exceed their normal power cost. That was roughly the set-up.

TC: And so, was this the first project? DWP did enter into one of these demonstration projects, right?

EK: There were two rounds of it. I think we got into the first one and, again, the second one.

TC: Was that your main job after you got back from Oak Ridge?

EK: No, remember I came back in 1956, and there wasn't all that much to do in nuclear, so I was in charge of technical economic studies of power sources. One of the problems with many engineering schools is they have economics as an optional subject, which to me is wrong. It should be compulsory. Anyway, a great many of Department economic studies were done haphazardly. And I was appointed in charge of economic studies. I wrote a number of memos telling them what fixed charges to use over what period of time. I reviewed the bids that were coming in and, generally, I had somewhat of a staff engineering job. I also spent quite a bit of time on investigating alternative energy sources. I'll mention just one.

Again, just at the beginning of World War Two, 1939, the USGS made another one of their predictions that in ten years we'd run out of oil. So, [Harold] Ickes of the Department of the Interior told the Navy they'd better do something about it--the Navy was running on oil. So the Navy decided to convert oil shale into oil and to build an experimental plant at Rifle, Colorado. Well, after World War Two was ended, they tried to make it as economical as they could and they were trying to unload the plant, and they asked us to look at it since we were in the oil

consumption business. So I went to Rifle and I investigated the plant, which was, of course, impractical, because basically it takes four tons of oil shale to be equivalent to one ton of coal, in terms of heat. Not only that, but oil shale is a very difficult thing to handle. When you burn coal, maybe 10 percent of the stuff is left as ash. When you get oil out of oil shale, your volume expands, so you have a terrific ash problem. Also you require a lot of water to handle it. So it was a completely impractical thing. That was one of the things I had to look at. And I looked at solar energy, I looked at wind energy, et cetera. And any time some half-baked idea was suggested, such as, building power plants on islands and what have you, I had to look at it.

Tape Number: 3, Side A

November 3, 1989

TC: Last time, we briefly described the AEC Demonstration Reactor Project, and we got off onto another point and we cut the tape there. And I thought maybe we could start again with the demo project and go into it in more depth.

Let's just get some of the background. The AEC, I suppose, invited utilities . . .

EK: To submit proposals.

TC: To submit proposals. This was strictly municipally owned and Cooperative utilities. Is that correct?

EK: They actually had proposals for both groups. A private utility could submit proposals and municipals. Municipals usually were given preference.

TC: Was that because of the difficulty that they might have in capitalization?

EK: No, there was a general government policy that goes back to the hydro projects. When the federal government built electricity generating hydro projects, the electric utilities could bid on running, transmitting, and then distributing it. Municipalities and government units always get the preference.

TC: Okay.

EK: That was policy.

TC: That was policy. This would have been around 1958 or 1959, I think, is the date.

EK: Yes, right.

TC: How did the Department learn of this? Was this a general announcement? Did the AEC directly contact . . .

EK: There was a lot of publicity and they sent invitations, and the Department, because of Mr. Morris [General Manager, LADWP], because the Department was known, received an invitation. And we really were expected to submit a bid.

TC: Oh, you were expected.

EK: Yes.

TC: Oh. What was the APPA's role, the American Public Power Association, in this?

EK: Well, the APPA, of course, was trying to get the most favorable conditions. They wanted the government to guarantee all possibility of loss and they were also trying to force the government to practically limit it to municipalities which, during the Eisenhower years, was not very easy.

TC: The APPA - I'd like to just get some statement as to the relation between the APPA and the Department. I believe that Ivan Bateman was on the board of the APPA.

EK: Right.

TC: What was the origin of the APPA? Do you know that?

EK: I don't. I think it started probably with rural electrification, the rural co-ops. There was a bunch of

little co-ops and I think they needed a spokesman and they organized a staff and it eventually became the APPA. But I was far removed from all of this.

TC: Yes, okay. Pasadena, I read, had some connection to the same demo reactor proposal.

EK: They were going to get a little bit of share, yes. Anytime we went in we tried to include the five utilities that were publicly owned, which were Burbank, Riverside, Anaheim, Pasadena, and Glendale.

TC: Yes. So it was only Pasadena that went in with the Department on this first proposal.

EK: On the first one, yes. On the Malibu [Project] everybody went in, Riverside, et cetera.

TC: Well, what were the steps involved in drawing up the proposal and submitting it? What did you have to give the government for their satisfaction?

EK: That we would provide a site and build the turbo generating facilities and we would operate it. It was not very elaborate in those days.

TC: Oh, it wasn't? That's what my question was. I mean, was it a huge document?

EK: No, that was very, very simple in those days.

TC: What sort of reactor were you proposing to use?

EK: We were willing to go either boiling or pressurized. I think the government wanted a boiling water reactor because the feeling was that Westinghouse had a head start with the

pressurized water reactor, and they were looking for alternate reactor design. Boiling water was the next best at that time. Later on, there was a lot of pressure put on us to get a sodium reactor, but we resisted in that. The government was always very worried that if they developed the nuclear power, some company, by their connection to the Rickover operation, could become monopolistic, and they did not want that.

TC: I see. So the process of accepting this proposal was pretty routine, would you say?

EK: Pretty routine, yes. They really wanted us and they were just waiting to sign on it.

TC: Yes, I understand. I seem to have run across, in my perusal of some of the documents that are available at the Department on this, some correspondence with Chet Holifield, the representative. What was his role in any of this?

EK: Okay, Chet Holifield was a great deal of the time the chairman of the Joint Committee on Atomic Energy. He was a congressman from--I forget the district--somewhere east of Pasadena. If I may be cynical, he was our godfather.

TC: Yes.

EK: He promoted the Department. I think his son was married to, I think, Peterson's daughter. There was a family relationship there.

TC: Oh, interesting.

EK: There were very close relations. Anytime we went to Washington, we looked up Northcutt Ely and we looked up Holifield. He held our hand.

TC: Yes, I see.

EK: He was the Department spokesman, if you will.

TC: To place yourself in this process of proposing and getting the proposal accepted, was it the Nuclear Study Group that spearheaded this?

EK: Correct.

TC: You were head of the Nuclear Study Group, right?

EK: Right.

TC: And how many engineers were members of that?

EK: There was Herbert Rubenstein, Louis Weidner, Melvin Frankel. Those were the engineers and I think we had one or two associates.

TC: Okay.

EK: But it was one of those deals that would keep shifting back and forth.

TC: Okay. And was Jerome Matosec involved in that?

EK: Matosec was in it, correct.

TC: Okay. And in the course of being members of the study group, you still had other duties to attend to in the Department.

EK: Yes, right.

TC: . . . which would have been in design and . . .

EK: Yes, economic study, staff work. I was partly staff. I was also looking at all kinds of new sources, new projects. Everything that was thrown in the steam design section I had to look at that was outside normal operation.

TC: Okay. That's right. You did mention that last time and you talked about how you had to go out to Utah to look at oil shale.

EK: Oil shale. Colorado, actually.

TC: Colorado.

EK: Yes, western Colorado, Rifle.

TC: Oh, just on that point, did the question of solar energy come up at that point to any degree?

EK: No, there was Casmalia in California. There are some oil sands in Canada. There was some discussion of the North American Water Project generating power and there were some deals with the Department of Water Resources. We were looking at geothermal power. The Department was looking at Owens Valley, around Diablo near Bishop so there were continuous ideas floating around.

TC: How about the matter of the Pacific Intertie? Was it being tossed around at this point?

EK: Right, but that was handled by the electrical group.

TC: Right. There were some [Southern California] Edison engineers also involved in the Nuclear Study Group, weren't there?

EK: No.

TC: No.

EK: Not in this case, no.

TC: I seem to have read something where . . . Was it later on in the game when some Edison engineers were involved in some of the research?

EK: No, the only joint project with Edison was Bolsa [Island Nuclear Power and Desalination Plant].

TC: Bolsa, oh.

EK: There was a lot of cooperation on the transmission. At one time, Edison suggested we might be interested to participate in San Onofre. But that was rejected. Floyd Goss was working closely with Edison.

TC: Okay.

EK: He and William Gould of SCE were continuously on the phone. There was a certain amount of cooperation between the two, but not at my level.

TC: Well, you had site options, is that correct? You did some searching.

EK: We looked at some sites. Essentially, we wanted to get somewhere on an aqueduct because of the water situation. At that time, we looked around Antelope Valley and we selected Haskell [Canyon], which became then the San Francisquito site.

TC: Why inland? Was it a toss-up between inland and the seacoast?

EK: At that time, we were not looking at the seacoast because we already had plants on the seacoast. The Department was, at that stage, hesitating between inland and the seacoast. They wanted the plants located at different points of the transmission loop.

TC: Oh, I see.

EK: We had already plants south and west and the idea was maybe we should have one north. That is why we built Valley Steam Plant. At that time, water consideration wasn't that crucial and the feeling was that you could get water. I think that was before we lost the Colorado share of the aqueduct, but then things changed.

TC: So the work went on, as far as selecting the site and drawing up the specs for the reactor for this?

EK: Well, no, we were going to jointly select the specs. The AEC was going to advertise the spec and we were going to evaluate their bids. But since they were paying for it, they were the leading agency. They wrote the specs and they were going to evaluate it with us.

TC: What was the outcome of that?

EK: The outcome was that there were two bids. Well, there were more than two bids, but the two main contenders were General Electric and Allis Chalmers. And we recommended General Electric because General Electric already had a reactor built and operating. GE was a big outfit, it had a lot of experience, if they ran into trouble, they'd make it good--

because of their reputation. Allis Chalmers, at that time, was already a very sick company, and they tried to diversify. And a company with no experience in that field trying to recoup their position, to us, was a hell of a risk. That was one consideration. The other consideration was we had the site approved by the AEC staff and by the Advisory Committee on Reactor Safety, but the approval stated the approval was only for a small reactor. Now we would be willing to take a chance of putting a reactor there, even if we don't get approval for big units later, if the operation was successful. But our feeling was to get a questionable site with a questionable reactor, it wasn't worth a candle. And we told the AEC more or less bluntly that if they get G.E. [General Electric] we'll go ahead with the project. If not, goodby. It was a rather stormy meeting.

TC: Well, you mentioned the ACRS and before we went on tape you were telling me about that.

EK: Right.

TC: Let's talk about that for a minute and then get back to this point.

EK: The original set-up of the Atomic Energy Commission, included a licensing division. Now the trouble with the licensing division was that they didn't pay all that much, so that most of their staff were fresh out of college with no practical experience. That still is even today. The

feeling was they just weren't experienced enough, they didn't have the judgment. Also, there was quite a bit of argument about the sodium reactor at Detroit, the Fermi plant. There was some question of how safe it was. The staff didn't do too well, so the [United States] Congress set up within the AEC an Advisory Committee on Reactor Safeguards, which consisted of fifteen people who were the leaders of the industry at this time. You have here, in this book the list of the first members.

TC: Okay. Let's cite that book so we'll have it on tape.

EK: The book title is Nuclear Reactor Safety written by David Okrent who had been with the Advisory Committee on Reactor Safeguards since it's early beginning. It lists here the first group. It started in 1956. It was a blue ribbon committee, the top men of the American industry. Let me read it to you, if I may.

TC: Yes.

EK: Roger McCullough, Monsanto Chemical; Manson Benedict, Massachusetts Institute of Technology; Conner, Hercules Powder Company; Doan, Phillips Petroleum; Freidel, [Case] Western Reserve University; Jones, Monsanto; Mills, North American Aviation; Osborne, Allied Chemical; Rogers, Allied Chemical; Stratton, Travelers Insurance--insurance man; Teller, University of California; Wollman, Johns Hopkins--he is a biologist; Wechsler, U. S. Weather Bureau; Russell, et cetera.

TC: Yes.

EK: That was maintained at a very high level, with men that had been in industry twenty, thirty, forty years, who had built plants. They were sort of the senior statesmen.

TC: Yes. You had, it seems, a little bit of everything, engineers and scientists and financial experts.

EK: You had engineers, geologists, biologists, right.

TC: Yes.

EK: Insurance people.

TC: So getting back to this matter of the site and the particular kind of reactor and the stormy meeting you had with the AEC. You opted then to not go ahead with the project, is that the reason?

EK: That is correct. It was not unanimous. I had some personal problems with my second in command who went over my head to some of the management who backed him up. But, finally, we dropped it.

TC: Who was that? Was that Rubenstein?

EK: Rubenstein went and talked to Bradley Cozzens and Bradley Cozzens was more of a research man than he was a manager. He loved things like that, so he made a strong pitch for it.

TC: He made a pitch to go ahead with it?

EK: Yes. So did Rubenstein.

TC: In my reading, too, there was another catch, which was that the AEC would not approve expanding that small plant.

EK: That wasn't quite what they said. They said, "We are giving approval only for the small plant now."

TC: Yes.

EK: "If you want to expand it, we have to look at it again." In other words, "Don't get the idea that we approve this site for a huge installation. All we are deciding now is on a small one. If you want a big one, you have to come in again and we will discuss it."

TC: But that shouldn't have been a problem then, right?

EK: It was a questionable thing. We had no guarantees that we could expand it. We might expand it, we might not. Our major interest was to secure a site for big expansion. All we were getting was an approval on a small site. A big one, that was in the future; we might get it, we might not.

TC: And so you pulled out.

EK: We pulled out, but the major reason, to be honest about it, we felt that the plant was a lemon.

TC: Oh.

EK: And that's how it turned out.

TC: That's how it turned out, yes.

EK: We didn't want to start a nuclear program with a lemon.

TC: It's funny that this point does not come across in the documentation. (And this is what I like about these kinds of interviews, that you get a viewpoint that is missing in the documents.)

EK: Right. Yes, we couldn't say that because, if we did say it, Allis Chalmers would have sued us.

TC: Yes, well, that's true.

EK: It just couldn't be said.

TC: It couldn't be said.

EK: So we made a big to-do about the site, but the true reason was that we would have gone ahead if we had G. E. We wanted to get experience operating a nuclear plant, even if it was just a small unit.

TC: Did Edison have a reactor?

EK: Edison didn't have anything at that time. Their first reactor was San Onofre. Pacific Gas and Electric had a reactor which they were operating in conjunction with G. E., the one at Vallecitos.

TC: Where was that?

EK: Vallecitos.

TC: Vallecitos.

EK: It is around San Jose. It's northeast of San Jose.

TC: But it was a demonstration reactor, small scale?

EK: It was five mega-watts.

TC: What was the role at this time of Atomics International, which is a subsidiary of Rockwell.

EK: Atomics International was developing a sodium reactor and they were continuously putting pressure on us to join them, and we continuously refused. That was a big headache to me because Atomics International had a pretty good access to

some of our Board members [Board of Water and Power Commissioners].

TC: Oh.

EK: The president of Atomics International used to play pinochle with Nathan O. Freedman about once a week. And then anytime things came up about nuclear power, he would say, "How about Atomics International?" I think we contributed a little bit of money to the AI, but it was a strictly defensive operation.

TC: But I'm thinking now, and I don't have the exact story, but there was some kind of experimental project set-up at Santa Suzanna?

EK: That was Atomics International. It was a small reactor.

TC: That was Atomics International. Was that simply a research reactor or were they generating anything?

EK: (chuckling) Well, the joke was they used more power than they were producing. (laughter) It had a negative capacity factor. They were trying to run it but sodium is a very, very tough customer.

TC: Interesting.

EK: One of the problems is that when you shut down the reactor sodium solidifies, so everything had to be heated electrically to start it.

TC: And so what you have is essentially a block of metal then.

EK: You have a block of metal, right. So if you run it for, let's say, three hours and shut it down, it takes you five

hours to start it. You use more electricity than you generate. Now, coming back to Allis Chalmers, Allis Chalmers did unload the reactor on a dairy coop in Wisconsin, of all places, who bought this Allis Chalmers reactor, provided the site, provided generating. It was a disaster. Allis Chalmers never built a second reactor.

TC: No kidding.

EK: And that thing just didn't work, so we were justified to that extent.

TC: I know that in the original proposals . . . I'm looking here at this American Public Power Association document, it's a memo to officials of APPA Member Systems from Alex Radin and it's announcing this [the Demonstration Reactor Program]. And he mentions a project at Elk River, Minnesota.

EK: That's correct.

TC: And one at Piqua, Ohio. Were those put in place and put on-line in those systems.

EK: Yes, and they were disasters. The Piqua, Ohio was an organic reactor which was using oil as a cooling medium, which also didn't work.

TC: Oh.

EK: The federal government was very optimistic. In the beginning, they were pushing as many concepts as they could think of. That's what they did in the Manhattan Project.

You never put your bet on one horse. You run four or five parallel ones.

TC: Oh, yes.

EK: So they ran the organic reactor.

TC: Oh.

EK: But I guess it's part of the progress.

TC: Yes. Well, I think, as you said last time, failure is one of the greatest, the best teachers.

EK: Right.

TC: It can be a very expensive teacher, though. I guess by the time you withdrew--I have the date here as February of 1961.

EK: Okay.

TC: Just prior to that, there was an accident in Idaho.

EK: That's right. It was a military reactor and they pulled out the rods and the rods took off and a guy was impaled on the ceiling, and they had to bury him in a lead coffin. It was pretty nasty.

TC: Pretty nasty. Did that publicity negatively affect your plans?

EK: No. What happened was even though a great deal of radioactivity was released, they had a simple Quonset shed and it was contained in it. So it demonstrated fairly well that you can contain the stuff. It was a military reactor and it had practically no safeguards.

TC: Yes.

EK: It used to be a standard joke about the Atomic Energy Commission that if you design a reactor and they don't approve it because of safety, sell it to the military. (laughter)

TC: So that didn't particularly affect your withdrawing.

EK: No.

TC: I think you'll be interested in this. I wasn't necessarily researching for any kind of critical appraisal of the project. In the files we have at the Department, there were some newspaper clippings, mainly reporting that this was going on. I did find one sort of editorial from the Inglewood Daily News, this is in June of 1960. It took a very negative position on what was going on, in terms of radiation. Do you know, was that the sole critical kind of voice out there commenting on what was going on?

EK: There were probably more than that but they didn't penetrate too far into the public consciousness.

In the fifties, everybody was gung-ho nuclear and, well, the sixties is where this whole opposition began.

TC: Yes. You have some notes here. I was just looking over at them, they have to do with PG&E and Bodega Bay. Is that next chronologically?

EK: Okay, let me explain a little bit. We began with Malibu in 1962.

TC: Yes.

EK: In the middle of Malibu occurred Bodega which impacted very much on Malibu.

TC: Okay.

EK: So what I was going to suggest, we go to Bodega first.

TC: Okay.

EK: Then we'll get Bodega out of the way. Then we'll start Malibu and then you'll see how Bodega fits into Malibu.

TC: Terrific.

EK: Well, you want to go to Bodega?

TC: Go ahead.

EK: PG&E proposed a nuclear plant in 1962, which was about a quarter mile, maybe 1,000 feet, from the San Andreas Fault on the Bodega headland. It's way up north.

TC: I know where that is, yes. North of San Francisco, yes.

EK: North of San Francisco, right. Getting towards Eureka. A quarter mile from San Andreas is the Bodega site. San Andreas is called a fault but it really isn't a fault. It's a crustal boundary between the Pacific and the North American Plate. It moves north west about two inches per year.

TC: Okay.

EK: And it moved about 350 miles at this spot, so it's a major feature of geology worldwide.

TC: Yes, okay.

EK: Anyway, they were about 1,000 feet from it, but their argument was first, it's a very remote site and secondly,

they were on a solid block of granite. Now granite was formed 200 million years ago, so if there was no faulting on that block, you could put the reactor on it. Well, there was opposition. The opposition originally came from marine biologists because they wanted to make a park of it and also a laboratory, a marine laboratory. Opposition also came from [Stuart] Udall who was Secretary of the [Department of the] Interior. Things were running pretty smooth but, because of the opposition, Udall offered to get the USGS into the picture and PG&E agreed. The USGS was working on it, things were still looking pretty good, and then for some reason Udall sent in a seismologist. And this seismologist, Jerry Eaton, I guess he had a cold, he wasn't too happy going there, wrote a very negative report. He, in effect, said we know very little for sure and, because we know very little for sure, this site should be rejected. Because if you don't reject this site, you can't reject any other site. The exact verbiage of his report, I have it here. If you want to, you can take a look at it.

TC: Yes, yes, thanks.

EK: That was one of the turning points of the nuclear power.

Tape Number: 3, Side B

November 3, 1989

TC: This is Eaton . . .

EK: Jerry Eaton of the U. S. Geological Survey talking about Bodega: "The primary difficulty is that the seismologist is called upon to make judgments that require large extrapolations beyond his personal professional experiences and even beyond those of the science he serves. Because we cannot prove that the worst situation will not prevail at the site, we must recognize that it might." In other words, we know very little for sure and, therefore, let's assume the worst. That, of course, gives the opposition a terrific handle.

TC: The book you are citing is The Atom and the Fault: Experts, Earthquakes and Nuclear Power, by Richard Meehan, MIT Press.

EK: So that concentrated the whole opposition issue on geology.

TC: Okay.

EK: What happened next is, as they kept digging a big hole for the reactor itself, which is about a thirty-foot hole going down, they discovered a small fault on the granite, a small fault that between 400,000 and 40,000 years ago caused a displacement and there was an argument on how much displacement. The figure varied from about a half an inch to maybe three feet. The USGS, based on their standard procedure, assumed the worst case. They said it's between two and one-half and three feet. Then the question arises,

"Can you go ahead?" And PG&E took the position that we'll design for a future displacement of three feet. And the Advisory Committee on Reactor Safeguards approved it. They said, "It's a good design. You really shouldn't expect more than three feet in the future. It hasn't moved in 40,000 years. This is still a solid block of granite, except for that one crack. Go ahead." The staff disagreed and the staff took the position that because it's a novel design, we don't want to approve it. And they also believed at that time, what the USGS told them, "Well, this is just one bad place in California. Move it somewhere else. There is plenty of unbroken ground, why pick this particular place." But there was something more behind it, which the book indicates, but it doesn't really spell it out as strongly as it should. The reason the staff rejected it, because they came to the USGS and said, "Will you agree to the three foot displacement?" And the USGS said, "Well, if there was no intervenors we might go along with it. But because there are intervenors, we would insist on eleven feet displacement." And once you say eleven feet, you can't design for it. That was repeated over and over again. They did it on Vallecitos, they did it with us. Now that doesn't show up in the record. At that time, I knew about it. I didn't put it in the record because I thought we could avoid it.

TC: Oh.

EK: But they did the same thing at Malibu and they did the same thing at Bolsa. And when they did it at Bolsa, I put it in the record. There is a memo in the Department file when they told us bluntly, "If there is no intervenor, we might agree to three feet. If there are intervenors, we couldn't defend less than twenty feet." That was the reason. Also, the AEC, at that time didn't, want too much public controversy, and they believed that they could move the reactor to another place in California. If there are plenty of good places on the coast, why pick it so close to San Andreas? So Bodega was rejected but the ACRS felt very strongly and they went public about it. Members of the ACRS told the AEC staff, "If you reject this site, you are setting up a precedent where you could reject any other site in California", which was prophetic. Now when that happened, I got, of course, perturbed and I went to Edson Case who was Assistant Director of Licensing.

TC: Assistant Director of Licensing for what body?

EK: For the AEC staff.

TC: Okay.

EK: I told him, "If that continues, you're going to lose every site in California because you are asking the geologists who have no background in nuclear power, who don't understand engineering, to make decisions on safety. This is not fair, their normal reaction would be, 'Why should I stick my neck out about things I don't know?' You either have to set up

standards, or you have to make your own decision, what is safe, what isn't safe, based only on the data of the USGS." He told me, "Well, Bodega was a bad place, that won't happen again. I talked to the USGS, and they feel quite comfortable with Malibu." I still wasn't too happy. I went to the USGS. I said, "Look, I don't want a situation that happened in Bodega. Give me a name of a consultant who we can hire that will have such a reputation and be so good that whatever he does will be acceptable to you." They gave me the name of Dr. Richard Jahns who, at that time, was the Dean of the Geology Department at Penn State and was negotiating going to Stanford. So we got him over. He was then our chief consultant at Malibu, with disastrous results, but that's a different chapter.

TC: Yes, okay.

EK: But that was the idea. That was the beginning of the problems at Malibu.

TC: But the seismology question was established at Bodega?

EK: Yes. I might mention, to clarify, Eaton was completely out of line because the seismology was not a problem. As we developed the criteria, we practically eliminated seismologists out of the process. There is no need for them. We can do it engineering-wise. Shaking is easily handled engineering-wise. It will cost a little bit more but it is not an insuperable problem.

TC: Yes.

EK: The fault displacement was crucial and that was geology, so Eaton was out of line. I don't know whether he really set it up but, anyway, it was the beginning of some of the controversies.

TC: So let's jump back now and talk about the origins of the Malibu idea. This is after the Haskell Canyon project was withdrawn. Was it simply a continuation of that, to build a larger plant?

EK: Right.

TC: Instead of fooling around with the experimental small reactor, let's just go ahead and build a big one was the idea?

EK: Well, it wasn't all that large. Malibu was going to be 300 mega-watts.

TC: Yes.

EK: Which was still not that large. We already had at that time General Electric and Commonwealth Edison of Chicago built the Dresden, Illinois, plant.

TC: Dresden, yes.

EK: So you had a plant operating already. Rickover was making a lot of propaganda with Shippingport. There was a question of Fermi at Detroit, which wasn't too good.

TC: Right.

EK: So the feeling was: This is an operating technology, we might as well go ahead, and we might as well get approval for a large site because this is ultimately what we want.

TC: Okay.

EK: And by that time, also, the feeling was we want to be on the ocean frontage because of the water situation.

TC: Just for a footnote, the demonstration reactor would be 50 mega-watts, is that correct?

EK: That's correct.

TC: And this would be on the seacoast?

EK: Right. So what we did, we looked at the seacoast from Seal Beach all the way to the end of Los Angeles County, which I think was Sycamore Canyon. We looked at the site and we looked at two phenomena. One of them was population, we didn't want to be in a heavily populated area, and we looked at geology. And there were some geological problems in some of them. Ventura, for instance, is sitting next to a very large submarine canyon and Ventura is built on saturated alluvium. So if there is rain and there is an earthquake, the whole thing will just slide down. So we looked and we selected Malibu as having a low population. We had at that time about 10,000 people within five miles, which was pretty good, and the geology looked good. We had some preliminary investigation by Converse Engineering and they assured us it was good geology. So that was the selection of Malibu.

TC: Did the question of an underground plant come up at this stage?

EK: Just in discussion. There were all kinds of discussions, but our basic design was going to be super safe design. We

were going to have a double wall where we were going to have negative pressure, suck the air out. It was going to be a super safe design, just to be sure that we didn't have any arguments about safety. It was a double containment, if you will.

TC: Okay, so 1962 is when the announcement was made.

EK: Right.

TC: It's Corral Canyon.

EK: Right.

TC: So how long did it take to get the AEC approval for this?

EK: Well, there are different stages. First, you get the staff approval, then it goes to ACRS, then the ACRS starts getting additional information.

We started the hearing on February 9, 1965, so I would say by 1964 we had the approval. That would have been about right, the middle of 1964, I would say.

TC: So it took a year for it to go through those stages?

EK: We had to get the geology. This is where the paperwork began.

TC: Yes.

EK: You have to come up with a more or less completed design. You have to have a very elaborate geologic investigation. We started in 1962, but I would say we probably submitted the first time in 1963, and then we continued submitting because they wanted more and more information. We used to say, kiddingly, that we can't start building a plant before

the weight of the paper is equal to the weight of the plant. (laughter)

TC: That's a good one. That's an engineering joke. At what point did you pull in Richard Jahns? Was that after this? Do you remember the year for that?

EK: I would have to look at my record. That is probably there. That list that I gave you, I must have it here, it's probably here somewhere. [EK checks his notes] A great deal of time was spent, for instance, on atmospheric conditions.

TC: Yes. What did that have to do with it? In the event of some kind of a radiation spill?

EK: They wanted to know what is the dilution, where would it blow. They wanted to calculate so, if there is an accident, how many people will be affected, et cetera. [EK finds note on Richard Jahns] We asked for Jahns, I would say, January 20, 1964.

TC: Okay.

EK: That was authorizing his employment, so he started in 1964.

TC: Okay.

EK: He came in after most of the geologic work was done, to give it his blessing, if you will. He looked over the geologic work, he went to the site, and then before the final submittal was made, we got his blessings.

TC: Okay. And just to reiterate, you hired him to come in there hoping to head off any kind of a hassle that would come up around the geology.

EK: Right. We didn't want to argue with the USGS.

TC: Okay.

EK: We felt that the USGS and we should agree. There was a lot of opposition. Let me back up a little bit. You might remember, in 1963 the Department had the Baldwin [Hills] Dam disaster.

TC: Yes, yes.

EK: The Department sued the oil companies because we claimed that the subsidence was due to the withdrawal of oil.

TC: Oh, yes, okay.

EK: So there were a lot of oil geologists who opposed Malibu. There was practically the whole oil geology group in Los Angeles and they made a lot of noise about the geology of Malibu.

TC: That was done as a sort of a revenge tactic or were they just acting in opposition because of the lawsuits that were going on?

EK: I don't know. The thing that got our goat, and that is also described here . . .

TC: In the Meehan book, okay.

EK: Morgan who was at that time, I think, chief geologist at Union Oil, threw a picnic at Malibu, invited all of the oil geologists right on the Malibu site. They all came in. They got fed, drunk and then they all signed the petition saying that Malibu was no good, based on that picnic.

TC: Oh.

EK: So we felt it was one of those public relations stunts.

TC: I'm still trying to get at what was justifying this in their mind. Was it that they had their eye on oil out there?

EK: I don't know. There are some arguments that the oil companies didn't want us to go nuclear power because we were using oil. I'm a little bit leery about conspiracy theories. We had the opposition of oil geologists. That was a fact. Now, Morgan was the president of the Society of Oil Geologists in Los Angeles. He also employed a lot of them.

TC: The government was financing some of this, is that correct?

EK: No.

TC: The government wasn't?

EK: There was no government money, absolutely none.

TC: So it was strictly DWP financing.

EK: It was strictly DWP, plus the five other communities, which were Pasadena, Riverside, Anaheim, et cetera.

TC: And Burbank and Glendale, right?

EK: And Glendale, right.

TC: So, by, say, 1965, you had pretty much the whole thing ready . . .

EK: We had the approval of the staff and the ACRS and we thought we had the approval of USGS. The USGS wrote a long report with all kinds of qualifications--but the bottom line was that, the probability of ground displacement at Malibu is negligible. Later on, that would cause quite an explosion.

TC: Let's continue on with this. Was there any construction begun at the site?

EK: No, none whatsoever. The only thing we had there were drill holes and trenches.

TC: Why was construction never begun? Was it a question of the opposition getting into it?

EK: You couldn't construct. You have to have the permission of the Atomic Energy Commission, and the permission you get only after the Atomic Safety Licensing Board, ASLB hearing.

TC: So that hearing hadn't taken place by this time?

EK: That hearing hadn't taken place.

TC: When did that hearing concerning this begin?

EK: The hearing began on February 9, 1965.

TC: Okay.

EK: And continued through July 1966. There were forty days intermittently. The commissioners went home and then came back, sort of a vacation, and it lasted 7,000 pages and it was mostly geology. And that's where two things happened: One of them, we found out that the geologists don't know anything for sure, that their terminology is meaningless, and that the USGS threw us quite a bomb.

TC: Let's talk about that. Since that's come up several times, it'll be good to capsulize here.

EK: We'll start with the geologic age. Geologists usually are trained to think in terms of geologic ages, which is millions of years. And their terminology, the Oligocene,

Paleocene, Pliocene, it all means recent. There is early recent, middle recent, whatever recent. Their so-called geologic recent goes back 70,000,000 years. So if they say the faults moved in recent geologic times, it could be a million years or ten years ago, you don't know.

That's problem number one. Problem number two is active faults. Nobody has defined an active fault. It could be a fault that moved 200 years ago, 500 years ago, 10,000, 100,000, half a million years ago. It could be a fault that has a structural relationship to another fault which is active, which I call tea-leaf reading, or it could be a fault that has seismicity and you can't connect seismicity accurately with anything, and so on and so forth. And then there is the Richter magnitude, which is also very misleading. All it is, is a deflection on a seismograph. It has very little connection with energy, very little connection with destructiveness. So we went around and around, and one of the things that was very unhappy to us, that our consultant Hugo Benioff who had been a world famous seismologist and Dick Jahns who was considered California's greatest geologist, folded up under cross-examination.

The opposition came from Marblehead Land Company which has a long and distinguished history of fighting anybody in Malibu. Are you familiar with the history of Malibu?

TC: No, not really. I know that there's the Colony there.

EK: The Rindge family, who were millionaires from Boston, came to California, Mr. Rindge and his young wife, and bought all of this area around Malibu--a huge area--and blocked it. And after ten or fifteen years, Mr. Rindge died and his wife swore she was going to keep Malibu as it was. She put gates on both ends, she fought the railroad, the highway department, the sheriff, the city, and the county. She had armed guards posted, there were shootings, people were kicked out forcibly. For lost travelers who had to stay overnight, she had a special house built that was just full of lice and fleas so they couldn't stay long. (laughter) But, anyway, she lost a great deal of the estate and, finally, when Mrs. Rindge died in 1941 the children built it up again. Her daughter Rhoda, which spells Adohr backwards, developed Adohr Milk Co. and they came back into a great deal of money. Well, anyway, they fought us and they fought us with money as no object. They got an excellent lawyer, William Norris, they had a good Cal Tech professor, they did a good job. Unfortunately, our lawyer, the Department lawyer, was ineffectual. We pulled him out of retirement, and he had experience mostly in land condemnation which is a very easy job. You get experts and, if you don't win, you settle. He was outclassed. Whether it would make much difference, I don't know. Norris and Camb, of Caltech made mincemeat of our experts. In essence, our experts said, "Well, if it happens in the past, it could happen tomorrow."

TC: Was this taking place in the AEC hearings?

EK: Yes. The hearings were in Santa Monica. In the City auditorium in Santa Monica. I had to live there for six months, in a motel, which was all right, it had a swimming pool.

TC: [The hearings were held] under the auspices of whom?

EK: The Atomic Energy Commission. Their ASLB, Atomic Safety and Licensing Board. But the final disaster came when the USGS and the Marblehead lawyer zeroed in on the statement: "negligible". And then the USGS said, "Well, you know, our report didn't say negligible. We said 'very low'. 'Negligible' was changed by the insistence of the AEC staff, (which was Case) who told our supervisor to change it. Now we didn't agree with that change. We thought it should not be negligible." Well, what can you do after a statement like that? The ASLB tried to salvage the situation. They said that nobody knows anything about geology. They said, in effect, "We'll give you the permit to construct under the condition that you design for ground displacement. The amount doesn't have to be large." They were trying to salvage the project but, of course, we would have to get the displacement amount from USGS. USGS indicated at that time "Well, if there is no opposition, three feet might be all right. If there is opposition, make it twenty." We knew that Marblehead would fight us tooth and nail and we just dropped the project.

TC: When you're talking about displacement, you're actually talking about how much the ground moves. Is that correct?

EK: No, no, how much . . . If you are sitting on a fault, you have this.

TC: Yes, okay.

EK: It moves up.

TC: Okay.

EK: And that is the displacement.

TC: That's the displacement. And so you have to design for that happening right in the reactor.

EK: Under the reactor.

TC: Now, if it's three feet, you say it can be handled.

EK: It can be handled.

TC: But if it's twenty feet, you're talking about something else.

EK: Well, it's difficult. It would be an experimental design. It would be very difficult to argue that you could do it.

TC: Yes.

EK: Even if I didn't have intervenors, I wouldn't do that. I wouldn't do it.

TC: The intervenors are . . . ?

EK: Opposition.

TC: Opposition, right.

EK: In other words, if they bring structural engineers in and all kinds of other experts and you get into detail, they would argue: It wasn't done before.

TC: Okay.

EK: It is a novel design. What they would insist, and this is where the gimmick comes in, what they would insist is that you really should test it in the full size. Well, if you test it in the full size, it could cost you $50 million.

TC: Yes.

EK: And even then they will probably argue, "Well, you tested this way. Now, test it the other way." It is difficult to prove something in the negative.

TC: Yes, yes. But there was local opposition, too.

EK: Very little.

TC: Very little? I knew there was some.

EK: Well, it was ineffectual. There was a lot of opposition but it was ineffectual. I mean, the thing that counted was Marblehead. They spent well over $100,000 on it.

TC: Okay.

EK: They had a good lawyer, a good expert.

TC: So the Malibu Colony dwellers, like Angela Lansbury, I believe, were vocal in opposition.

EK: Yes, she came in there.

TC: That was not particularly effective?

EK: No, that was not effective.

TC: Okay.

EK: She appeared before the Board of Supervisors, where we brought three mayors of other cities that lived near nuclear reactors who testified that they loved it.

One of the problems we had, and this is a problem the Department is going to have no matter where they go, we don't pay taxes on assessed evaluation. This is one big advantage a private utility has over us. If they move into a small community and they build a $5 billion plant, everybody's tongue is hanging out. This is one of the reasons when we went into the Central Valley that we wanted PG&E as a partner.

TC: Oh, I see.

EK: Because they would pay taxes. We also had, of course, the Owens Valley ghost behind us, which was another handicap.

TC: Yes, that's true.

Tape Number: 4, Side A

December 1, 1989

TC: We've been away from this for a few weeks. In the meantime, I got the chance to read Richard Meehan's book The Atom and the Fault and, before we went on tape, we were talking about that book and geology as an art. I wonder if you could just repeat what you said.

EK: Well, there are two problems in geology. One of them is terminology, which is very ambiguous and nebulous. For instance, the terminology that we deal with, like fault, recent geologic time, magnitude, is very poorly defined. A fault could describe something like San Andreas, which is about 700 miles long, and moved 350 miles during geologic history. Or you can have a crack in granite that has maybe a displacement of a couple of inches. Both are called faults but both are drastically different things. If the terminology was precise, half of the arguments would not occur.

The second problem of geology is that geologists are trained to think in terms of the geologic time scale, which is millions of years. For instance, the word recent could mean anything from 200 years ago to 70,000,000 years ago. And when geologists think in terms of geological time, they are not thinking in terms of the human scale. So, to them, something that happens a couple of million years ago is a recent movement, and it could happen tomorrow. But in terms

of a practical human time horizon, something that happened two million years ago is highly unlikely to happen within the next fifty or a hundred or a thousand years. So terminology and time scale, these are the big problems.

TC: Well, this is a good transition point for getting back to our Malibu discussion.

EK: Right.

TC: Would you say the upshot of the whole Malibu process was that geology got in there and put the damper on it based on this kind of geological reasoning, which runs counter to practical engineering reasoning?

EK: Right.

TC: I wanted to pin down some dates because, when listening to the last tape, I wanted to make sure that we had some of these dates stated. This is after the hearings, I believe it was 1966, that the Licensing Board okayed the DWP application, and there were qualifications . . .

EK: The hearing was from February 1965 to July of 1966.

TC: Okay.

EK: And this was when they finally made the decision that was the permission to construct with qualifications, that it has to be designed for ground displacement. They also mentioned that they believed that the ground displacement was small and that the plant could be designed. (reading) "The amount of permanent ground displacement may not be great, and we find that this facility can be designed to withstand

permanent ground displacement forces from an earthquake." It was their position that the movement probability was small and we could design for it.

TC: Okay.

EK: But, of course, we ran against the USGS demand for a twenty-foot displacement then.

TC: Okay, so when did that demand get filed and answered? Was it within the next year?

EK: There was informal discussion with the staff of the AEC and the USGS and this is the feedback. And once we had that feedback, plus the Bodega precedent, the decision was made to abandon the project.

TC: Okay.

EK: The decision was also made to abandon the project because we were faced with a very strong and wealthy opposition, and it was our belief, if we go ahead and design for ground displacement, the opposition would contest it. The amount of money that was available to them was unlimited--they could get the best experts--it would keep dragging on. It was a no-win situation. So it was just dropped.

TC: So it was formally withdrawn. The application was formally withdrawn in 1973.

EK: Right.

TC: So that means that for a period of some five years it lay dormant. Is that what happened?

EK: It lay dormant. It was our hope that there might have been created a precedent by some other plant somewhere else that would design for ground displacement, or that the USGS would become more reasonable, or that the Atomic Energy Commission would come out with some standards. In effect, PG&E and the Department organized the committee, tried to nudge the AEC to get some standards. That particularly became clear after the Bolsa affair, where the ground displacement issue came up again.

TC: Okay.

EK: And again, the USGS took the position of twenty feet. By then we started working on a standard in the hope that we could come up with a reasonable standard. But when that became impractical, we dropped it.

TC: I want to get to Bolsa, but I'd like to find out a couple of things about the opposition group. You mentioned last time that it was spearheaded by the Marblehead Land Company.

EK: Right.

TC: And they also worked with a local public relations firm, I understand. I'm just trying to get an angle on who exactly that opposition was.

EK: There were actually two types of opposition. There was a guy by the name of Wolf. There was a group called the Malibu Citizens for Conservation, which was a group of local citizens. We never investigated who they were, but I think there were a number of oil company geologists involved and

possibly an oil company, but we couldn't put our finger on it. But it wasn't too important because they weren't very effective. Their experts were more or less demolished by our experts and they didn't have either the money, or I don't think they had the political muscle. Our true opposition was Marblehead. They had the money and they had the political muscle. They eventually got Senator George Murphy to intervene.

TC: Oh. And how did that happen? Did he show up at the hearing?

EK: He wrote a letter to the Joint Committee on Atomic Energy, pointing out that the AEC was misleading the Department. They approved the site, they didn't know what they were doing, and they should either approve it, go ahead, or drop it, and not continue this kind of confused operation where their experts more or less contradicted themselves and they didn't know what they were doing. In other words, he felt that the whole operation was a mess, and there was some justification for it.

TC: Now, there was also a citizens' committee in support. It was the Nuclear Power for Progress Citizens' Committee.

EK: Right.

TC: How did that group get initiated? I know that, for instance, the chairman was Paul Iverson. Is that right? He was an attorney . . .

EK: Right. The project was going to be shared by a number of communities. Electricity was going to be supplied to Pasadena, Riverside, Anaheim, et cetera. There were also local people who were interested in it. There were real estate people, people who felt that that could be an addition to the area, and our people worked with them. I think [Samuel] Friedman--he was the head of public relations of the Department at that time--worked with them, and I think they were essentially Los Angeles people. The feeling at that time was that nuclear power would reduce smog, that oil was in limited supply, and the Department usually had a pretty strong citizenship support. The support also came from the mayor and what have you. So the city backed the Department, and that particular group--I think it was a Chamber of Commerce connection, that kind of stuff.

TC: Okay. But, ultimately, they weren't effective, in the sense that the project was cancelled, but were they effective at the time? Somebody did a poll and they found, even in Santa Monica, there was general support from the man in the street for the project.

EK: Right. There was support. We had a pretty good public support, but the decision was fought before the Licensing Board. That was the crucial issue.

TC: Yes.

EK: And the crucial issue was, of course, the USGS. That was really the pivot. And the opposition had money, had

expertise, and they were quite effective. Also, they had a much better lawyer than we had.

TC: How did the lawyers fit into it? Did they have to lead the hearing discussion?

EK: That was administrative hearings, so the lawyers presented witnesses, cross-examined, made the arguments.

TC: Oh, I see.

EK: Their lawyer was William Norris, who was young, knowledgeable of geology, and very good. We pulled a guy out of retirement whose specialty was land condemnation, who was not knowledgeable of geology and was no match for Norris. But in all fairness, I don't think it would have made a crucial difference. It was just embarrassing, that's about it.

TC: Who was it that we had?

EK: That was Russell Jarvis.

TC: Yes. I had a last question on Malibu. As I was reading some of this citizens' committee support material that I found among the historical records, there were press releases or magazine or newspaper articles about labor support.

EK: Very much so. The union supported that, of course. The Department has the International Brotherhood of Electrical Workers.

TC: And one of the things that was pointed out was that the IBEW was starting to develop a training program for nuclear technicians.

EK: Correct.

TC: Did you have anything to do with that? What was this training?

EK: It was very primitive in the beginning. It was very little, really. It was mostly lectures telling them about nuclear power, making them acquainted with some general principles of nuclear power. Eventually, the training would have been much more rigorous.

TC: Yes, because it would be significantly different from, you know, steam plant operation.

EK: Right.

TC: It was initiated but it was not developed.

EK: Correct.

TC: Well, the last point on Malibu was something that I could ask now, or even later on in a sort of a summation, but when the Department gave up on Malibu--this is prior to 1973 . . .

EK: Right.

TC: So, even by 1968 or so, you knew you weren't going to go ahead with it, what was the emotional and the mental response on your part or the part of the engineering group? Was it disbelief that how did this thing happen? Or was it

that you saw it coming and you could have guessed that this sort of thing would happen?

EK: We saw it coming. We had a pretty good idea it was coming, and before the end of the hearing I suggested that we drop it. But the feeling was that we'd spent so much time and money on it, let's proceed to the bitter end, and we proceeded. I would say that roughly two-thirds through the hearing, when it became clear that our experts didn't stand their ground, that the opposition had a pretty successful attack, I felt that it was a lost cause. But you know how it is when you get involved . . .

TC: Oh, yes.

EK: [Floyd] Goss came out to Santa Monica and during the last half of the hearings he was there. He and I discussed it and we felt, well, you never know, maybe the board will have enough guts to overrule the USGS or the AEC will get them under control. But that didn't happen.

TC: Well, in the meantime, as this was dragging on, you got involved in the Bolsa Project.

EK: That is correct.

TC: Is there anything else that I've missed on Malibu that you can think of?

EK: No, I would think that would do it. If I forgot something, you can bring it up again.

TC: Okay.

EK: Now, Bolsa.

TC: Bolsa, yes. That was quite a unique or innovative idea, as far as my reading goes, to have a massive desalination project and a power generation project at the same site. Where did this idea come from?

EK: It came from Oak Ridge from a guy by the name of Phillip Hammond.

TC: Oh.

EK: Oak Ridge didn't have much to do. They tried a number of things that didn't work out and they were looking around for new ideas, and Hammond came up with this idea. This idea was sold to the AEC and then it was sold to President Lyndon B. Johnson, who was sitting in front of his dry Pedernales River, and it was sold to a number of organizations. It was sold to the Department of the Interior because of the Colorado River problems. They had divided more water than there was in the Colorado River, and the U.S. was lousing up the part of the Colorado River going to Mexico, and it seemed to be a good idea. Metropolitan Water District [MWD] needed water because, at that time, I think the Colorado River Decision by Simon H. Rifkind was made that, in effect, withdrew the allotment from the MWD and was going to give it to the Central Arizona Project.

TC: So it was Arizona v. California then.

EK: Right. And the Metropolitan Water District was interested and the AEC was interested, so there were a number of organizations who were interested. The utilities were not

too enthusiastic about it, neither Edison or we, but we were dragged in.

In effect, we were told that this was a public project, that there was a lot of support, and if we didn't go along, they'd keep it in mind the next time we came around for some favor. So the Department then joined it with Edison and San Diego Gas and Electric and a number of other small units.

TC: Well, what exactly were these reservations? Let's pin a year to this. This would be about 1966?

EK: Yes. Actually, the studies were made by Bechtel Corporation even earlier. I'm not sure now of the exact date, but Bechtel was making studies about 1965. They did a pretty good design. They went ahead with geology, seismology, desalination, what have you. The project was packaged to the utilities in 1966. That's when we first saw it.

TC: Did somebody contact you or was it through Floyd Goss . . .?

EK: It was through the management.

TC: Yes.

EK: It was from Goss or Edgar L. Kanouse. One of the two was approached in Washington. I'm not even sure Kanouse was our General Manager just then. Somebody else was approached and eventually Goss got involved. And the first time I heard of it was from Goss.

TC: And what was your particular personal response to it when you heard it?

EK: Well, we looked at it. We didn't like the location and we didn't think much of the economics. We looked at it and, essentially, our answer was, "Look, you're in a very high population density area. Within five miles, you have half of Orange County. You are very near to the Newport-Inglewood Fault, which is a known, active fault, and you're sitting, in effect, on a mud pie. And if there is an earthquake, it will act like a jelly bowl, you will have liquefaction. So, on the basis of what we learned at Malibu, we don't believe it could be licensed."

The cost of water would be quite expensive just at the plant. One of the things that we liked to point out about this whole desalination business was that if the Pacific Ocean was a fresh water lake, the city of San Bernardino could not afford that water because the pumping costs would be prohibitive. The cost at the site is one thing, the cost of delivery is something else. But anyway, though our position was we didn't think it could be licensed, we had no choice, so we proceeded. There was the hope that because there was such a high sponsorship of the project, that maybe they can make a decision that would not leave the whole nuclear power safety question to the USGS. We were more or less told that, "Look, you guys at Malibu, you didn't have the support that this project has, all the way from the President down to the AEC, the Department of the Interior. There is going to be so much pressure that the USGS won't be

able to pull the stuff they've been pulling on Bodega and Malibu."

So we crossed our fingers, and went ahead, but my major effort was not to place large equipment orders. I didn't want to have 10 or 20 million dollar orders that would have to be cancelled.

TC: Well, in terms of that federal support, and there was also state support, I guess, there was legislation both at the state and federal level authorizing this, correct?

EK: Correct. Oh, very much so. The California State Department of Water Resources always wanted to develop their own nuclear power plant. They looked, by the way, up and down the coast. They made a study of sites. They were very much interested in it because, again, it would be a precedent. If you can build stuff like that, you can build a plant practically anywhere on the coast. After Malibu, there was some serious question whether they could build anything on the coast.

TC: Well, why was that site chosen to begin with if it was such a bad one?

EK: Well, the Metropolitan Water District laid down the conditions. "We are going to participate only if you put the site in our location, where we want it, near our filtration and water treatment plants." They specified it in a very narrow area.

TC: So Bolsa Island was an island that would be created. It would be built.

EK: Yes, as you drive by Rincon Point, you saw an island there, an oil company island?

TC: Yes, yes, I've seen that, okay.

EK: That kind of stuff. That has been done. The technology is nothing new, you could do that. But the rock and the geology were pretty bad, as well as the population density.

TC: And that would be off, say, was it Playa del Rey?

EK: No, Huntington Beach.

TC: How far out?

EK: Half a mile.

TC: There were various entities involved in this. You just mentioned there was Edison, San Diego Gas and Electric.

EK: Right.

TC: And DWP, and then the cities, the municipalities.

EK: Anaheim, Riverside, Pasadena, Glendale, Burbank.

TC: How would this break down, as far as the generating units themselves go?

EK: Well, there was more or less a precedent established. We would take half and Edison would take half. Within Edison's half, 20 percent would go to San Diego. Within our half, I think 5 percent would go to Pasadena, 3 percent to Anaheim, 4 percent to Riverside.

But we would probably split about 20 percent among smaller municipalities. We would take 80 percent of our

half, Edison would take 80 percent of their half, San Diego 20 percent, Anaheim, Riverside, Burbank, Pasadena, Glendale a total of 20 percent.

TC: A total of 20 [percent]. So you're just really dealing with two halves.

EK: Right, that was the generation. The water plant would be essentially MWD with a very substantial subsidy of the Department of the Interior. The Department of the Interior would not get any water, but they would get the experience, AEC would also contribute some research and development.

TC: Now, had the desalination technology--I'm trying to get a picture of it--was it just massive distillation?

EK: That's essentially what it is. It's a low pressure evaporation. In other words, you evaporate in a vacuum because if you evaporate in a vacuum you can evaporate at very low temperatures; 90 to 100 degrees would give you the steam that you would then condense by ocean cooling water. It's a very simple operation.

It has a number of serious problems. One of the problems is, of course, you have thousands and thousands of ocean water tubes. If any one of those breaks, you have contamination of ocean water in it. Also, because of low temperature, you might have some coliform bacteria, so there is a question of maintenance of millions of tubes, and there is a question of bacteria because you're taking ocean water. Under normal conditions, bacteria will be killed at about

160 degrees. You don't do it here because you have low temperature, so you have to treat the water. So there were some technical problems; but, of course, that's only a question of money. There are a lot of evaporative units in Saudi Arabia and on certain islands.

TC: Yes, that was a question that I had. Where else in the world are these types of desalination plants?

EK: Well, there are a lot of them in the desert. Saudi Arabia has a lot of them; probably the biggest ones are in Saudi Arabia. We have some in Guam. We have a number of them on other islands. We used it quite a bit during World War Two. It's a simple process. All you need to worry about is keeping up the tubes and killing the bacteria.

TC: So there would be this desalination plant on the island, say, and then two generating units?

EK: Correct.

TC: Connected to that?

EK: Right.

TC: Had you gotten at all to the point of writing up the contracts for this?

EK: Oh, no. We wrote and we advertised and we had bids. By then, Edison and us, it became suspicious that this thing wasn't going to go very far, so we stalled. And the way we stalled was, we argued. The general idea was that units had to be identical. We used our evaluation technique. Let's say, we came up with a General Electric reactor, Edison came

up with Westinghouse, and we just kept arguing until the project died. The AEC got very annoyed and they sent down people to knock our heads together and it was lots of fun, but it was also unpleasant because there was a lot of pressure.

TC: Yes. What year? This would have been 1967 or 1968?

EK: Nineteen sixty-seven or nineteen sixty-eight.

TC: So it was early on that you thought that this would probably not fly.

EK: Yes, the recommendation of the committee came in October of 1967 and that just about did it. Goss and I went to Washington.

TC: Now, which committee is this?

EK: The Department of the Interior appointed a Committee on Geology and Seismology. The question was: What sort of geologic design do we have to do to accommodate the geologic condition? And the committee recommended a design for ten inch ground displacement. Not only were we close to Newport-Inglewood fault, but it's difficult enough on dry land to determine where are the faults. Here you are in the ocean environment, which was difficult. There was some faulting under the possible island, but the faulting might

not have gone all the way to the surface. It was a little bit ambiguous. Anyway, the committee felt there were probably no faults greater than ten inch displacement at the surface, so they recommended a ten inch displacement design, which could have been handled. That goes back to Malibu or Bodega. You can design . . .

Tape Number: 4, Side B

December 1, 1989

TC: Okay, you were saying . . .

EK: Yes, the question is the amount of ground displacement. If you have less than two or three feet and if you are in mud, you probably don't even need to design for it, because you have to keep in mind what a nuclear foundation is. You talk about a twelve-foot thick concrete raft, so that if the ground moves it wouldn't crack the foundation. If you have, of course, a ten or twenty foot movement, this is something else. But anyway, they recommended ten inches. We hoped that was more or less the end of it. But just to be sure, Goss and I went to Washington and we met with two top men of the USGS and we said, "Are you going to sit still for ten inches?" And they said, "No. If there is no opposition, we might agree to three feet. But if there is opposition, we would not be able to defend anything less than twenty feet." We went home, and that was the end of the project.

TC: What sort of opposition was there? Did that ever materialize?

EK: There wasn't any opposition, but there probably would have been, and our feeling was that they used this opposition claim simply as telling us, "Don't count on us defending anything less than twenty feet." There is always opposition. The question is how big the opposition is, how knowledgeable they are.

TC: Yes, I seem to have come across a quote--perhaps it was in Meehan's book--where someone was saying "Count on it, no matter where you site the plant, there will be opposition."

EK: Right, no question about that. The question is: How good is the opposition? How good are their experts? How much money do the have? How much public support do they have? But it really boils down to the Licensing Board. And to the Licensing Board, the experts and the lawyers count.

TC: Did Bechtel stay in the whole process?

EK: Bechtel stayed in it, right. And Bechtel complained about my attitude. I was more outspoken than Edison and efforts were made to get rid of me, to transfer me somewhere else, but the management stuck with me.

TC: Because you were able to see that, there were a lot of holes in these plans?

EK: I was asking questions. Probably, on the basis of Malibu, I was the most experienced of the group. Edison had practically no opposition. They'd built the plant very easily. The Bodega experience was short. The Malibu experience was the longest and the most intense, so I was probably the best qualified of our group, and I asked the questions that were raised at Malibu, and Bechtel didn't like it.

TC: Bechtel didn't like that. Well, had Edison had plans at that point for San Onofre?

EK: Edison had San Onofre by then practically.

TC: By then? Oh.

EK: They had submitted their preliminary report in 1963, the day President John F. Kennedy was assassinated, and they had a permit by 1967. See, they were building on federal land. They were building on Camp Pendleton, so the only opposition that had were the Marines. But that was taken care of in Washington.

TC: The Marines at first didn't like the idea?

EK: Oh, the Marines fought tooth and nail against it.

TC: Oh.

EK: There was actually a deal struck at that time. The Edison Electric Institute, which is a lobby of the private utility companies [Power Administration], was opposing a federal operation of Bonneville Power Administration. Bonneville was going to be expanded. They were going to build plants, put transmission . . . Edison Electric was opposed and they were giving them a very rough time in Congress. Part of the deal was, Southern California Edison (SCE) who was at that time, I think, either heading Edison Electric or very high up, told the Federal government, "If you give us the Pendleton land, we'll drop the opposition to what you're doing with Bonneville." And that was the deal, then. The Marines were told, "Scram!" And Edison got Pendleton and, there was little opposition. They were worried about the cliffs that were going to be dug up or something. But

people had neither money nor expertise and Edison just swamped them.

TC: Yes. I suppose it was far enough away from San Diego that any small group in San Diego would probably be lost to them.

EK: No, it wasn't so much San Diego. It was San Clemente, because they were very close to San Clemente.

TC: San Clemente. That's true, yes.

EK: Very close to a sizeable population but nothing like Bolsa. There may be about 15,000 people within five miles. Bolsa had over half a million. So the population wasn't that crucial, but it was close, very close to San Clemente.

TC: Well, once you realized that Bolsa was not going to be economical, that it was not a good idea but you were locked into it . . .

EK: Well, it couldn't be licensed. That was the basic argument. It wasn't economical. Desalination was of no great interest to us. We weren't going to pay for it. We were pointing it out, but we weren't going to pay for it.

TC: Yes.

EK: Our major question was [that] it cannot be licensed. That was the issue: It could not be licensed.

TC: There was also a problem with the cost escalation too. This shows up in the documents.

EK: That was used as an excuse.

TC: Oh?

EK: Eventually the project was dropped and nobody wanted to admit that we couldn't license it. The AEC certainly didn't because they pushed the whole thing, so the story was made that the cost was escalated and the story was made that the utilities, public and private utilities, couldn't work together, which, of course, had some believability because we pretended to fight. But we didn't want to place orders. . .

TC: Well, no equipment was . . . ?

EK: No equipment was bought. Not only was no equipment bought, but I kept the costs down and so did Edison. We kept it down.

TC: Did Edison end up buying anything?

EK: No.

TC: No, and no site.

EK: Very little money was spent.

TC: My last question on Bolsa is, was that idea put on hold for another time?

EK: Dropped.

TC: Apparently, early on it was dropped. But it wasn't a matter of trying to rethink this or find a better site for it, it was just a bad idea from the beginning?

EK: Right. Not only that, but Edison got very upset because another precedent was created. First, you talk about ground displacement, then you can't design for it. They got very sore about it, and I don't blame them because they were

proceeding by then with the San Onofre construction and that gave another shot to the opposition. Fortunately, Edison didn't have any to speak of. But outside Pendleton, if you go ahead with a plant the ground displacement will be brought up again, and the question will come up again, "Why didn't you design for ground displacement?" Of course, nobody wanted to say at that time that the USGS would demand twenty feet. There is, by the way, a memo of mine where I described the meeting with USGS.

TC: Oh.

EK: Where they said that if there is no opposition, maybe three feet could be defended. If there is opposition, it's got to be twenty.

TC: Just for a final point, I guess, on this, the organization that was formed to oversee this was yourself and a representative from Edison, mainly?

EK: Well, San Diego people came a couple of times but they left it to Edison. The cities that we represented left it to us, so the group essentially was Edison; the Department; the Metropolitan Water District, who had a lot of money in it; the Department of the Interior, because they wanted to know what was happening; and the AEC. There were five of us, five project managers. But the knowledgeable group was myself and Edison. The rest of them were fairly green, as far as nuclear siting was concerned.

TC: Okay. Now, 1968 is when this is finally put to rest. Is that right?

EK: That's correct. When we came back from Washington, that was it, but Edison suspected already that it was dead.

TC: You started looking for sites, then, outside of L. A. County?

EK: Right.

TC: And when would that have been? About this time?

EK: Yes. We began to look at the Central Valley.

TC: The Central Valley. And you located a site in Porterville, outside of Porterville.

EK: Correct.

TC: Well, what was the rationale for that, for going outside of L. A. County?

EK: To get an unfaulted block of ground. That was strictly a geological criteria that we were looking for: no faulting. We knew at the Central Valley where the Sierra Nevada Mountain Range slopes down, and as it slopes down it is under very deep deposits, miles deep, that there was a good chance of finding something that wasn't faulted for millions of years.

We looked first at Porterville, which is at the foothills of the Sierras. And it looked pretty good for awhile, but then we went into our geologic exploration, large-scale geologic exploration, dug trenches, and we found

a fault that we felt would give us problems, so we dropped Porterville.

TC: Well, had you also in Porterville started the work of contacting the community and doing all that?

EK: Very much so, right. We had pretty good support from the local paper, pretty good support from the community. There was, of course, opposition, as there always is, but Porterville is a community that had an insane asylum there for kids, for delinquent kids. They were more receptive.

One of our problems was water. They were worried not only about water but what was happening in the Central Valley. As they get more and more irrigation, you get more and more fog. You get higher humidity and that interferes with some of their crops. So there were a number of problems, but we felt they could be managed.

TC: Had you gotten to the stage of coming up with the plan for the reactor and having the feasibility study done in Porterville?

EK: Well, we were looking for geology. Once you have a site, a feasibility study presents not much problem.

TC: Okay.

EK: The only problem is water, if you're inland, and we believed we could handle it. I don't know how much you know about the Central Valley, but one of the problems is that they're poisoning the ground by dumping a lot of stuff in it. They need a drain very badly the so-called San Joaquin Drain

towards San Francisco. One of the deals we were going to propose is that we put a lot of money in their irrigation system, like we have in the Imperial Valley. They have tiling underneath the ground, so that the water, the irrigation water, doesn't stay in the ground but is drained into the Salton Sea. We were going to do a similar deal. Metropolitan Water District is doing it now with the Imperial Valley, where they collect the water and use it. So we felt we could handle that. That was not, at that time, much of an issue.

TC: That water would have to be, then, purified? Or could you use it as it was? It would be coolant water, right?

EK: It would be coolant water. It would have to be treated, but it wouldn't have to be treated to a potable condition. It could have been just cleaned a little bit and then used for cooling water.

TC: So, as far as Porterville-Tulare goes, it was simply a matter that the site had been chosen and there was a fault problem there and you knew that that would create the same sort of response from USGS.

EK: USGS, right.

TC: And so you figured that, rather than continue try somewhere else.

EK: Right.

TC: Where did you go from there?

EK: We sent to Wasco.

TC: Wasco, okay.

EK: That was the last spot. But also, at the same time, we were trying to set up some sort of criteria. We were working on that.

TC: Yes. Well, was this the criteria that you would then present to the AEC for them to adopt?

EK: Well, yes. They were working and we were working. And it was our feelings that we'd better get into that, because our belief was that the AEC was not at that time putting enough expertise on the subject. The guy who worked on it was Minogue. He was a physicist who had no background and he was under the thumb of the USGS; and we thought that we would have to create a rival group of experts that would balance the USGS, so that the AEC would have the benefit of an independent view, at least of two viewpoints. So I think AEC at the same time came to the same conclusions: that they needed criteria. And they began to work on it and we began to work on it, the utilities, it was quite a group.

TC: Well, what other utilities were involved? Let's talk about that. I'm not familiar with that.

EK: Well, we had Bechtel, we had ourselves, we had PG&E, Southern California Edison, San Diego Gas and Electric, Stone and Webster from New England, TVA, Virginia Electric, a number of consultants, and a Jesuit from Columbia University. But the basic core was PG&E, the Department, Edison, and Stone and Webster. The others were from the

East they were, of course, interested but they didn't have the expertise we had here. But that was about the size of it. We used consultants. We used Jay Smith and others. We didn't use Dick Jahns, we had enough of him.

TC: Yes. So what happened to Jahns? He went back to Stanford?

EK: Jahns became the Dean of Earth Sciences at Stanford and PG&E was stuck with him and so was General Electric up in Vallecitos. Because he was their original geologist, they had to live with him. Edison wouldn't touch him and we wouldn't touch him.

TC: So the criteria that were drawn up, was this presented as a formulated set of criteria, would you say?

EK: Well, basically, we were concentrating on two items. One of them was shaking, another was ground displacement. The shaking, I think there wasn't that much disagreement because that was generally handled by engineers and they had come up with some good figures. The ground displacement was the issue. We abandoned the term "active" fault because it was meaningless and we introduced the term "capable" fault; which, was a fault that hasn't moved in 35,000 years, had a negligible probability of moving again, in the life span of the nuclear plant. There was also the belief that, unless it's a very large fault, the movements will be small and the nuclear plant foundation can take it. Even if it cannot take it, and there is a crack in the foundation, that doesn't mean a major disaster. So that was the basic

thinking. The reason that 35,000 was selected is that was the limit of carbon 14 dating. That's when you can date accurately. Beyond that, dating became approximate. This was accepted except that the AEC, under the USGS urging, added gimmicks saying that if it moved more than twice in 500,000 years, that still was "capable". This means that if it hasn't moved in 100,000 years, you're home free. Except, they put in another gimmick that created a lot of problems, that the fault is "capable" even if it hasn't moved in 100,000 years, if there is a structural relationship with a "capable" fault. And that is a real killer because we were getting in what I call a tea-leaf reading. You have a "capable" fault, twenty miles from where you are, but there are little faults in between and you can somehow connect them all if you have a good geologic expert.

TC: And that's what they would call the structural relationship to the faults.

EK: That is the structural relationship. There also was macroseismicity, which is another nebulous concept. Macroseismicity is earthquakes over a magnitude three. We thought it should be five, they said three. But the trouble with macroseismicity, it is very hard to tie it in to any particular fault because the shakes are five miles below ground and it can project in more than one way.

The classical case was the Point Arguello earthquake of 1927, which was in the ocean. Until the Diablo Canyon

Nuclear Power Plant controversy, it was agreed by everybody that it was on the Santa Ynez Fault, which runs east and west, right here behind the Santa Ynez Mountains. When Diablo came up and they discovered Hosgri Fault near Diablo, they tried to connect the Hosgri Fault for 30 miles to the Point Arguello macroseismicity earthquake. You could argue either way but nobody knows for sure. If you can connect that, then Hosgri becomes "capable". But you're way out in the ocean and nobody really knows. The geologists have a favorite expression and that is: "You can't rule it out." This is what Jahns liked to say, "I think it's this but you can't rule out that it is something else." That leaves you nowhere.

TC: Yes, that's true.

EK: Anyway, this is where we are now. We have a pretty good standard on shaking and have no movement in 100,000 years. We can live with that, but the structural relationship and macroseismicity are problems. If you have a good opposition with lots of money, they can give you a lot of grief.

TC: So the standards and the criteria that you set up, they were discussed, they were adopted with qualifications, and then . . .

EK: They were, yes. There was some agreement and there was some disagreement. And the disagreement essentially is the macroseismicity and the structural relationship. It's sort of an open end.

TC: Well, I guess I'm just trying to see what the outcome would be. Was the hope that the AEC would adopt something that you could all live by?

EK: Right.

TC: And then would that have to become some sort of legislation or just something that would be . . .

EK: Well, we have it. This is the seismic and geologic siting criteria. It is a federal regulation.

TC: Federal regulation, okay.

EK: 10-CFR-100.

TC: Okay.

EK: Code of 10, Code of Federal Regulation, Regulation 100, has an appendix and the appendix then defined what a "capable" fault is.

TC: So just as a footnote, this is Appendix A, Seismic and Geologic Siting Criteria for Nuclear Power Plants. So this is how it was incorporated.

EK: Right.

TC: Okay. Well, maybe it's a question I can keep for another time, but it seems to have not done that much good, in terms of resolving your problems.

EK: Not in terms of faulting. It resolved fairly well the shaking. It's a question of money. You can handle it. You can always design and plan for an 8 1/2 magnitude and nobody can claim anything worse than that. An earthquake adds a couple of percent to your total costs, so shaking we can

handle. It costs a little bit more, but it's a dead issue now.

TC: Yes, okay.

EK: Faulting is not.

TC: Well, can we start talking about the San Joaquin Project?

EK: All right.

TC: Okay. So after the Porterville site location and finding the fault, that was abandoned and a site was found at Wasco, as you said. Now, what was the process thereafter? So this was about 1970?

EK: It was about 1971 or 1972.

TC: Nineteen seventy-one or nineteen seventy-two. Well, let's just get the general description then of what the San Joaquin Project was all about.

EK: The geology was good and the question that became crucial was water.

TC: Yes. It would have been the same sort of question that some people may have raised at Porterville, right?

EK: Yes. We were a little bit better at Wasco. As I mentioned before, the Department had a problem with not paying taxes, so we came in with a partnership with PG&E.

TC: Okay.

EK: PG&E was going to get 40 percent, so there was a pretty good money inducement to the community. But the issue of water came up and that is eventually what sank it.

TC: Well, who did you have to approach initially on this in the community? Was it the Chamber of Commerce or the county council or something?

EK: Well, Bakersfield - most of the discussion was at Bakersfield. Going a little bit into the history of Bakersfield, Bakersfield had ambitions to become a very large town, so they contracted to use a lot of water from the Kern River. They were paying for but not using the water, so there was a negotiation with the city of Bakersfield. The city of Bakersfield would sell us some of the water at a pretty good price, naturally. I forget the amount, $200 per acre-foot or some such figure. So we felt we had the water deal under control and we also felt that we'd be willing to help the farmers with the San Joaquin Drain, because that was at that time a hot subject. That was the approach and it looked pretty good for awhile, so we concentrated on getting the geology and getting the environmental impact report PSER--preliminary site evaluation report, and all that.

TC: Yes, yes.

EK: And that worked pretty good and then opposition arose and they demanded a referendum. And we agreed to abide by the referendum, which I don't know whether we could avoid it. I don't know the politics. By then I was out of the picture, I retired in 1974.

TC: By then you had retired.

EK: In 1974 I retired. I didn't follow it any more. The Department concentrated, during my time and during Bob Burt's time, on getting a clean construction permit, and neglected the politics.

TC: A clean construction permit?

EK: We wanted to get a good construction permit. We didn't want to have anything hung up. We didn't want the statement that the construction permit is okay unless you do this, that, and the other thing. Then you start dragging on . . . We wanted to go to the hearing with a clean approval and no loose ends.

TC: Yes.

EK: And I think they got it, but they got hung up on water.

TC: Well, who exactly were the opposition then?

EK: I think it was the Irrigation District. I was not involved at that time in politics anymore. But I think there were people in Bakersfield, like in any community . . . You always have a group that feels that if you give up water, you limit the growth of the city. In the sixties and seventies, everybody wanted to grow. (chuckling) Now it's the other way around.

TC: Yes, yes.

EK: But they felt that Bakersfield had a great future and giving up some of the water was the wrong thing to do. There was a big controversy in the fifties about fluoridation and the Health Department made a study of about 3,000 communities.

They wanted to find out why fluoridation won and why fluoridation lost. And they found out that, if the city fathers stuck together and made the decision to put in fluoridation, that was the end of it. If there was a split in the establishment and an opposition developed, and no matter how silly the opposition was, if they made enough noise and if there was a referendum, fluoridation usually lost. Because the people felt if there was no agreement on top, there was something fishy about it, and would rather not do it. And that's essentially, I think, what happened in Bakersfield.

TC: Well, that's an interesting analogy to what went on with nuclear plant siting.

EK: Anytime there is a controversy, if the opposition makes enough noise, you are in trouble.

Tape Number: 5, Side A

December 15, 1989

TC: The last time we spoke, we generally described San Joaquin Nuclear Project, and I wanted to go back and round that discussion out with some specific questions, an obvious one being the planned size of the reactor. I found it funny that the Sierra Club described it as, ". . . gargantuan, the largest nuclear fission project in this part of the world," and this was in about 1973 or 1974 that they described it that way. Was that the case?

EK: No, because the plant was essentially, like Diablo, 1000 mega-watt units. We were figuring on four units and so was Diablo and so was what the Southern California Edison was thinking of San Onofre. Now San Onofre, they got into a problem of expansion. They stopped with three units. Diablo has two units now; eventually it might have four.

I don't know whether we would have gone to four, but we probably would have had two for sure. So it was in line with what other people were doing. The Arizona Public Service was thinking of four. It was so difficult to get a site, so once you get a site you want to utilize it to maximum capacity.

TC: Well, that leads into another question which is the one item that actually was submitted to the AEC, which was the Early Site Review Report.

EK: Right.

TC: What was the function of the Early Site Review Report? Tell me if I'm reading this wrong. Did it help to speed up the process?

EK: No. You went through three stages. You'd get a preliminary site report, then you ask for a construction permit, and then you go to an operating permit.

TC: Oh, okay.

EK: And with the preliminary, you wanted to be sure that you had a reasonably good chance of getting approved for construction.

TC: Okay.

EK: And that was then the PSAR, Preliminary Site Analysis Report. Eventually, it would lead you to a construction permit.

TC: Okay, okay.

EK: Then you could start constructing.

TC: DWP was the project manager for this, and we talked a little last time about why the other entities were involved, but DWP maintained project management.

EK: And the majority investment in the generation. We were going to get-- about 60 percent, or some such figure.

TC: And that would account for why the Department held the management position on it?

EK: Right.

TC: One of the confusing areas was the role of the State of California in this whole thing. The [California State] Department of Water Resources was involved. Is that correct?

EK: Right, correct.

TC: And that had to do with the fact that there'd be energy used for pumping water in the California Aqueduct?

EK: Well, the California Water Project required pumping. At that time, they were still talking about getting water around the [San Joaquin River] Delta. The Department of Water Resources needs power. They used to buy some of the power but, eventually, they want to develop entirely their own generating capacity, and they always were looking around. At one time or another, the Department of Water Resources looked up and down the coast for their own nuclear power plant. They also thought, at that time, there was some talk of desalination. But power is always a very valuable thing in California.

TC: The Metropolitan Water District was involved, too. I read that they introduced an amendment to the MWD Act which would allow it to sell water outside its service area, which would have been the county .....

EK: Right. Yes, we might have gotten some water from MWD. There were some water negotiations.

TC: Yes. Well, we mentioned last time how Bakersfield had this surplus water.

EK: Right.

TC: And that was how that would enter into it. But there was also this other aspect of MWD offering water too, or swapping water.

EK: Swapping. It was essentially a swapping operation. MWD generally doesn't like to give up any water because they have this Colorado [River] withdrawal hanging over them.

TC: Yes. Well, just to date that, that was a 1962 or so Supreme Court decision?

EK: I thought it was 1964 but I'm not sure.

TC: Yes, it might be 1964. I might be off a couple of years. Arizona v. California.

EK: Right.

TC: And in that, California lost part of its water allotment. Is that correct?

EK: It wasn't so much that. Arizona didn't use the water and MWD was using it, so partly it was Arizona's water to begin with, but there was a question whether the use of that water for agriculture wasn't really the thing to do. It should have been used for urban needs. It was a very complex suit that really originated when the Colorado River was originally divided between the states, and Mexico. They divided fifteen million acre-feet, which the Colorado did not have. There was a shortage of about a million acre-feet. The actual flow was fourteen. So the question was

who is going to give up their share because there was only so much in the river.

TC: Well, this is slightly off the subject of San Joaquin, but while we're talking about the Colorado, there were also a number of other ideas coming up in the mid-sixties for building new hydro projects, for instance, like Marble Canyon.

EK: Yes, Marble-Kanab in the Grand Canyon. That was . . . David Brower stopped it, where he said, "Flooding the Grand Canyon is like flooding the Sistine Chapel to get a closer look."

TC: Nobody was talking about flooding the Grand Canyon.

EK: No. Floyd Dominy, the Director of the [Bureau of] Reclamation, got in a helicopter and he flew--he was holding on with one hand and then taking pictures--and he showed that the total rise of the Colorado was about fifty feet. So, if anything, before the dam, you couldn't see the Colorado from the Grand Canyon rim. With the dam, you could see a little bit of it. But it was a very emotional issue and the Sierra Club stopped it. The result of it was David Brower was kicked out of the Sierra club because he lied and he used money that he shouldn't have. Then he organized the Friends of the Earth.

TC: Oh.

EK: The Sierra Club disowned his operation.

TC: Oh, I wasn't aware of that.

EK: If you want to read it, there is a book by McPhee.

TC: Yes, John McPhee.

EK: Yes, and he wrote a book called Archdruids where he describes all of those things I told you between David Brower and Floyd Dominy.

TC: Oh, yes.

EK: It's rather interesting.

TC: And then there was a project proposal, I believe it was Floyd Goss who was behind it, to build a dam at Hualapai. Is that right?

EK: Yes, Hualapai, right. At that time, David Brower argued that hydro is too expensive, we should build a nuclear power plant. That was his major argument.

TC: Yes. And so how did . . .

EK: Well, the Glen Canyon Dam was . . . Lake Powell was, in essence, what was created.

TC: Oh, I see.

EK: Yes. The Glen Canyon Dam.

TC: Okay. Getting back to San Joaquin, I came across this concept of quality assurance. Now, was that a new feature to the regulatory process?

EK: When you build a power plant, a conventional power plant that can take hobnail boot treatment, your quality isn't that crucial. When they build a nuclear power plant, you're going into an entirely different situation, experience which the utilities at that time didn't have. And a great deal of the trouble came because of poor quality assurance, since it

required a much more elaborate and much more precise construction operation. And, in effect, we were setting up a new technology and quality was crucial.

TC: Well, was there a quality assurance office?

EK: There was a quality assurance engineer that would follow the operation with a large staff. One of the biggest problems was welding, because in a conventional power plant you use either steel or low alloys. In a nuclear power plant, you use highly enriched alloys. In a conventional power plant, you use carbon steel with maybe 2 or 3 percent chromium and nickel. In a nuclear power plant, you usually use stainless steel which is 18 percent chromium and 8 percent nickel, and the welding is very crucial. And on some of the power plants, the original quality assurance was so bad that you had to tear out all of the piping and re-weld it again. It became very expensive. You simply required a much higher level of sophistication and control.

TC: So was that quality assurance engineer part of your staff?

EK: Yes. He was reporting to me but he was independent of the construction operation. There was a construction supervisor and I was the project manager, but the quality assurance engineer was independent of the construction. There was a lot of friction--not just on that because we never built the plant--but, generally.

There were cases where there were fistfights between the inspector and some of the welders, because after the

welder completed a job the inspector or the quality assurance man would say, "It's no good, tear it out." It was a rough job but it had to be done.

TC: Yes. In this case, who was that who was quality assurance engineer?

EK: Eventually, it would have been Weidner.

TC: Oh. It's just that you hadn't gotten to the point . . .

EK: Remember, we were still in the paper phase.

TC: Well, going back a minute to the state's role, now the Environmental Quality Act was passed somewhere along the line there.

EK: Near that, right.

TC: It might have been after your time with the San Joaquin.

EK: No. It was in the sixties.

TC: Oh, I thought the . . .

EK: What was required in the environmental impact report, started the paper mill.

TC: So did you have to file a state environmental impact report and a federal report?

EK: Well, the way it was usually used, the federal was a stricter one. There were going to be two hearings but you tried to get by with one environmental impact report. Our first, when we first started with Malibu the thing was in a flux, we thought we'd make it efficient so we invited all the people involved, which was water quality, air quality, toxic, et cetera. And the first thing we found out, they

would start arguing among themselves who had jurisdiction over what. But eventually the biggest one, the most elaborate one, was the federal. The state raised some additional questions but they were minor. Generally, the federal tried to incorporate all of the state requirements.

TC: Okay. And those requirements would have to do with pollution and toxicity?

EK: Anything in the environmental impact report. For instance, we used to get an archaeologist who went over the ground looking for Indian relics. We used to have a biologist look for some plants that could be endangered, some animals that could be endangered. He made a list of all the animals, of all the plants, of all the historical things, whether there was any passage of Indian ghosts or whatever. It came up here at the Point Conception Liquified Natural Gas Plant where they had to keep away from the Indian burial ground, and the Indians claimed that from the grounds the ghosts got up and they moved through a certain area, and this liquefied natural gas plant would obstruct the area so they had to move it to have the ghosts pass unobstructed. Anybody that had an axe to grind would come in.

TC: That's a tough one, too. I guess that's the sort of thing you had to comply to because of public outcry.

EK: Right. The fishermen would come in. The fishermen would come in and the surfers and the tourists anybody and everybody had standing. It was a battle of attrition.

TC: Yes, and you had to show that you were sensitive to this.

EK: You had to show that you considered it, that you made provisions for it. It was either you removed the objection or you mitigated it. I think you should look at the environmental impact report. It was, I would say, about eight volumes. Everything, everything was looked at.

TC: There were some public meetings, and I found a document that is very interesting. I'll show it to you. It's a progress report on the San Joaquin Nuclear Project to the Kern County Board of Supervisors, May 29, 1974, and it's Howard King speaking about what's going on.

EK: Right.

TC: It's a very lucid expression of where you were at, at that point.

EK: Yes.

TC: First off, Howard King at the time was . . .

EK: Head of System Development.

TC: So part of his job would be to face the public, as it were?

EK: Yes, he was a spokesman.

TC: How did that fall under System Development though?

EK: Well, the System Development determined the need for plans and how to integrate it into the system. And at that time, I think I was under the System Development.

TC: Oh, I see, okay.

EK: I was working for Howard King.

TC: Well, in something like this, there were probably several of these meetings - did you face a hostile audience?

EK: Yes, there were always people who objected. By and large, I think we had a reasonably good reception, but there was opposition, and the question that was bothering them was water.

TC: Yes.

EK: Safety wasn't much of an issue.

TC: Safety wasn't? There were other divisions within DWP that you had to coordinate with, and Public Affairs was one of them, I know.

EK: Right, I did.

TC: Did that consist of getting together at the beginning of the week, say, or the beginning of the month, and saying this is what we've got to do this month? I just want to get a sense of the meeting mechanics that went on between you, your group, and Public Affairs, for instance.

EK: Well, I worked with Richard Nelson.

TC: Yes, Dick Nelson.

EK: Dick Nelson. I worked with Dick Nelson. Actually, he was a liaison man with some of the agencies and public bodies. Dick spent quite a bit of time in Bakersfield and Kern County. He was very helpful, he was very good. And when the need arose, when there was a public meeting, I would come in with him and give a speech, answer questions.

One of the problems we had was one of those union deals. The local unions, the Kern County unions, more or less told us, "We will support you. We will support the Department if we get all the jobs." And our answer, of course, we couldn't do it, "We have our own union, we'll try to split the work. We'll try to hire a great many of your men, but we have to give some work to our own union." It was that kind of a meeting.

Then there was a meeting about a duck hunting pond there. The hunters were interested whether we were going to interfere with their hunting ducks, whether we were going to disturb the ducks' wintering place, et cetera. And then there were a number of educational institutions who wanted to know whether we would spend some money or put an exhibition there, give some money to the school. Everybody was trying to get a piece of the action. And you had to satisfy them without making too strong of a commitment. If we make too strong a commitment to a local union, we'd have our own union on our backs, so you had to be diplomatic, you had to maneuver. It was a substantial PR operation.

TC: In this document, Howard King mentions that there will be an office set up in Kern County somewhere, Bakersfield perhaps.

EK: Right.

TC: Was that ever set up, do you know?

EK: No. I mean, not in my time.

TC: Not in your time.

EK: Remember, I left in August of 1974.

TC: In 1974, yes. This is May, the end of May, actually, so you're talking a couple of months.

EK: Yes.

TC: Well, what were the mechanics of handing over your duties? It was Bob Burt [who followed you].

EK: Bob Burt was transferred to my section and worked there for about a year and one-half, two years, I'm not sure anymore. And he was eventually phased in.

TC: Yes.

EK: He was very good, very energetic.

TC: And you had given notice of your retirement sometime previous to all of this?

EK: No, not at that time. Well, I think I gave them notice about July, I would say, but Bob was brought in before that. I was at that time, about close to sixty. My health wasn't the greatest. I looked at this operation, and it was my feeling we were looking ten or fifteen years down the road, and I needed a replacement and he was the logical man. So he was brought in before I even announced my retirement.

TC: So, upon your retirement, you had thirty years in or something like that?

EK: Twenty-eight.

TC: You had twenty-eight years. Was it that you were ready for retirement or was it health? You mentioned something . . .

EK: I had two things. I had developed high blood pressure, which wasn't too good, and my wife was developing Parkinson's and Alzherimer's disease and was becoming quite a burden.

TC: Oh, I see.

EK: And I just felt that the roughest period was ahead and I felt I might not be able to handle it.

TC: Well, let me just ask this sort of a summary question on the nuclear project experience that you had. I'm not sure how to phrase this succinctly. Was there a change in the regulatory environment between Malibu and San Joaquin? We're only talking here about ten years. . .

EK: There were two changes. Jerry Brown, Jr. was elected Governor of the State of California at that time. He was anti-nuclear. And the whole environment was becoming hostile and more complicated. They found out that you could stop nuclear power plants. They stopped three of PG&E's power plants at Bodega, Point Arena, Mendocino. They stopped us at Malibu, and it [all] became a vulnerable operation.

TC: Yes. We're talking about this opposition that began forming. In the earlier phase, in the Malibu period, the opposition were land developers.

EK: We were in a rich neighborhood, which was tourist and the well-to-do Malibu Colony or Hollywood crowd, so that was really a powerful opposition. We had most of Los Angeles with us. We were stopped by money and influence. The

sixties were the beginning of the environmental decade. I think the Santa Barbara oil spill was 1969.

TC: Yes.

EK: Earth Day was 1970.

TC: Earth Day, right.

EK: The whole politics changed drastically, and the beginning of the cry was: "Not in my backyard!" And the politicians then took the position: "Not during my term in office." That was the general atmosphere.

TC: It seemed like there were stages of development between that USGS type of opposition, land developer type of opposition, to the ideological opposition that permeated my generation, for instance.

EK: Correct. We were the ultimate in establishment types and we were also a technology that scared people, that people couldn't understand. We were a perfect target.

TC: Yes.

EK: We were these big, big technical guys with lots of money, shoving it down peoples' throats, and we were vulnerable.

TC: There was another document that I found that was very interesting. It was your own writing on . . . it's called "The Moratorium on Nuclear Power," and it's dated January 18, 1972.

EK: Right.

TC: Apparently, that was a public meeting of some kind, a paper presented, which you were opposing an initiative at that point.

EK: Right.

TC: Now, was that a California initiative?

EK: Correct. There were two of them. There was one stopping nuclear power altogether. That was defeated. Then, after I was retired, they ran another initiative which, in essence, says that we're not stopping nuclear power but it has to be proven perfectly safe.

TC: Okay.

EK: That, of course, you couldn't prove. I mean, that requires zero risk and you couldn't prove it. So, in effect, the second initiative stopped it. This first one was defeated.

TC: Okay. That was the early one.

EK: That was the first one. That was when they came out too bluntly. They wanted to stop nuclear power. That didn't fly, but the second initiative which was supported by Brown was: Let's not build nuclear plants until we have perfect safety, until we have built a depository where we can get rid of the waste.

TC: Well, that would have been . . . This early one was 1972 or so, and then the other one was, I think, around 1976.

EK: That's correct.

TC: So who was behind the early initiative, this one that you are referring to in your talk?

EK: I think it probably was the Sierra Club, a number of environmental organizations, probably the Audubon Society and a number of activists. But they didn't have the money or the organization behind it and they lost. The second one was much more powerful because they had the state behind it.

TC: Yes. One of the attachments to this moratorium talk you gave analyzed the John W. Gofman and Arthur Tamplin Poisoned Power book.

EK: Right.

TC: I would like to talk a little bit about that. Who were Gofman and Tamplin, first of all?

EK: Well, that's a funny story. Originally the biggest opponent of nuclear testing was Linus Pauling. Linus Pauling made quite a bit of a splash because he was a Nobel Prize laureate. His biggest opponent was John Gofman. He made the best arguments for nuclear testing. On the basis of his performance, the Atomic Energy Commission was going to build a special laboratory. He was going to do a lot of testing of the effects of low-level radiation. Then, President John F. Kennedy agreed with the Russians to stop atmospheric testing. The laboratory idea was scrapped and Gofman was without a job. Then Gofman joined Pauling, became the most violent anti-nuclear speaker. He talked mostly nonsense. He was completely discredited by about every professional organization, including the International Committee on Radiation Protection and the National Academy of Science.

But he became a very effective speaker and rabble-rouser. His best performance was concerning a lady who worked for a nuclear weapons factory, Kerr-McGee, Karen Silkwood.

TC: Silkwood, yes.

EK: She got contaminated with plutonium. Gofman was the expert for her lawyer, who I think was Spence. They won a $10 million settlement for her heirs. It was set aside on appeal. She had got drunk and had taken a Quaalude and had a fatal car accident, but they claimed she was killed by the Kerr-McGee Management and all kinds of nonsense. Anyway, that was Gofman's high point. He was a very effective speaker. He was actually an M.D. He had done some useful work in the treatment of heart disease.

TC: Oh.

EK: He was a good man in his specialty. He was a very emotional man, but a very good speaker. I once had a debate with him. I nearly got hit by him. I said that nuclear power is safer than Gofman because with all of these meetings that Gofman organized, with people driving back and forth, somebody is going to get killed just travelling to see him. I was on the Tom Snyder television show and he lunged at me and Snyder stepped in between.

TC: What year was that?

EK: I would say it was in the late sixties, 1969 or 1970, something like that.

TC: That's when Gofman and Tamplin were making their first big splash there with that book.

EK: He wrote a number of books. In every book, the number of people killed by nuclear power grew fantastically. He started with 16,000 and went to 72,000, 96,000, 300,000. When the lab was eliminated, he was still on salary and had a staff. And then he started making propaganda, how dangerous radiation is, and we really should have a lab operating. The lab wasn't built, and they kept cutting down his staff. They wanted to get rid of him instead of giving him the lab. If you're interested, I have a collection of his quotations where he says how wonderful nuclear power is.

TC: This is a short paper that you've put together called "The Record of Dr. John Gofman," and so, this is . . . Let me just describe this for this record. It is a set of quotes that, I believe, show his change in position over the years. Is that it?

EK: Yes.

TC: Well, and Arthur Tamplin was his . . .

EK: Tamplin was his assistant. The two worked very closely together.

TC: So, not long after they came out with the Poisoned Power book, the RAND Corporation came out with a statement saying that, based on certain studies, that we should go slow with nuclear power. Do you recall that particular report?

EK: Well, then the RAND Corporation really had no connection with Gofman. They made a number of studies where they said we really should not develop too much water resources because we can conserve and we can use underground water. And they looked at the electricity demand in California. At that time, the utilities were projecting about a 7 percent growth per year, which is doubling every ten years. The RAND Corporation questioned that projection. They felt there was more room for conservation, building plants possibly outside the basin. But it had nothing to do with the danger of radiation.

TC: Nothing to do with Gofman, okay.

EK: That was not the issue.

TC: Okay. But as a respected . . .

EK: Think tank.

TC: . . . research facility, they must have added some to the fire of the opposition. They must have contributed some-

EK: Well, not too much. The question at that time was how many new plants should we build. The utilities were very enthusiastic about projecting a lot of plants; the RAND Corporation questioned it.

TC: Who funded their research on this?

EK: I don't know. I think they had probably done their own research and then tried to sell it. At that time-- the Federal government wanted to get a national survey for electricity demand, sort of make an inventory of what we had

and figure out how much more did we need. We were trying to develop a national energy policy, and I think RAND was part of that operation.

TC: I see.

EK: That was essentially a Federal project.

TC: Then, shortly after this RAND analysis, the Union of Concerned Scientists then got into the picture.

EK: Right.

TC: Who were the Union of Concerned Scientists? Did they come up at this point or had they been in existence for some time, do you know?

EK: Well, they originally started as an anti-nuclear weapon organization, which at that time was fairly common. There were a number of organizations who were against the proliferation of nuclear weapons. And then they branched into nuclear power, but they didn't become all that vocal. It was essentially Daniel Ford . . .

TC: Yes, we spoke of him, The Cult of the Atom.

EK: Right. What happened was the original organization was about anti-nuclear weaponry. When Ford and a couple of his buddies started to go against nuclear power, it split, and the original organization still remained against nuclear weaponry, with big names like Hans Bethe. Then Ford, who was a drop-out economics major, more or less organized his own group. It concentrated against nuclear power. But the

people who originally organized it were pro-nuclear power, against nuclear weapons. Hans Bethe was a good example.

TC: Okay. Well, in this same period, 1973, 1974, 1975, Ralph Nader was becoming a national spokesman.

EK: Right.

TC: To me, this is when it starts taking on this strictly ideological kind of tone, where maybe even the phase before that there were analysts and scientists saying, "We're not sure of this." And then this person like Nader, a consumer advocate, comes out. . .

EK: Right, he lent his name to it. He generally does that. If he sees a good issue that he can publicize himself, he joins it, whether it's California automobile insurance or fluoridation or chemical additives to food, he'll join.

TC: Oh, yes, that's right: red dye number two.

EK: Right.

TC: You mentioned, off tape last time about Nader's . . . where he got his start in this whole thing, and you mentioned that it was the anti-fluoridation [movement].

EK: Right.

TC: That would have been in the fifties, or so, or early sixties, do you think?

EK: No, it was the sixties. I have a reprint, if you're interested, of his speech against fluoridation.

TC: Okay. Well, it's funny that that fluoridation issue was always considered kind of a right wing . . .

EK: The John Birch Society, right.

TC: Yes, the John Birch Society, yes. Was he at all connected to that?

EK: No. He generally has any objection to chemical additives to food and, to him, fluoridation is a chemical additive. He's a natural food advocate.

TC: Oh. In 1975 the big conference he called was called "Critical Mass."

EK: Right.

TC: Were you following this? By this time, you were retired.

EK: I was active here, arguing against the California Anti-Nuclear Initiative. We had a group of about half a dozen college professors and other people.

TC: At UCSB [University of California, Santa Barbara]?

EK: At UCSB, and I was making speeches. I found out there are hundreds of clubs in this little city of ours, so it's a never-ending occupation.

TC: (chuckling) Oh, so it was like a speakers' bureau?

EK: It was a speakers' bureau, correct, and since I was only teaching part-time, I was mostly the speaker.

TC: So, were you called on to answer? Nader's famous quote was that nuclear power is "unsafe and unreliable".

EK: The big issue here was Diablo. And a number of doctors put a big ad that we were going to have more cancer cases from the Diablo operation, so we pointed out if there is a single

case of cancer here from the Diablo operation, then the medical X-rays were responsible for all cancers.

You dealt with a lot of kooks. There are people who like to hear themselves, who go to meetings just to heckle the speaker, and there are all kinds of opposition. Chiropractors didn't like it because chiropractors don't like anything that is not natural. All kinds of people come out of the woodwork, and that's what you had to deal with.

TC: Well, in your experience, how did you respond to some of these people? Did you ever lose your cool?

EK: Well, occasionally you do, but you get used to it.

TC: And you're able to just fend off the wacky kinds of questions?

EK: Well, you try to beat their argument. There is a guy here, a retired doctor who says that we are going to poison the earth by creating all of this extra radioactivity. And, of course, the answer to that is that nuclear power reduces the radioactivity of the earth because we take the natural uranium and we burn some of it, we destroy some of it, we convert some of it into short-lived isotopes. They reduce the radioactivity very rapidly, they decline, and whatever is left, which is very little, we'll bury. So the total radioactivity of the earth will be reduced if you go all-out with nuclear power; so he was completely wrong. But, basically, what you do is, you quote authority. You quote the National Academy of Science, the International

Commission on Radiation Protection, that's all you can do. That's all I did with Gofman.

TC: At this time, you mentioned you started teaching at UCSB. How did that occur? Was it nuclear engineering that you taught?

EK: No. I went to the UCSB and I asked some of the engineers what was needed, and they told me they were organizing an environmental group and the environmental group, of course, is very strongly anti-technical and anti-nuclear. And they really should know what they were talking about, they should learn about energy. So I taught energy to the environmental group.

And that didn't work out too well because I permitted the engineers to take that course. And what happened is I had to give the As to the engineers and Ds to the environmental group. I found that the environmentalists had no math background. People who go into an environmental movement are usually liberal arts graduates and, in general, their mathematical background is so meager that you really have difficulties teaching them energy because of the numbers. So, then I just said, "Why don't I just teach the engineers?" and I started teaching engineering economics, engineering management, and I've been teaching it ever since, mostly engineering economics.

TC: You're still teaching now?

EK: No, I finished in March. The University had to let me go because if I stayed another year, I would have to have tenure. And they didn't want to do that.

TC: They didn't want that. You were consulting and you mentioned Diablo. I'd like to discuss some of the issues around Diablo.

EK: Okay.

TC: That was a PG&E project, right?

EK: Right, right.

TC: When did that get started?

EK: Well, it got started in 1967. The original cost estimate was $360 million, and when it was finished, which was in 1985, it was about twelve years after the project date-- it was sitting there for twelve years--the total cost was $5.5 billion, from $360 million to $5.5 billion. The issue that I got involved with was that a utility sets its rates based on its asset costs. And the Public Utility Commission, which allows the rate setting, said that PG&E loused up the project and they are not entitled to this $5.5 billion asset base, they would only allow them $1.6 billion, so there was a $4 billion difference. And PG&E, of course, said it wasn't their fault, that it was caused by the Nuclear Regulatory Commission changing requirements plus the discovery of the offshore Hosgri fault. And then PG&E had presented testimony proving their case. I think they submitted something like 500 volumes of testimony, it came

on a truck, and they had about-- thirty experts. I was one of those experts.

TC: Where was the testimony? Where did the hearings take place? In San Francisco?

EK: There was no hearing.

TC: Oh, there was no hearing.

EK: After PG&E submitted the volumes and after the PUC people read them, they decided to compromise. In essence, PG&E got most of what they asked.

TC: Oh.

EK: They got it on the basis, of course, that they have to perform, they have to justify the investment.

If the investment operates as projected, if their power is cheaper than alternative power, then they're entitled to the rate. The bottom line was really very simple. The cost of the Diablo nuclear power plant was about $2,500 per kilowatt. At the same time, the Department of Water and Power built the Intermountain Power Project, within schedule and within budget, and that cost $3,000 per kilowatt. So, no matter how much of a blunderer PG&E was, they came up with an economical plant. That was really the whole argument.

Tape Number: 5, Side B

December 15, 1989

TC: You mentioned the Nuclear Regulatory Commission. What year did that come into being? Was that in Jerry Ford's administration?

EK: I'm not sure now.

TC: What was the relation between the NRC and the AEC? Was it that regulatory section was just removed and made into a commission in itself?

EK: Yes, that is right. Originally, the Atomic Energy Commission was a promoter and a regulator of nuclear power, and that was particularly the case at Bolsa. There was opposition who that you really couldn't do two contradictory things, so it was split. I would say it was, maybe in Nixon's time.

TC: Yes, I think it started out around the time that Nixon was leaving office.

[EK checks his notes]

EK: That begins to look like about 1972.

TC: Was the response among nuclear engineers that it was a good thing to separate the functions this way?

EK: We felt so, yes. It would make it cleaner and avoid some of the criticisms and it was justified. I had no problem with that.

TC: Did you have any connection or any opinion, even, on the Sundesert Project?

EK: The San Diego deal?

TC: Yes, you must have been . . .

EK: Well, it was a good site, but it was killed by the state.

TC: Was it Jerry Brown . . .

EK: Right.

TC: Well, on what basis could he have cancelled it?

EK: There was no proven waste disposal depository. He didn't want any nuclear plant built until we had a proven waste depository, which is a contradiction in terms because, to prove it, you have to operate it for 2,000 years. But, anyway, it worked as far as he was concerned.

TC: Well, let's talk about that issue because you've addressed that issue, too, in public.

EK: Right.

TC: In fact, in my own earlier period, when I was reading into and following all these developments, one thing that did concern me as a citizen was, well, what do we do with this waste? I wasn't sure that the technology was there. It was more of an immediate response than something that I looked into, studied and assessed rationally. Could you talk a little bit about what . . .

EK: Well, you start with the basic concept that if you have a family of five and you use nothing but nuclear power, the amount of nuclear waste, highly radioactive nuclear waste, that you would generate would be smaller than a golf ball. So you deal with a very small volume.

Now, the question, of course, is how do you insulate it? Well, the best proof is the so-called Oklo Reactor. This is on the west coast of Africa. Through some geological accident a couple of million years ago there a natural reactor was formed. There was a concentration of plutonium. That plutonium was sitting there for two million years, not getting anywhere. So the handling of a very small volume of waste, which is put in all kinds of containers, three or four or five barriers around it, put deep in the ground, does not present that much of a problem.

There are two things to be kept in mind: One of them is you will monitor it and [two] it is removable. Now, if for some geological reason you put it in salt and it begins to leak, it moves through the ground very slowly and you can take it out and you are not near an aquifer . . . It is not a technical problem, it is mostly a political problem, an emotional problem. Nobody wants it in their own backyard. Politicians don't want to get involved in it. And there is always the question that you can do it a little bit better.

Now, the Europeans, outside the United States--we have only 100 reactors--outside the United States you have 300 reactors. It is not considered a problem. They're handling it. Here we get very emotional about it and the federal government is trying to respond. And, as far as I'm concerned, it's not much of a problem, technologically.

TC: Well, what's the basis of the emotional response? Is it that, you know, I may trust the technicians who are handling it today, but I won't necessarily trust the next generation? I mean, it's something, it's a long-term commitment.

EK: Well, you embed it into concrete or glass, or what have you, and you forget it. You set up monitors and you forget it. It's deep underground in some impermeable geologic formation, which could be salt or basalt. And we know that geology moves very slowly.

TC: Right now, where are these depositories? I know that this Hanford, Washington has one.

EK: They're sitting in tanks, essentially. They had some leakage of those tanks. Remember, Hanford was built during World War Two, they were rushing, and they were putting them in just carbon steel tanks. They are rusting, and leaking, so they're putting them now in stainless steel tanks, they're moving it out. There has been a small amount of leakage.

Of course, if you leak the stuff, the earth is a filter and it moves, very slowly, so it takes hundreds of years to reach any water. By then, most of your radioactivity decays. See, when they talk about it lasting 250,000 years, it's really a misleading statement. Most of the intense radioactivity disappears within about 500 to 1,000 years. It never disappears completely.

TC: Yes.

EK: For instance, you have potassium 40 in you and you're going to be radioactive for a couple of million years. So if you're worried about radioactivity, don't get near a cemetery because they're all radioactive. So, sure, the radioactivity lasts for 250,000 years, but the high level of it is about 500 years, and then it becomes very low.

TC: The other issue that comes to mind, as far as broader kinds of theoretical and philosophical considerations so, is the whole question of risk. It seemed like, in the early period, say, when you started your training at Oak Ridge in the mid-fifties, that this concept of risk in technology was something that was accepted that we live in an advanced technological society and there will be these risks and we can handle them. At some point, that began to be questioned and a new concept got put into place that said we can't, we have to live without risk. What accounts for this shift in your experience of it?

EK: As we become richer, of course, we can afford better things. But, essentially, it's the information explosion. The public got educated. The public before the fifties or sixties didn't realize all of the problems that they're facing and, as the opposition against technology arose, there was a movement against technology, a back-lash against technology. The public got educated. Once the public was educated, there was demand for zero risk. Actually, the zero risk, the classical case of zero risk, was the

fluoridation issue. Before that, you had vaccination. The fluoridation issue sensitized the public that they live in a probablistically dangerous world. And there were always groups that promoted, fear of electricity, of aluminum pans, of chemical additives to food. But the information explosion spread it. Television, the media, publicized it. It was good copy. The public got sensitized. It's a process of sensitizing. You can take any crazy idea and you can sensitize the public to it.

There was also an anti-technology movement. The technology became too complicated for the ordinary man to understand. Until about the fifties, the liberal arts graduates felt that they were the top of society and they were able to get the top positions. The technology explosion threatened their predominance and the revulsion against technology, was promoted by the liberal arts group.

TC: Somebody like Lewis Mumford, I guess, . . .

EK: Right. Jacques Ellul, and others.

TC: Jacques Ellul, yes.

EK: The American intellectual elite, the liberal intellectuals, felt threatened by technology and they attacked it. They felt the engineers were getting too uppity, they were getting the better positions, the better pay.

TC: Certainly engineers were coming more into government in the Kennedy and Johnson administrations.

EK: Right.

TC: And with something like the Atomic Energy Commission, although it was established in the late forties, I suppose they could see that as some kind of threat . . .

EK: And there wasn't any. It's very easy to connect a nuclear weapon to nuclear power. That's a very easy connection to make.

TC: I was reading an older article by a guy from UCLA [University of California, Los Angeles], a nuclear scientist, and he was talking about the reactor that they have at UCLA where you can go and see it, stand next to it, turn it on, turn it off, get on top of it if you want. He said very few people realize that this thing is there and it can be operated and it's not a danger.

EK: There was some opposition to that.

TC: Oh, I didn't know that.

EK: Oh, yes. They had a rough time getting a permit to renew operating it.

TC: Really?

EK: Oh, yes, there was quite an opposition.

TC: But this guy was saying that somebody called him, a man who was connected to movie production, and he wanted some information on it, because in the movie they were making they wanted the nuclear plant to blow up like a bomb, like an atomic bomb.

EK: Was that the China Syndrome business?

TC: I don't know if it was China Syndrome. The guy didn't mention what it was, but he said he explained to the guy very carefully how they're two very separate things and that if there's a problem in a nuclear plant, a generation plant, it won't blow up like a bomb. And he said that despite his careful reasoning with this man, he had the fear that the guy went ahead anyway in his movie and had the nuclear plant blow up. It was probably a "B" movie that didn't get big coverage. But something like China Syndrome had a strong ideological type of impact on the public.

EK: Yes.

TC: I know, in my own experience, I found it a very strong statement.

EK: That china syndrome would be the best thing that would happen, if it melts down and goes in the ground, it just sits there. It would go down maybe about, oh, fifty to one hundred feet and just sit there. That's about the size of it.

TC: Really? Well, with the present attitude, or the recent attitude--I want to still keep this in an historical perspective . . .

EK: Okay.

TC: Do you see any changing of that? Or what would it take to, to balance the picture? Would you agree that in the early phases of nuclear engineering and nuclear plant construction, there was a real gung-ho, go ahead attitude?

EK: It was over-enthusiastic, yes. It was partly that the government pushed it and the utilities were afraid if they didn't start building it, the government would take it over. The utilities are always scared of a government power monopoly. Yes, it was over-enthusiastic, mistakes were made, but that is not unusual for any new subject or technology.

Do you read the Los Angeles Times?

TC: Yes.

EK: Last Sunday there was an issue on environment and they had a big discussion about air pollution control. Everything is going to be electric. And the California Energy Commission evaluated the electricity demand and they came up with the fact that twenty nuclear power plants will be needed to satisfy that demand.

TC: Oh.

EK: Now, what will happen, I don't know. I take a very cynical attitude. As long as the American housewife turns on the switch, and gets electricity, she's against nuclear power. Women are, generally [against nuclear power]. Once she turns on the switch and there is no electricity and the frozen food in the refrigerator begins to melt, that attitude will drastically change.

No plants are being built now. Most of the plants that supply power to Los Angeles are coal plants in Arizona, New Mexico, Nevada, and Utah. If there is a power shortage,

those plants could be redirected to supply their states, so I think ultimately nuclear will be built. How soon, I don't know. I do know, though, and I'm not too happy about it that when there is a crisis you're going to have the same attitude again--gung-ho. But that's the way things are.

TC: Yes.

EK: People don't do anything until there is a crisis.

TC: Yes, it's sort of a pendulum swing to it.

EK: It's a pendulum swing. Right now, nothing is being built, and the demand for electricity is going up, 2, 3, 4 percent per year.

TC: The prognostications in the early seventies were that by the mid-eighties, if nothing gets built, the demand will be so much, we'll have blackouts, brownouts. Now, that didn't happen.

EK: The 7 percent didn't happen, no. Actually, we were able to do a lot of conservation. No question about it, we were very wasteful and we cut down a lot. But there is a limit to what you can do with conservation. And I think we're getting close to it.

TC: We're getting close to that, yes. And, you know, I suppose there's a limit, too, to what can be done with the fossil fuel burning . . .

EK: Well, if you look at what the Air Quality Management District is doing, and they're serious about it, they're going to phase out underarm deodorant. (chuckling) All of

the power plants have to be out of the Los Angeles Basin. They want electric vehicles. You should read what they're planning to do. They're making regulations and they're serious about it. It's going to be very, very rough.

TC: Oh, I've been following it in the newspaper, yes. Well, there were a couple of last questions, and we've still got some time here, and I'd like to still speak in these broad terms. The power industry backed off from nuclear power. Now, was that because so much opposition had come up? For you engineers who were in the forefront of this, did you react in any kind of bitterness that the industry itself finally just said, "No, forget it. We'll go with some other means," and didn't stick to it's commitment?

EK: Well, we engineers, we always took the position that we were servants of the society. If that's what the society wants, there isn't much else we can do.

There has been less electricity demand. There has been less opposition to plants outside the Los Angeles basin. The thing that bothered us about nuclear power is it's unpredictable how long it'll take and how much it'll cost. If there is no clear economic advantage, and we have to look at the economics, nobody wants to stick his neck out. The Diablo experience from $360 million to $5.5 billion, and plants sitting there for twelve years, has been a very sobering experience. From a personal point of view, why

should I wreck my health if this is what the majority does not want.

TC: Things like Three Mile Island and Chernobyl brought the whole issue back into the public mind, casting it in a negative sense.

EK: Correct, right. Before Three Mile Island, Carter was going to give a big push to nuclear power with everything lined up. Before Chernobyl, I think the Reagan administration was going to bring it up again. I don't know what the next generation will do.

TC: But those were two very different accidents. Is that correct? Three Mile Island and Chernobyl.

EK: Yes, but in the public mind, it brings the nuclear power scare back again.

TC: What was the Three Mile Island accident? What caused that? Do you recall?

EK: It was basically the operating crew was ignorant, they made blunders, and it resulted in a partial meltdown. From an engineering point of view, it wasn't all that bad because it showed very clearly that we can contain the worst possible accident.

TC: Yes.

EK: Essentially it was lack of operators' training - something that I was complaining about years before. You've got to have engineers to be there who know what's going on. You cannot have taxi drivers operate Boeing 747s. And

Chernobyl, of course, there was no containment. The whole Russian technology, whether it's nuclear or whether it's anything else, is very primitive. They're about ten or fifteen years behind us. And to them, human life, until now, didn't mean very much.

TC: Well, you say there's no containment. There was no dome?

EK: That's right, there was no dome.

TC: So their plant was just out . . .

EK: In the open.

TC: The Soviet Union is one example of, ongoing still, I suppose, ongoing nuclear construction. France and England and Germany still are building these things and somehow overcoming this kind of opposition.

EK: France didn't have opposition to speak of.

TC: As far as opposition?

EK: No opposition to speak of. I think there may be a little bit now, but most of their plants were built practically without opposition, which is amazing for the French.

TC: I know. What accounts for that?

EK: They're keeping it out of the public domain. They have a committee of scientists that discusses it and there was no public discussion. The English more or less take the same position, that it's not something for the public to decide. It is a policy decision, that experts should decide it, and that's it. The Germans permit public discussion. And once they permit public discussion, there is public

opposition: "If they're not sure of it, there must be something wrong with it, we don't want it". I feel that these kinds of complicated questions are not really too suitable for public discussion, and particularly in our legal climate, where you regurgitate the same thing ten times over. Have you followed the McMartin child molestation case?

TC: Yes.

EK: Three years, $16 million. The longest case in American history.

TC: Yes, yes, it's incredible.

EK: That's not, really, in terms of nuclear power. Diablo had a much longer hearing than that. (chuckling)

TC: I have covered everything I wanted to cover in these five interviews, and I'm wondering if there's anything that you want to have the last word on?

EK: Let me read what you have done . . .

TC: Sure, and we can add to it. That would be fine. I want to say, though, that I really thank you for these sessions and I really appreciate this opportunity to sit and have such an involved conversation about this, because it has certainly affected my thinking on a lot of matters. So, I thank you.

EK: Well, thank you. I appreciate the opportunity. It was very interesting for me.

TC: Good. And we'll meet again, I'm sure, to discuss the transcript.

EK: Okay.

END OF INTERVIEW