Chapter 8.0 Consulting

A. Introduction

Sometime about 1957 Dr. Walter Zinn, Dr. John West, and a few others resigned from Argonne National Laboratory and moved to Dunedin, Florida, to set up a design and consulting company. As I have stated, I think Dr. Zinn is one of the few very great men that I ever knew. While I met Enrico Fermi once, I never knew him; so I can only place both Dr. Zinn and Dr. Fermi as equals. Dr. Fermi was the one that got the Nobel Prize. Both Dr. Zinn and Mr. Samuel Untermyer should have received Nobel Prizes, as I have mentioned. I never could evaluate Dr. Alvin Weinberg properly. I believe that he is just below the Fermi-Zinn-Untermyer league in respect to new ideas. He is a brilliant man and equal in other respects. I always regarded James A. Lane as superior to Dr. Weinberg, and equal to Samuel Untermyer.

Later, Dr. Zinn's firm was purchased by Combustion Engineering; and he became Vice President of that Company. He has now retired. John West, I believe, is Vice President of Combustion Engineering Company. I should have left with Dr. Zinn. There was a mix-up about my going with him.

About one year later I resigned to do consulting. The main reason for leaving the Laboratory was my general disagreement with the direction that Dr. Norman Hilberry was leading the Laboratory's Program -- into High Energy Physics -- which I considered a dead end -- as I keep repeating. Further, I thought the University of California people had the advantage of years of research in the High Energy Physics field. They should have designed the Monstrosity, my name for the National Accelerator Station west of Chicago, not Argonne people -- better the Monstrosity should never have been conceived. The California people did design and operate an equivalent or perhaps a more advanced accelerator that the Monstrosity. Both were of no use, and both are a waste of our taxpayers' money. Certainly one was enough -- if not too many. I believe that they are basically different in design.

About one year later Dr. Walton Rodger and Dr. Joseph Thie joined me as McLain-Rodger Associates. This partnership broke up after one year due to the fact that Nuclear Fuel Services Company hired Walt to act as General Manager of the design and construction of the Nuclear Fuels Reprocessing Plant at West Valley, New York. Joe continued to work some with me. We both continued as consultants for several years. Joe is still doing consulting while I turned more to teaching and writing.

B. Clients

The discussion of various companies and countries presented below is in somewhat of a chronological order. There was considerable overlap.

While I was still at Argonne, a New York firm, American and Foreign Enterprises, asked me to help them in some discussions in Germany. I actually talked to some engineers from Gummersbach, Germany.

Also, while at Argonne, I had to do a lot of official entertaining. This was especially true the year after Dr. Zinn left. Of special interest was a visit of Dr. Otero, General Vital, and others from Spain. It was due to their visit, and Professor Jodra's statement to Dr. Otero that we later visited Spain.

1. EBASCO Services

Sometime in 1955 Leonard Reichli resigned from the Atomic Energy Commission and joined EBASCO Services to organize a nuclear group. EBASCO Services is the construction end of Electric Bond and Share Company, which was an Utility Holding Company, particularly active in Mexico and South America.

Reichli and others had the idea that at least one small nuclear power plant should be built in Latin America, even though it probably would not be economical. This would introduce the Company to the problems of nuclear power.

So Reichli hired James Lane and me to act as consultants. We had several meetings on weekends in New York. We suggested that a small boiling water reactor of 30,000 kwe, or so, be built. So, we worked out some cost figures. The question of site came up. The most promising areas included one near Havana in Cuba and one near Puebla in Mexico. Since Winnie and I were planning to take a vacation in Mexico, they asked us to contact the Power Company in Puebla and discuss the subject with them. On arrival in Mexico City we called the Superintendent of the Puebla area; and he sent a car to Mexico City for us.

On arrival at Puebla they took us to the proposed site to see if it was adequate. Actually, it was very close to the City of Puebla, and not at all suitable. However, west of Puebla were open areas that we suggested might be adequate.

While in Puebla, we visited the Cathedral and the old "Bishop's Library." When I asked to see the "Bishop's Library," the Superintendent was surprised as he had never heard of it. It was less than two blocks from his office. It is world famous.

The other proposed area near Havana was abandoned when Brother Castro took over. By that time the Company had decided that small plants were too costly -- which we had been preaching.

Reichli worked for EBASCO Services for years. I think they have submitted some bids and may have done some construction. I think he became an Officer of the Company.

Later, I visited Mexico and presented a discussion relative to the use of a heavy water research reactor like the CP-5.

2. **Junta de Energia Nuclear**

While I was still at Argonne, Professor Otero and the head of the Spanish Atomic Energy Commission, General Vital, who was a friend of General Franco, visited there. I spent two days with them. Also Professor Jodra had recommended that I be asked to visit Spain and present the series of lectures that I presented to the International School.

On return to Spain, Professor Otero had asked me to suggest a program for their Atomic Energy Commission. One evening I dictated a long letter rather offhanded. This was adopted as the official Spanish program. One part was not carried out; but most of my suggestions were followed. I had suggested a reactor designed to test fuel assemblies. The Spanish Utilities later found this unnecessary and opposed it -- they were right as things developed.

The next year Winnie and I spent three months in Madrid. I gave three lectures per week at the University to about 35 people. I also helped them what I could in fuels and fuel recovery work.

When we arrived, they had a cocktail party for us. Then they took us to a Hai-Lai game and to Spanish dances. Later, many of the people entertained us. We also were taken on a trip to the south of Spain to the uranium mining area. While on the trip, we stopped at Cordoba and Seville. Then we visited industry in the north of Spain, especially Bilbao, Escabar, and other industrial areas. Later, we stopped in Barcelona to visit the industries there. It was our conclusion that Spain could build many of the components or entire nuclear power plants. They seem to have lacked confidence in themselves. They did not need our help. The needed confidence and perhaps imagination.

The Junta gave an extended contract to Burns and Roe of New York to assist in evaluation and plans. Burns and Roe sent Sy Baron and one other engineer to Madrid; and we all worked together for an extended period. Sy and I became good friends; and after Winnie left, we had fun eating at different restaurants and evaluating them. The usual highly touted and advertised restaurants like Horchers, did very poorly in comparison with the pensions both in price and quality. "It Pays to Advertise."

They subsequently carried out an extended development on organic cooled reactors. However, most of the reactor work was dropped when the Utilities insisted on buying complete plants from Westinghouse or General Electric. I have always believed that Nuclear Power Plants are simple devices compared to oil or coal fueled Power Plants.

The fuel manufacture and the fuel recovery plus the mining and ore processing were continued and full scale plants built.

3. **Germany**

Following the first trip to Spain, Winnie and I flew to Frankfort at the request of American and Foreign Enterprises of New York. We were met by people from Gummersbach who entertained us over the weekend. These people owned a heat exchanger manufacturing plant and were interested in the components they could build. We talked to them twice also in this Country. All we did was to give them background information.

On the Sunday we were there they took us for a ride to Koln (Cologne) and Bonn on the Rhine. Later we went to Hamburg, Hanover, and Dusselsdorf. While at Dusselsdorf the phone rang one night just as we were going to bed. It was the manager of the Power Company at Bremen. he said he had just heard at that late hour that we were in Germany; and would we come to Bremen? I told him we were leaving for Holland in the morning; and we could not do it. But he insisted. He said their travel person would take care of the changes in our tickets. Further, he pointed out that a plane left Dusselsdorf in an hour; and they would meet it. Of course, we went.

It was a rainy night. We hurriedly dressed and packed a few things; and caught a cab to the airport. We had a few minutes to spare. They had orders to wait for us. If I remember correctly, we were the only passengers. The plane, I think, had a total capacity of five. On arrival at Bremen two men met us and took us to a midnight lunch and then to a hotel. They met us for breakfast the next morning.

What they wanted was someone with a knowledge of nuclear power plants to look at a site on which the Power Company had an option and to tell them whether or not it was suitable for a nuclear power plant. They drove us several miles out of Bremen to a site on the Rhine River. On the site was a building in which the Germans had assembled submarines during World War II. It was one floor with a canal along one side. The inside was perhaps 500 feet long, 200 feet wide, and 50 feet high. The walls and roof were heavily reinforced concrete eight feet thick. After the War the British had practice bombed it with armour piercing bombs; so the roof was shambles.

We walked into the building and the Manager asked my opinion. I simply said, "No," Then he said, "I thought that would be your answer. We did not want to release our option on this area and building until we had our opinion confirmed. Let's go have a drink."

They took us for a ride around the area, to lunch in the 16th Century wine cellar of the City Hall, and back to the airport. Winnie was tired so they spruced her up with wine. Finally, I billed them for a day's work and expenses -- which I should not have done in my opinion. But they might have resented it if I had not done so. One never knows. And American and Foreign Enterprises had told them that I was in Germany. I should have told them to pay American and Foreign Enterprises.

4. **Textron**

While I was still at Argonne, I was asked to visit Yellow Springs, Ohio, and present a talk to a meeting relative to a combined school/work or cooperative program. The reason for this was that Argonne had developed a part of the program and had some cooperative students.

Afterwards there was a banquet. When I walked in, I immediately ran into Jerry Ottmar of Metals and Controls of Attleboro, Massachusetts. He had been working with Arthur Matheson and James Dutton. Metals and Controls had a Navy fuel assembly contract and wanted to expand into power plant reactor fuels.

Jerry asked me to sit with him as he wished to discuss possible consulting. Then a man and woman came in and as she sat down next to me, she introduced herself as, "I'm Mary Pickford."* She then turned and said, "This is Bruce Rogers, my husband." I introduced them to Jerry. She them started quizzing us about our work. Then she got up and asked me to move over next to Bruce so she could better talk to Jerry and me.

Mary was well to do; and, it turned out, one of her pet projects was support of Antioch College at Yellow Springs, Ohio. She was also very well informed and very intelligent. I was very impressed. She claimed her age as 67.

Later in the evening Jerry and I had a long talk. I agreed to visit Attleboro regularly and discuss their problems and present a series of lectures. This I did over the next several months. Afterwards, I visited Attleboro less often; the total time was something like two years. Then Metals and Controls was bought by some other Company. Jerry left and my contract was dropped. Jerry then became Vice President of Textron company. Royal Little was just putting Textron together; so Jerry asked me to act as consultant to Textron on acquisitions. This I did for about three years.

5. **Pickard-Warren-Lowe**

I worked with James Pickard in the AEC. I met William Lowe at the shipbuilding yards at Bath; I think it was called the Bath Iron Works. Fredrick Warren worked in the AEC, I believe, also.

About the time I left the AEC, Jim left and set up as a nuclear consultant in Washington. He had one contract I think at the start with A. O. Smith and Company of Milwaukee. Jim did very well and soon Fred joined him and a little later William Lowe also joined the group. They asked me to consult with them; and this I did for several years. They also asked me to join the group. I would have liked to but for Washington traffic. Life is too short let along fighting with Washington traffic. Winnie never liked Washington as she thought that it was too impersonal. It is. Nevertheless, we made many friends there.

Thus, I worked for Pickard-Warren-Lowe about one day a month for several years. Then they set up Nuclear Utility Services, and expanded into a number of related businesses. They got money from one of the liquid air companies for finance. All their companies have done very well -- and I would have also, had I joined them. In 1980 they hired James Fulford from Purdue University. He "took" his doctor's Degree with me.

One interesting thing happened. One day I was working at the office of Pickard-Warren-Lowe when there was a heavy snowstorm. Some six inches of snow fell. So about 1500, everyone went home, including the janitor of the office building where I was working. I thought nothing about it as I planned to take an overnight Pullman to New York.

Since the train did not leave until near midnight, I simply stayed in the office and worked until about 2200. Then I packed up and planned to

get a cab or walk to the depot and go to bed on the Pullman. When I got to the front door of the office building, I found it locked and there was no emergency way to open it except kick it down. I never knew what late working people would do in case of a fire. Burn up, I think. The Office had become cold as the heat was turned off in the evening. So I had to go back to the office and get the front door key. But the office was locked; and I had left the key I had used in the secretary's desk. To get in the office I had to either break the door in or something. Since there were transoms, I stood on the office door handle, broke the transom, unlocked the transom, and crawled in. After getting the key I left a note, and took the key with me after getting out the front door.

Several months later Pickard-Warren-Lowe's office was robbed by someone breaking in through the transom. So I was presumed guilty. What would people do in case of fire -- burn?

6. **Gibbs and Cox**

Dr. Harold Mott-Smith of Gibbs and Cox asked me to help Gibbs and Cox in respect to the application of nuclear power to ships. They had a contract with the U.S. Government to develop means of protection of reactors in ships involved in collisions.

The problem became one of analyzing the damage to ships that resulted from collisions and then designing hulls to minimize the damage in those parts of the nuclear ships in which vulnerable components might be located. So, first, a design of a nuclear powered ship of 80,000 dead weight tons, I believe, evolved. The locations of the critical items were indicated. Based on this study, we subcontracted with a ship salvage company to review the data available on ship collisions involving the central portions of the hulls. This was done in order to estimate the extent of possible damage to the nuclear components. Then we designed energy absorbing structures to limit the damage in the critical pieces of equipment.

The review of the collision data indicated that a ton of steel torn from a ship's structure absorbs nearly a constant number of ft-lbs of energy. This simply means that all ships are built very much like one another. We then designed oak and steel bulwarks to absorb the maximum amounts of energy. This program involved nearly two years of part time study.

It was interesting since Gibbs and Cox was one of the world's leading ship designers. Mr. Gibbs at that time was, I believe, well over 70; and yet every day he sat on a stool all day at a drafting table; and while he drew, he dictated enough to keep two secretaries busy. He also

kept a little black book in which he wrote his own thoughts about things such as the design of the Andrea Doria, which he had, at the time of its construction, loudly condemned. He also designed the ship: "United States". This ship was built with steel bulkheads that required lots of stair climbing to move between parts fore and aft.

The United States was a powerful ship as it was designed for conversion into an aircraft carrier. Winnie and I crossed the North Atlantic on it, East to West. At one time we were heading into a 53 mile per hour gale with 50 foot waver, so it was reported on the ship, and which I doubted -- more like 22 feet. Even on the United States, we felt seasick and the nurse gave us pills in the morning. It was beautiful.

The Queen Mary lies dead on it side in Hong King Harbor, a rusting hulk. It was burned. People in Hong Kong told me that at least seven fires started at once. They claimed Communist agents set the fires.

7. General Motors When Laurence Hafstad went to General Motors as Head of Research, he took Donald Loughridge with him. And he asked me at act as consultant. We really didn't do much, however. General Motors did make a bid on design and construction of the Gas Cooled Reactor built at Oak Ridge. We also discussed the possibility of seminars production of small power plants with the Cleveland Diesel Division. But this was quite impractical due to the high costs of auxiliaries and the low unit power production.

8. Curtiss-Wright Curtiss-Wright had built an isolated Research Laboratory on a mountain near the center of Pennsylvania some 30 miles north of Black Moshannon Airport and north of Phillipsburg. The reason for the location of the laboratory was that it was built to test jet engines. Curtiss-Wright then made the sad mistake of trying to place multiple engines on the larger planes rather than building the supersized engines now in use; so they lost out. I had no part in their discussions. I knew nothing about their cost comparisons. I have no data on comparative weights, maintenance, and life of the two types of engines. I always wondered if anyone did! I suspect total maintenance is less on the larger engines.

In order to make use of the facilities they started work at the Laboratory on various things, including nuclear energy. They did get contracts on a couple of training reactors and the design of part of the Brookhaven Test Reactor. In this case the entire nuclear group resigned; so that Combustion Engineering Company actually ended with the design contract. I never asked about the personnel situation.

In the midst of this program, I was asked to act as a consultant. Finally, I actually served as Director of the Nuclear Branch for a time. We did have a few isotope use programs that paid expenses.

The President of the Company had been told there was a great future in design and construction of nuclear power plants. At a meeting in New York, I was asked what such a development program would cost and how many years would be required before such a program could be profitable. I could not answer the first question other than to say over $100,000,000; and seven years was a conservative answer for the second question. The President simply said, "We can't do it." I agreed that they should not try.

About that time Curtiss-Wright did buy the Western Hemisphere rights for the Wankel engine with the idea it could be developed for lawn mowers. They did cash in on this engine for a time. I soon lost contact with the Company.

Then a bit of humorous things happened while I was working with Curtiss-Wright. Normally, I took the evening plane from Chicago to Pittsburgh, stayed overnight; and took the Allegheny Airlines local plane from Pittsburg to Black Moshannon. At Black Moshannon, I rented a car and drove to the plant. One morning on arrival at Black Moshannon it was clear and warm with no snow. So off I went. But as I climbed into the mountains I ran into snow and I got stuck. Supposedly there were chains in the trunk; but I couldn't get it open. Finally, a truck driver stopped; and together we did pry it open. The chains were there; and I soon got going.

Another time it was raining in Pittsburg when we left by air. And at Black Moshannon it was snowing enough that we simply overflew the airport. Also at Williamsport and Wilkes-Barre the same thing happened. Finally, about 1230, we arrived at Newark. So I leisurely had lunch, and got the 1500 train to Chicago, and home.

One evening the wife of the director of the Laboratory, Mrs. John Dickey, had asked me to dinner as I was to stay two or three days. In the afternoon her folks, who lived some 30 miles north, called and said they would like to come for dinner. she told them that was fine as she was having "Stew McLain" for dinner. When I walked in and was introduced as "Stew McLain," they had quite a laugh at the "McLain stew" they expected to eat.

9. McLain-Rodger Associates

After I had been doing consulting for about three years, Dr. Walton Rodger suggested we join. Walt was a Chemical Engineer. He had spent several years on Nuclear Fuel Reprocessing at Oak Ridge. Later at Argonne, he was Associate Director of the Chemical Engineering Division. So we set up the partnership as McLain-Rodger Associates.

Soon after we organized, Dr. Joseph Thie also joined us. Joe is a theoretical physicist with a very high IQ -- as Walt has also. I'm not in their class.

(a) Atomkraftkonsortiet Contract The first sizeable contract was a nuclear fuel cycle study for Atomkraftkonsortiet of Stockholm, Sweden, for the Simevard 50 mwe Reactor. This was easily done; but the study led us into a study of fuel cost calculations, and a suggested revision of the Atomic Industrial Forum's Manual on fuel costs. This Manual had been prepared by William Lowe of Pickard, Warren, Lowe. I had not studied it. Walt ran into the first troubles; and then we both spent several days on it.

We did a study for the Simpevarp Reactor relative to higher power levels, and we reviewed the proposals submitted for the reactor.

(b) Insurance at Sandia We were next called on to make a study of insurance risks at Sandia to assist the Zurich Insurance Company to make a bid. I evaluated the risk as less than that for private companies doing general work. Nevertheless, Zurich did not get the contract. I don't think that they believed me.

(c) International School We prepared a series of lectures and Walt presented them to the International School. These covered radioactive wastes and ther disposal. Walt did most of the work.

(d) Illinois Institute of Technology Walt presented a course on Radioactive Wastes at the Illinois Institute of Technology.

(e) Nuclear Fuels Services The State of New York Atomic Energy Department asked Walt to assist in locating a suitable site for an irradiated fuels recovery plant. Actually, we did relatively little work on this. Later, Nuclear Fuels Services contracted with us for assistance on design of the radioactive waste portion of the plant that was built near West Valley, New York.

At about the same time the company building the West Valley plant asked Walt to become General Manager. We talked it over and we all recommended that we break up the partnership.

Walt took the position at West Valley; Joe continued his consulting; and I assumed more responsibility at Purdue University. We soon moved to Lafayette, Indiana.

Walt remained as General Manager until the West Valley plant was in operation. He did most of the flow sheets in a few months after the partnership disbanded. Then he and his family moved to West Valley. After the plant began operations he left; and with one or two other men moved to Rockville where he headed a consulting company.

Joe remained in the Chicago area. Later he moved to Minneapolis. We worked together some. Joe has carried out continuous Fuel Management for one of the Power Reactors. Soon Winnie and I moved to Lafayette, Indiana; and I spent time at Purdue University until I retired.

(f) Aluminum Laboratories, Ltd. One consulting job that took quite a bit of time was with the Aluminum Company of Canada. This work was divided into two completely different parts. Both were non nuclear.

The first dealt with the seals on a pump used to handle liquid aluminium chloride, AlCl3. All commercial seals failed in minutes, or at most in a few hours. When I visited the Plant, I suggested a loose non load carrying seal backed by a gas pressure with gas leakage into the AlCl3, and the gas chamber backed by a conventional seal. I also suggested the possible use of a frozen seal. The latter was tried in a few minutes. It worked almost perfectly. Actually, the clearance was adjusted later by experiments over a few days. Leakage was less than two cubic centimeters per hour. Of course, frozen seals had been used extensively for liquid sodium and were not new.

The second problem was a bit more involved. They wanted to go back to carbon, or carbon monoxide, reduction of the aluminium ore. This was used to produce small particles of aluminium prior to Hall's Patent. They had a complicated process in mind, using an aluminium chloride intermediate step for purification.

Their chemists and physicists had carried out successful experiments at Aravida. So they designed a pilot plant. The layout was something awful. I suggested elimination of about one half the piping and most of the valves. This was not done. So the plant was built. It was a mess. Then they shut it down. At the last visit I

made to Arvida, they were removing all the mechanical valves and most of the excess piping. From then on they used frozen seals for valves. I never knew whether they ever built a production plant or not.

(g) Other Work. During the period that we had the partnership, I continued my consulting for several companies and membership on the ASME Special Committee for Nuclear Power. I also worked nearly a year part time on the Reactor Handbook.

J. Other Consulting Contacts At various times I carried out consulting from one day to several days for several other companies, as listed below. I believe there were others. I have forgotten their names.

Skidmore, Owings & Merrill (with Walt Rodger, I think)
Austin Company
Giffels and Vallee
Bendix Corporation
American Machine and Foundry
Martin Company (this included work on a proposed Antarctic reactor)
Commission Narcional de Energia Atomica, Buenos Aires (two weeks in Buenos Aires -- mainly presenting Lectures)
Nuclear Development Associates
Stanley Engineering Company
Notre Dame University (shielding design)
Nuclear Industries
Burns and Roe

Following is a typical travel schedule while I was consulting, for one month, June, 1961:

5 June	O'Hare 1650 Capical 248 Pittsburgh 1929 Motel Pittsburgher
6 June	American Nuclear Society Meeting, Penn Sheraton Hotel, Pittsburgh Motel Pittsburgher
7 June	1930 Allegheny 600 Phillipsburgh Curtiss Wright 2002 Allegheny ? Newark 2150 Commodore Hotel, New York
8 June	Parsons Brinckerhoff, Quade & Douglas 0930 Burns and Roe 1100, Dr. Seymour Baron Chase Manhattan 1400, Dr. Paul Genachte

	1730 Idlewild to O'Hare Field, Chicago
11 June	1630 O'Hare Mexicana, 1930 Mexico, D. F.
12-13 June	% Dr. Victor Flores Maldonado Col. Moctezuma Mexico 9, D. F., Mexico
14 June	1415 American Airlines 52, O'Hare 1840
16 June	To Ann Arbor by car
17 June	Ann Arbor
18 June	Detroit 1620, American Airlines 840 New York, Hotel Commodore
19 June	ASME Special Committee on Nuclear Power 1815 Northwest 227, Detroit
20 June	Ann Arbor -- Lafayette by car

It is sometimes amusing when you have a travel schedule like the above one, to talk to some of the experienced travel agent people. I offer three examples as follows:

1. In Downers Grove I used a travel agent that thought nothing about my capers. But one day a new girl came to the desk and asked to help. She had a pad and started to write; she soon stopped and stared at me. I wanted to turn in two unused airline tickets and a Pullman and Railroad ticket. Then I started to say what I wanted, which included a few Airline tickets plus some train tickets. Of course, travel agencies are not supposed to handling Railroad tickets. That's one of the reasons that the Railroads lost a good part of their Passenger business -- they did not integrate their operations with those of the Airlines and Buses into a Transportation System. Whoever heard of a "Boat Train" in this Country? The Travel Agencies, Bus Companies, Airlines, and Railroads should have integrated all their facilities into a Transportation System. The railroads did operate some Bus Lines, they should have operated airplane and buslines on schedules that fitted the train schedules. The overnight Pullmans might still be operating. They were very useful.

So one of the regular girls walked up to the new girl and said, "Just don't stand there, Woman. Bawl him out. He stays awake nights thinking up these things for us to do." They she turned to me with a polite "May I help you?"

2. The next two are similar. Fredrick Beierle and I were in Joplin, Missouri, I believe, one Friday evening. Why, I don't know. We caught a local plane to Omaha. Since we did not know our schedules, we had no reservations out of Omaha. Of course, all planes were filled. Fred said he wanted to go to Portland; and I said I wanted to go to Chicago. We couldn't, so Fred says, "How about Denver." No Denver, so "How about Chicago." By that time the girl asked Fred, "Do you men know where you want to go, or do you just want to get out of Omaha quick?" The girl next to her said, "Of course, they know. Put one on standby on Flight ---- to Chicago, and one on standby on Flight ----- to Denver." We both got home without further troubles -- he to Richland, Washington, and I to Downers Grove, Illinois.

3. Fred and I were in Chicago one Sunday night and seemingly all flights were filled. After several questions the girl trying to sell us tickets also asked, "Do you men care where you go?" The girl next to her almost shoved her aside and said, "May I help you?" Then she turned to the other girl and said, "Frequently men come in like this. They know where they want to go during the week; but they will start in any direction."

In recent years my consulting has dropped to zero. I have been too busy to do much outside work. Actually, I did only about $1,000 in 1972. Later, I did practically no consulting due to lack of interest on my part; I was out of date with some of the latest developments; I was writing a book; and operating a Radioactive Waste Company. So I kept busy. Now, 1982, I 'm writing a book about myself, but nothing else. No. Handbook.

C. Kuljian Corporation and India

Soon after I left Argonne National Laboratory, I got a call suggesting that I talk to Mr. Harry Kuljian, President of the Kuljian Corporation in Philadelphia. This meeting was arranged by the Editor of one of the nuclear trade magazines whose last name I have forgotten, (Mr. Norman --). Sometime later I had a meeting with Mr. Kuljian, his Chief Engineer, Mr. Livonian, and their nuclear engineer. It was agreed that I would act as consultant when called upon.

Later, after the partnership of McLain-Rodger Associates was broken up, and we had formed the firm of McLain Associates in Lafayette, I got a call requesting that I meet Mr. Kuljian in Chicago. This meeting was a bit difficult to work out as Mr. Kuljian said he would be at the Palmer House Hotel, I think it was. When Winnie and I arrived at the Hotel, he apparently had not checked in as the information clerk had no

room assignment for him. It was the Hotel's error as he had checked in on schedule. So we sat in the Lobby for an hour; and then we ate lunch. Finally, just as we were leaving the Lunch to go home, Mr. Kuljian, Mr. Livonian, and Mr. Harry Kuljian, Jr., came into the room. "Stuart's Rule" is, "The best known establishments offer the poorest services."

Mr. Kuljian stated that they wished to bid on an assistance program to the Government of India on a nuclear power plant. Would we supply the nuclear backup? I had previously done several days of consulting for the Kuljian Corporation; thus, I knew their personnel and organization; so I agreed. I also had working agreements with Dr. Joseph Thie and others whom I might need.

The Kuljian Corporation, I believe, was nearly all owned by Mr. Kuljian and Mr. Livonian. I never saw their financial reports. The Company consisted at that time of about twenty engineers in Philadelphia plus offices in several other countries, one of which was India. In fact, the office in India was the largest Kuljian office; and I believe that it was one of the largest engineering design offices in India. It had an excellent director and reputation.

The Indian Government was interested in building a Nuclear Power Plant north of Bombay. Since this was to be the first nuclear power plant in India, they wished to have an American built plant and American consultants. I thought both were wrong. I still believe they were (1981). They also wanted American financial help -- so do I. Nuclear Power Plants are simple devices--basically much simpler than Coal Fueled Plants to build and operate. Critical Mass Calculations and Fuel Recovery are more complicated for the Nuclear Plants.

1. Conferences in Calcutta There were, of course, many meetings and discussions. These included trips to Washington and San Francisco and to Calcutta and Bombay. The trip to India was my first visit there. I flew via Cairo and Bombay -- my only view of the Pyramids from the air. We flew just above them in mid afternoon. They are spectacular. Why were they built? A WPA Project? Or was it to keep the slaves busy during the hill floods? On arrival at Calcutta where I went first, I was met by the Indian Manager of the Kuljian office.

We drove from Calcutta airport into town late in the afternoon. This was a very interesting trip as every family was cooking dinner. We arrived on the last place allowed to land at Calcutta for several weeks as an influx of refugees from East Pakistan (now Bangladesh) had just started.

Calcutta is hot most of the year. So to sleep out of doors in the dry season in a Park is no great hardship such as it would be here. It does not cool appreciable at night, to 70 F perhaps.

The area of Calcutta between the airport and downtown is low and at that time it was very wet. In that particular area, most of the people lived in huts about fourteen feet square. They cook on charcoal braziers out of doors most of the time in the dry season. The huts were close together. There was a real neighborliness by necessity, as neighbors could see what was in others' rice pots, that is those that could afford rice, might be empty. If you were poor, you mighty have a candle for a time in the evening; and if you were a little better off you might have a 40 watt bulb. All days are nearly 12 hours long with 12 hours of night. Remember the old Kipling statement, "The Sun goes down like thunder;" it is sunny and in a few minutes, it is dark for 12 hours in Calcutta. There is very little twilight--a few minutes.

Calcutta is located on the Houghly River, which is one of the mouths of the Ganges-Brahmaputra systems. Due to the construction of railroads and roads with tier built up embankments, there was no easy way for flood waters to flow to the Sea. Also the area seems to be sinking. Perhaps due to the weight of the Himalaya Mountains as the area is too young to be stable. Apparently, the mountains are still growing due to the northerly movement of the Indian Subertland. When I was there the first time, there was water inches deep seemingly everywhere. The roads and sidewalks were built up.

At that time they were building a barrage, or dam, on the Houghly River to control flooding of Calcutta and its environs. This probably was successful. The dam must have added more flood water to Bangladesh.

The refugees were the poorest lot of people that I have ever seen -- I think the poorest in the world -- I have never visited Western China. Each man carried the worldly goods of his family. In most cases this consisted of a roll of tattered clothes about eight inches diameter on the end of stick. Nearly every person was almost skin and bones. The upper arms of many of the men were almost as small as my wrists. Starvation at its Worst!

These people were simply given places to sleep on the ground in the Parks. Luckily the British cleared several sizable areas for Parks -- Queen Victoria Park is a mile or more by about a half mile. Soup kettles were set up and food prepared for these people.

Every person was clean. I noted uncleaned fingernails and toenails; but the flesh and clothing were uniformly clean. They took

baths daily by scrubbing themselves at the public water "fountains." These fountains consist of a pipe and valve from which you can draw water. Toilets consisted of most anywhere at any time.

I tried to get statistics on numbers. Everyone had a different number. In the first two migrations of which I saw a very small apart of the second, officially there were about 2.2 millions of people. Unofficial estimates given me by people that I considered very knowledgeable, were just ten times the official figures. The truth was probably between the two numbers. It could have been higher. I don't know.

Imagine that, if a number of destitute and denationalized people, equal to the population of Lafayette, walked into Lafayette next July between the first and fourth, what would we do? The people in Calcutta fed them in their Parks, let them sleep on the ground--wandering cattle keep the grasses mowed and supply cooking fuel -- and then processed them and found homes for most of them in a few weeks. As noted the temperatures are warm for the full 24 hours; so protection from the weather even at night was nonessential. I admired the Calcutta people.

Later, when I was in Calcutta, there was no evidence that anything had happened. On one trip they would not let me off the plane at the Airport due to our backing of Pakistan, or Banagladesh -- which I had not agreed with. India is ten to twenty times more important, and our Congress, possibly egged on by our anti-nuclear people, has forced India to turn to Russia for nuclear fuel. How foolish can we become? Don't we make friends by acting like friends? Indians hate to do business with Russia.

The next day I spent at the Kuljian Indian office. They had over one hundred engineers and a large staff of other people. We reviewed what might be done and got acquainted. We had lunch with several other visitors and several Kuljian staff people at the Old English Club. In the evening the Manager, one other engineer, and I flew to Bombay.

2. Conference in Bombay We stayed at a motel near the airport on the Arabian Sea. We had a lobster dinner and an evening swim; and then we sat on the beach and talked until after midnight.

The next day we met with the Head of the Indian Atomic Energy Commission. He was also the man in charge of the power project, Mr. Chadravardi. I presented something of our backgrounds and outlined how we would handle consulting for them by review of the drawings and specifications.

The following day I spent walking around Bombay and taking a private tour. I told the clerk at the hotel that I wanted a guide and a taxi. An University girl showed up as the guide. She was quite good.

She was a Junior, I think, in Economics. First we went to the University which she attended. Ten we went to the Museum to see the relics of the Harappa Period. I then wanted to see the railroad and shipyards and markets. She refused to take me to the fish market as "too smelly." Where did she think I grew up? We did visit the rest. Then she insisted on showing me the tourist things, including the place where the Zorostrians leave their dead to be eaten by the vultures. I couldn't care less. She also took me into a Zorostrian church. A rather tired old man was playing a piano. In front of him were two rows of quite overweight women, all dressed in white, sitting on the floor. Each had a stick about one foot long in each hand. As they sang, they kept time by hitting the opposite person's sticks. I remarked, "It looks like fun." The guide didn't appreciate my humor. I think she thought I was some sort of a spy, or a least a "dummy."

Bombay is a different city from Calcutta. Rather than a mass of huts with a minimum of larger buildings as Calcutta is, Bombay is an industrial center with large modern office buildings and high rise apartments. Other than more antique automobiles on the average, downtown Bombay was just like Chicago. Another exception is the "weather." Rain -- I don't know about in Bombay; but I do know about snow in Chicago. Stay away Joe! Bombay is usually 72 to 74 F at all times which I prefer to Chicago temperatures.

There are as many Middle Class people similar to Americans in culture, homes, etc in India as in the United States. Most of these people live on the second and third floors; so most American "tourists" never see them, rather they do see the poor servants on the first floor.

As noted, in 1980 India had a very slight negative population change. To me, this a vital fact.

3. Contract Negotiations General Electric Company contracted to design and construct the nuclear portion of the two plants; the Kuljian Corporation contracted to design to e non nuclear portion of the plants and the Bechtel Corporation contracted to design the utilities and to construct the plants. Nuclear Utility Services was the consultant on the non-nuclear portion of the plants; and McLain Associates was the consultant on the nuclear portion of the plants. Since the Administration for International Development was furnishing the capital, their people went over the various contracts in detail. In fact, it was AID that required NUS and McLain Associates as consultants.

Finally, the contract was approved on 10 November 1964. So representatives of all the organizations met at the Indian Consulate Office in San Francisco to sign the various contracts. Our portion amounted to about $35,000. We did about 20% of the work for 2% of the Consultant Contracts.

At the final contract negotiations in Washington with the Administration for International Development and the Atomic Energy Commission, the negotiations nearly broke down. I had always insisted that Kuljian sign for complete responsibility. I took the view that McLain Associates was a consulting firm and not a responsible engineering firm. If we should be sued, we, as individuals, were responsible as we did not have limited liability as Corporations do have. On the other hand Kuljian wanted me to sign for the areas named in the McLain Associates contract. Mr. Chakravarti requested that a single engineering firm sign and finally Kuljian did so. McLain Associates should have been consultants to the Kuljian Corporation.

4. Design Work General Electric Company had the major portion of the work. They designed and built two nuclear power plant and accessories for 150,000 kwe each. The contracts were about $150,000,000. This amount included the design and construction of all the buildings and utilities.

In order to review the drawings and coordinate the work of Kuljian, McLain Associates, and NUS, an office was set up in San Jose, California, a few miles from the General Electric design offices. Provision was made for two Kuljian engineers, two NUS, and two McLain people, plus secretaries, desks, supply cabinets, and auxiliary equipment.

I had contracted with Joe Thie to check the physics calculations, etc, while I planned to review the layout and process drawings. The Kuljian Company sent two engineers from the Calcutta office. These were excellent men. NUS sent one man even though their contract was larger than ours. He did very little work; and it was of very little benefit to the Indians.

It turned out that Joe Thie was so efficient that he did not have to work full time. I spent only one week a month at San Jose rather than the two weeks that I had planned.

The Indian government people were given an office by General Electric. Besides Chakravarti there were 10 or 12 men in their group.

5. Reports We issued reports whenever we completed review of a set of drawings, specifications, etc. Usually at the end of each week's work in California, we had a conference with Chakravarti and his staff. What they did with our reports in respect to General Electric was the business of the Indians. Most changes we suggested were adopted. However, one recommended change was not adopted.

Two of the most significant arguments are discussed below. Most other arguments were minor; and we were usually able to compromise; or the changes were accepted by everyone with minor additions. This was the case in perhaps a hundred or more minor changes that we recommended.

The first argument arose during the review of the initial layout drawings prepared by General Electric. General Electric had designed and built the Dresden I Reactor. This design was based on the Experimental Boiling Water Reactor II built by Argonne National Laboratory, and a smaller boiling water reactor built at Vallicitos, California. I never saw the Dresden I drawings.

Anyway, the layout drawings for the Indian Reactors showing the piping arrangement for the primary cycle, including the steam and water piping, were an unholy mess--my comments are not printable. There were simply too many pipes and too many valves.

I criticized the drawings and recommended removal of about half of the piping and most of the valves. I also recommended rearrangement of the locations of several pipe lines. When we got the revised set of drawings, I found they had followed essentially all of my recommendations except for the location of the small emergency cooling lines. These were actually placed where I wanted them by a field change during construction. How many thousands of dollars this saved General Electric, I do not know. My guess is at least 50.

I was told later that about half of the General Electric engineers had argued almost the way I had about the piping layout and valves.

The second important argument that I got into dealt with the radioactive waste disposal system. The radioactive waste system, as designed by General Electric, was, I believe, completely unworkable -- it was simply terrible! It consisted of an automatic centrifuge, a discharge into barrels on a chain platform, a remote header operation for the barrels, and remote handling. I predicted that addition of solidification materials would be impossible, spills would be frequent, and cleanup almost impossible. Nevertheless, it was built as designed. Then after it was built, they tested the system on non-radioactive wastes. Of course,

it was necessary to use a cellulose material instead of Portland cement, as specified, to absorb the excess water; the centrifuge worked; but there was no possible method to repair it without excessive radiation doses to the repair people; the discharge from the centrifuge dropped in chunks which sparked radioactive particles around the impact area; the barrels became contaminated on the outside; etc, etc. As the Kuljian Engineer that supervised the construction and acceptance tests said "Why, it's even worse than Stuart said it would be." I took that as a compliment. It never worked as designed.

When they got into trouble during the non-radioactive tests, they called me and asked me to go to the Plant as quickly as possible. So I flew over the next weekend. I stopped in Bangkok as my plane, a Pan American, went to Delhi instead of Calcutta. When I got off the plane in Bangkok, the Kuljian Calcutta Manager met me. I was very surprised. He was in Bangkok on other business. As it was about 0200, we drove to the hotel and talked to 0400. As we were going to our rooms he said, "I've set up a breakfast with the Editors of the local papers for 0900."

So that morning I had breakfast with the Bangkok Newspaper Editors. The meeting was called to discuss a paper plant; but the discussion was 90% re Communism and Vietnam. The editors all agreed that it was essential for the United States to stay in Vietnam no matter what the cost. They also said that if we should pull out of Southeast Asia, it will all go Communist. And we have partially pulled out! (Written about 1977).

As an Army Officer I had my own ideas. Vietnam was not fought there, but on the streets in our cities by Communist led groups; and we and our Government didn't take action. We lost "Face" in Asia as we looked so weak. We didn't fight a War; we lost a Propaganda duel. The War is still going on. (1981). And we lost it by not letting out Troops fight. When they did fight, they fought well.

I'm not sure that the American people realize that one of the potentially richest areas in the World is Southeast Asia. I am sure that Americans do not recognize Communist Propaganda -- and our Congressmen don't seem to care! We may have to fight a War, World War III, as a result. At present, in 1981, the Vietnamese Army is still in Cambodia. They are still backed by Russia. Why don't we do something? They are weak -- and hated by their people -- as all Communist Governments are.

To come back to the Tarapur Project, I caught the 1100 plane to Calcutta. We flew over the mouths of the Ganges-Bramapurtra Rivers and what is now Bangladesh as well as earlier over parts of Thailand

and Burma. All the lowland areas were paddy with the usual wood shacks and canals. Life doesn't appear worthwhile working in paddy. "Paddy" is, of course, growing rice by hand. It is worse than growing wheat by use of a spade, a rake, and a handknife, with "threshing" by a flail. It is the American farm tool inventions that have changed our "Way of Life" -- and is changing that of the world very rapidly. Why, Why should every person take a "Mineral Pill" everyday? What is peculiar about our Midwest? Recent glaciation?

On arrival at Calcutta I went to the Kuljian office for the rest of the day. I stayed at the Victoria Hotel. The next day, I flew to Bombay. I was met by Prakash and spent part of the day in the office in Bombay. In the evening I took the train up to the plant site near Tarapur, 70 miles or so, north of Bombay.

The Tarapur plant is located on the Arabian Sea. It consists of two small Boiling Water Reactors. Seawater is used for condenser cooling. The area surrounding the plant is very poor. At that time the people were simply harvesting the native grass for hay, baling the hay, and shipping it by rail to near Bombay where it was used for cattle feed. The people had a reputation of being very lazy and backward. At that time the hay was being cut by scythes and moved on bullock carts to a baling machine. That was also operated by bullock power. The worst part was that most manure was, at that time, being burned as fuel, rather than used to maintain soil productivity. This has been true for Centuries all over India. The land just continues to lose productivity--and the poor people to starve. How much fertilizer is used is a question.

Bechtel had built a few houses, a small motel-like hotel, a swimming pool, etc, near the plant. The Kuljian representative, Mr. Prakash, lived in one of the houses; and of course, I stayed at the motel -- and used the pool.

When we got to the plant, they arranged a meeting of the Bechtel and General Electric people and the Indian representatives. This meeting was of interest in that General Electric tried to impress on me that the waste system could be made to work. So I said, "Just don't try to make the ---- thing work. Take the equipment out before it becomes contaminated and sell it; and let us design a workable plant." I added some more of my pet cuss words. It's design was simply terrible -- it was God awful to say the best.

We then proceeded to a demonstration. On inert stuff it did work after a fashion. The young General Electric engineers had done an excellent job of attempting to make it work. After the demonstration we went over the equipment. It was easy to point out what additional

protection in the way of guards, replaceable covers, etc should be installed. For example, the chain link conveyor drive was uncovered. A metal cover that could easily be cleaned has kept radioactive materials out of the chain -- think how you would clean a roller link chain -- you wouldn't. If the General Electric engineers had only used a little thought, they could have designed a satisfactory and workable system.

Mr. Prakash told me later that not only all the bad things I had mentioned come true; but that there were others also. I had thought that I had complained about every part of the whole waste system.

Later, we had a meeting of General Electric, Bechtel, and the Indian people to discuss changes in the whole plant that the operating staff wanted. Apparently, before I arrived, they had agreed that I would be the arbiter; and that whatever I said would be accepted. But they didn't tell me so. They had perhaps 40 different things listed on several sheets of paper. The Chairman, who was an Indian Government person, would read the item, each side would offer comments; and all would turn to me for my comments. After the first two or three items, I caught on that I was the arbitrator.

Most of the items were trivial. I pointed out that the cost of the salaries of the people present at the meeting for the time involved in the discussions were greater than the cost of most of the changes, let along the "lost power" due to the delay in getting the plants "On the Line." So I was quite arbitrary on most items in telling the Indians to accept the Plants; and then they could have their plumbers make the minor changes when they had free time, and that they should not worry about "fault" or "responsibility." Power costs money when we talk of the millions of kilowatt hours per hour! There were, I think, three rather large items. So I suggested we go to their locations in the plant and have a more detailed discussion. This was done. I think I ruled all three against General Electric. But everyone seemed satisfied. Apparently, General Electric and Bechtel had fought all the changes. However, they seemed willing to correct those changes that I suggested were their responsibility. And, of course, to the Indians "face" was important. Even if I ruled against them, they could blame me without loss of "face." And I didn't care about "face." I don't think that I have any--or ever did have. I'm not sure that I understand what the term really means in Asia, and I don't think other Americans do. I would translate the term as honor or personal honor.

One change that I could not settle easily dealt with installation of an air conditioner in the instrument room. It was too hot for human comfort but not for the instruments. So, I finally said to the Indians that it was their responsibility.

Every day's delay in operation of each of the two Plants cost perhaps $35,000 less the fuel cost, or perhaps $15,000 to $20,000. They hadn't thought of that indirect cost. When I pointed it out, they immediately began to take an interest in the time involved and how to get the two Plants on the Line. It was the cost of oil versus nuclear fuels for Plants built and manned, or ready to operate at any time. Nuclear fuel simply is much cheaper than oil for use in Electrical Power Production.

General Electric and Bechtel had their own sets of problems. The steam cycle used was the same as at Dresden I. In all three Plants, the steam produced in the reactors, passed through heat exchangers to produce lower pressure steam, and back to the reactors. The tubes in the Indian heat exchangers had not been properly heat-treated and all the tubes had to be replaced before the Plants could start. "That" was not the Indians fault. But the delay in startup and use of the Plants was over two months, if I remember correctly--a large loss in power. The Indian Government should have sued General Electric for the loss in power, or $15,000 per day times 60 days, times two plants, or perhaps $1,800,000. Power production requires huge, expensive Plants and lots of money. General Electric, in my opinion, did a very poor job. Apparently, the Indians hadn't thought of that cost, or savings.

One item of interest was that Bechtel brought in British welders only to find that they were very limited in the amount of welding they could do per shift due to "Union Rules." So they tried Indian laborers who proved to do better work; they were not limited by Unions in numbers of tubes they could weld per shift; so they did two to three times as much work per man-day. The British welders were promptly sent home. In summary, the Plants were poorly designed and built. Operating problems have been a steady occurrence.

When I went through one of the Plants, I found that the condenser had been built and tested several months previously. It had been left filled with seawater. I was worried that the tubes might be corroded. An inspection proved that they were not harmed. They immediately filled the condenser with purified water treated with anti-corrosion agents. I "guessed" that, had I not caught that item, it would have cost at least a month's delay with about $500,000 for electrical power loss, and $80,0000 for the tubes plus labor retubing costs for the condenser for each Plant. The actual loss would have been the increased power and overhead costs plus the retubing costs perhaps as low as $400,000 to $500,000. This does not include the extra specialized labor--or the overhead charges, probably another $100,000.

These are the Plants that our Congress refused to allow fuel to be sent to in 1981 since the Indians exploded a Nuclear device. The Russians will supply the fuel. I think that Congress' action was atrocious. We certainly have lost "Face" as well as the profit on the fuel. More important, we are losing a friendly country that will turn more to Russia. Further, India has a high population, industries, and resources. How "Dumb" can Congressmen be? The Indians simply "hate" to do business with Russia. I do not know what will happen in the future. India is now assumed to be under Russian influence (1982). But as a retired Army Ordnance Officer and a man that reads history as a hobby, I would like to see India have many Nuclear devices ready for action. It is only 700 miles from Shrinigar, in the north of India, to the main Siberian Railroad transfer center. One Indian nuclear rocket could cut Russian in two! I have stood in the Shrinigar Pass and looked towards Russia, some 200 miles north. The Pass should be filled with Nuclear Rockets set to "go" on a few seconds notice. War is Hell! You make friends by treating people as Friends, not as congress did.

Since the plants have been in operation, their on-line efficiency has been low. One or the other of the reactors has given almost continuous trouble. I am not familiar with the specific details. In my opinion, General Electric did a very, very poor job of design and constriction. I believe that the Indians would have done better with our help had they left General Electric out of the design. Joe and I would have done better working with their design staff than General Electric did.

The last night that I was at the plant Mr. and Mrs. Prakash asked me to dinner. Mrs. Prakash had told the "Houseboy" not to add more than "a touch of curry" to my food. But even then I could hardly eat the chicken.

The next weekend I flew home.

Part of my contract was to provide assistance in fuel management. So after I returned to the United States, Joseph Thie and Cifford Zitek went to Tarapur. Joe was responsible for the startup tests and bringing the reactor to power. Afterwards, Joe spent quite a bit of time helping the Indians get their fuel codes in operation on ther computers; so they could handle their own fuel management.

Clifford Zitek had been Associate Director of Commonwealth Edison's Power Plant, Dresden I. As mentioned above, he attended classified lectures which I gave a Argonne National Laboratory. Later, he helped build, start up, and operate Dresden I Reactor, and to design Dresden II and III Reactors. While it was not in my contract with the Indian government, I asked Cliff if he would go to Tarapur for two weeks

during the start up tests and advise the Indians on operations. This he and Commonwealth Edison agreed to do. So I paid his travel and salary for two weeks as a gift to the Indians. But Joe Thie had worked so fast that my profit on the contract was greater than I had expected. In summary, the Plants have given continuous troubles in operation. As noted, in my opinion General Electric Company did a very poor job of design and construction.

D. Argentina

Just after I left Argonne and started consulting, the President of the Argentina Atomic Energy Commission invited me to go to Argentina to the Commission's Laboratories at Mendoza, some 600 miles west of Buenos Aires, and give a series of lectures. When we got down to the practical questions of who pays for what, Argentina wanted our Government to pay my salary plus travel to Buenos Aires. Since I was not a Government employee, our AEC refused to pick up either the travel expenses or pay checks. And I didn't want to go badly enough to pay my own expenses and make a gift of my time. So I did not go. I always thought that our Government should have considered this of more value than most of its "Giveaway Programs." I don't think Goodwill is a Commercial Commodity. You earn Goodwill!

Several years later Argentina began to consider a nuclear power plant very seriously. Dr. Frank Foote and Dr. James Schumar of Argonne National Laboratory, and several other Americans, were invited to spend from a few days to a month in Buenos Aires with their Atomic Energy Commission. Dr. Foote and Dr. Schumar of course got their travel and expenses plus salaries paid by our government. The purpose of my visit was to review data on possible power plant locations and to assist in selecting the type of plant to be built. They offered all expenses plus consulting pay; so I agreed to go.

The city is located on the Platte River near its mouth. Here the river is very wide. It is very shallow, only a few feet deep, in fact only one or two feet deep in many places. It has been necessary to dredge the river from Buenos Aires to the ocean. Before dredging, you could walk across the river as it is only about a foot deep in one place -- I did walk part way across it where it was dredged. It was not above my knees.

We also considered the type of reactor that might be built as well as size. The Argentine Atomic Energy people wanted to use an American design, preferably boiling water. There was very little difference between the boiling and pressurized water in our evaluation. However, after I left Argentina, their AEC issued bids to French and

German, as well as U. S., Companies. Both the French and Germans under took to "buy" the contract by underbidding. Actually, the contract, I believe, was awarded to the Germans.

While in Buenos Aires, I was entertained by the Kuljian people there. I enjoyed all the people we met. We also enjoyed the food. Lunch was served at the Commission. They certainly overfed us as a "portion" of the meat served was enough for four people. Only beef is considered meat. When they embargo meat shipments or have a meatless day, it only means beef. Lamb, pork, and fish are always superabundant.

The Sunday I was in Buenos Aires* I spent walking through their Parks. These are spacious and since the weather was warm, there were lots of flowers. The flower beds were well maintained. The suburbs were very poor in many areas and very rich in others. Railroads for freight were primitive. Only one or two roads had reasonable passenger service. Now most travel any distance is by air.

E. Nuclear Fuel Management

A year or so after I moved to Lafayette, I began to think more and more about what the Utilities knew about their nuclear power reactors. Nuclear Utility Services* was set up to aid the Utilities in calculating the fuel depletion, the program for movement of the fuel within the reactors, etc. But I have always believed the Utilities in calculating the fuel depletion, the program for movement of the fuel within the reactors, etc. But I have always believed that Utilities should have their own staffs trained for this and other work such as how to compare a nuclear and a coal fired power plant before choosing one or the other. I still believe that I was right (1982). So I wrote a letter to several power companies and power plant design companies. Only one replied. Bechtel Corporation replied immediately, saying they would cooperate, and that we should proceed. No one had any good ideas how, least of all me.

Several months passed. I nearly forgot about the letter. Then one day I met Eugene Bailey, Administrative Engineer of Commonwealth Edison Company, on a street in Chicago. He said, "You remember the letter you wrote about fuel management? Well, it has been the basis for many discussions within our Company. Someday we will answer it." After several weeks he did answer it. He asked that members of the Purdue staff meet members of the Commonwealth staff for discussions relative to nuclear fuel management.

We set up a meeting in Hammond, I believe. Dr. Phillip Powers and I represented Purdue University, and several Commonwealth Edison

people, including Eugene Bailey, Robert Bowers--Treasurer of Commonwealth, two people from Dresden, I think, Clifford Zitek and Al Veras, and two Vice Presidents, represented the Company. I expressed my thoughts and indicated the reasons that I thought Commonwealth Edison should proceed with their own fuel management.

I still believe that every Utility should do its own Fuel Management as it is only each Utility's Engineers that can know all the problems involved. After about three weeks the same group met again, and again after about three more weeks. Why they bothered to meet with me, I don't know. They must have worried that I knew something that they didn't. Perhaps they were just being polite.

This third meeting started off by the Commonwealth Edison People stating that there appeared to be no economic advantage to their doing the fuel management as General Electric was doing it at reasonable costs for them. I used a few of my "Favorite Cuss Words." I then tuned to the board in classroom we were meeting in and showed them that their fuel costs for Dresden I were about $2,000,000 per year higher than they should have been. I admit that I may have been off a few cents. One of the Vice Presidents asked Bailey quite in surprise, "Is he right?" Bailey scratched his head, then replied, "I guess so. I don't see anything wrong with his calculations."

That ended the argument. The next Fall we started fuel management courses at Commonwealth Edison Company. Nuclear fuel does cost a lot of money even though it is cheaper than coal or petroleum. General Electric was specifying too low an enrichment for the fuel. This resulted in low fuel life and too high an U235 content in the rejected fuel.

Commonwealth asked the other Utilities near Chicago to join and send people. Actually the following Companies sent people: Commonwealth Edison, Chicago; Iowa Power and Light, Davenport, Iowa; Northern States Public Service, Minneapolis; Consumers Power Company, Jackson, Michigan; Arthur Anderson, an accounting company, Chicago; Sargent and Lundy, a design company, Chicago. To repeat, every utility should do its own calculations and not depend on others. Commonwealth should have continued with me as a consultant. I have always maintained that the Utility Engineers should do as they should know more about the Plants than others. Further, if they don't know, they should know, they should learn or be discharged.

We had about forty men, mostly engineers. I gave most of the lectures. We did ask James Lane from Oak Ridge, Walton Rodger, and one of the Professors from Ann Arbor, Milton Edlund, to give lectures.

Most of the lectures were background and dealt with the uranium supplied, manufacture of fuel for reactors, costs of reactors, etc. We then turned to questions of fuel life, how to charge off the fuel cost over its life of several years, cost of money, etc. We then set up a code for fuel management cost studies. This was partly done by Professor Edlund from Ann Arbor. One of his graduate students worked out a detailed computer program.

This code we named CINCAS after the first letters of the companies represented. Since then, many other codes have been developed; but CINCAS was in extensive use for a time particularly for accounting purposes.

It is interesting to look back on this course. Our predictions for the growth of the nuclear power industry have not been realized due primarily to the suits and objections raised by the so-called environmentalists. However, the number of reactors appear to be only about two years behind schedule and the lack of fossil fuels will, I believe, result in a great increase in orders in the future. Last year's orders were up to schedule (written at the end of 1973). (In 1981 the whole Industry is in the doldrums -- thanks to the lack of growth of Industry, audits, President Jimmy Carter and the antinuclear people.)

James Lane and others emphasized the low amount of uranium available. They stated that prices for uranium would increase by 1970 and considerably by 1980. I was asked my opinion; and I disagreed because I thought many more bodies would be found. This led to considerable discussions. I have been proven to be right. I knew of one very large deposit not yet described (1981).

The fuel management course was presented at the Commonwealth Edison offices every other Thursday. Four people came from Minneapolis to attend overnight by train to change and return the next afternoon by train. I had to drive from Lafayette.

I did a very poor job of teaching the course because of lack of time. I was spending only half time at Purdue University; and this course was only part of my duties. I was also acting as President of California Nuclear. I should have spent full time on the course.

The course was repeated the following two years at Commonwealth Edison. Later, James Fulford gave the course in a shortened form, I believe, three times at Purdue University. In November 1973, we had letters from two companies asking that it be repeated. James Fulford recently jointed Nuclear Fuels Services (1981).

1. Commonwealth Edison's Moves. Commonwealth Edison asked Professor Owen Gailor from Purdue to assist in working out a more detailed physics code for a nuclear power plant. When this was done, Commonwealth established a subsidiary Fuel Management Company, capitalized at $10.000.000. I thought that I should have been given one share of the stock of that Company, or of Commonwealth Edison.

Commonwealth, in cooperation with General Electric and with Westinghouse, has constructed two training centers, one for Boiling Water Reactors and one for Pressurized Water Reactors.

2. Nuclear Management Centers

Lugene Hungerford suggested that the Utilities should combine their efforts and build and jointly own Operator Training Centers. If they did this, the Centers would be tax exempt. They have followed General Electric's and Westinghouse's lead -- which we contend is wrong – as I am sure that it is as neither General Electric nor Westinghouse Electric Companies want the Utility Executives to do any thinking or know anything about Fuel Management or the Reactors. If the Executives understood where their money was going, they might ask questions. A noted elsewhere, the Utilities have guaranteed profits; so their Officers are not interested in the lowest costs. The State Utility Board Authorities are in the same group -- and the Public just pays and pays.