ORAL HISTORY INTERVIEWS

FREDERICK (FRED) O. RUUD

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STATUS OF INTERVIEWS:
OPEN FOR RESEARCH

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Interviews conducted–1996
Interview edited and published–2007-2008

Oral History Program
Bureau of Reclamation
Denver, Colorado

SUGGESTED CITATION:

> **Ruud, Frederick (Fred) O.,** ORAL HISTORY INTERVIEW. Transcript of tape-recorded Bureau of Reclamation Oral History Interviews conducted by Brit Allan Story, Senior Historian, Bureau of Reclamation, in 1996, in Denver, Colorado. Edited by Brit Allan Storey. Repository for the record copy of the interview transcript is the National Archives and Records Administration in College Park, Maryland.

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FREDERICK O. RUUD

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INTERVIEWER:_____
Brit Allan Storey

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Introduction

In 1988, Reclamation began to create a history program. While headquartered in Denver, the history program was developed as a bureau-wide program.

One component of Reclamation's history program is its oral history activity. The primary objectives of Reclamation's oral history activities are: preservation of historical data not normally available through Reclamation records (supplementing already available data on the whole range of Reclamation's history); making the preserved data available to researchers inside and outside Reclamation.

The senior historian of the Bureau of Reclamation developed and directs the oral history program. Questions, comments, and suggestions may be addressed to the senior historian.

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Oral History Transcript of Frederick O. Ruud

Storey: This is Brit Allan Storey, senior historian of the Bureau of Reclamation, interviewing Frederick O. Ruud, R-U-U-D, a retiree from the Bureau of Reclamation, on January 18, 1996, at about 8:30 in the morning, in Building 67, on the Denver Federal Center. This is tape one.

Mr. Ruud, would you tell me where you were born and raised and educated, and how you ended up at the Bureau of Reclamation, please?

Born in Waterville, Washington

Ruud: ~~Yeah.~~[1] My name is Frederick O. Ruud, Frederick Olin. I was born August 10, 1925, in a little town called Waterville, Washington. Waterville is about ninety miles southwest of Grand Coulee, halfway between Spokane and Seattle, the county seat of Douglas County, Washington.

Had a Gift for Math

I went to grade school and high school, at Waterville. ~~, and after high school,~~ We lived on a combination hardscrabble ranch, a little bit of wheat land and a lot of scab rock to graze cows on. But I was one of the kids that could do math. I had a gift for it. ~~, and I could make [unclear] even as a young man.~~

Tour of Duty in the Army at the End of World War II

So after a short tour in the Army at the end of World War II, and only was in a little less than two years, but I got enough time in to go to college, then I went to Washington State College.

Graduated from Washington State College in 1950

I made a short stop into what's now called Eastern Washington State University, it was Eastern Washington College of Education, at Cheney, Washington, for a year, where I met my future wife. Then I went to Washington State College and graduated from there in 1950. I started work with the Bureau of Reclamation after my sophomore year in college, as an engineer trainee at Grand Coulee.

Now, this has a long history. Previously I grew up on this farm and we had

1. Note that in the text of these interviews, as opposed to headings, information in parentheses, ( ), is actually on the tape. Information in brackets, [ ], has been added to the tape either by the editor to clarify meaning or at the request of the interviewee in order to correct, enlarge, or clarify the interview as it was originally spoken. Words have sometimes been struck out by editor or interviewee in order to clarify meaning or eliminate repetition. In the case of strikeouts, that material has been printed at 50% density to aid in reading the interviews but assuring that the struckout material is readable.

The transcriber and editor have removed some extraneous words such as false starts and repetitions without indicating their removal. The meaning of the interview has not been changed by this editing.

a creek that ran through the farm, and I was always out playing on the water on the creek like kids will, but I was making little water wheels and stuff like that, and dams. So I had a great interest in it.

Grandfather Was an Engineer

I had one grandfather that was an engineer and had come to this country to be a railroad engineer, but he was the first county engineer of Douglas County for, oh, maybe forty years, from about 1880 to 1920, approximately.

Storey: His name?

Ruud: His name was Ole, Ole Ruud. He had gone to school in an agricultural college in eastern Norway, and then he came to Douglas County. My [own] father just recently passed away. He was at the age of ninety-four years and nine months. But my father was born in Waterville.

My Grandfather Ole married a lady from—she had come to this country from Sweden on a summer visit, to just visit some half-brothers and sisters, and she was so sick on the boat coming over, she said she'd die before she ever went back. And she did. She just came for the summer, she and her brother. The brother died of typhoid fever in Brooklyn. So, she never went back. She worked her way across the United States. She was working in a sweatshop in Chicago, and answered a mail-order ad and took the train to Spokane, and my grandfather met her in Spokane and took her out to Waterville, and she worked out there. She was a maid in a hotel, like kids ski bumming, you know, fixing beds and stuff like that. Well, that's what she did.

Well, she married my grandfather and they had something like eight children, seven of which lived to die of old age, my father being the oldest and the last to die, just about two years ago now.

My mother is also ninety-eight. Her father was a banker. Actually, he was a farmer who wanted bigger and better things, so he became a land loan examiner for a national bank in Spokane. So they got together. My mother was a teacher, and my father was a farmer. Like the classic American story, she came to town as a schoolteacher and he married her. They've got seven kids. So I come from a *big* family. Now my mother is ninety-eight, and unfortunately, she's not in good health at the moment. It's very, very tenuous. Even as we speak, it's not good.

So they raised a big family. I being the oldest boy, I was a very independent sort, and off I went to college after the Army. Then I met my wife, and we were married in 1948, just before I went to work for the Bureau. Matter of fact, we went on our honeymoon up in the Cascade Mountains, head of Lake Chelan, and it was the rains of 1948 and the huge floods, the roads were washed out, and a lot of other stuff.

Worked at Grand Coulee Dam

Went out to Grand Coulee to my job to go to work, and the first day of work, it was 104 in the switchyard, and I got sunstroke my first day at work. (laughter) But, working out there, I got to carry the bag of stakes on my first day. I couldn't drive the stakes, I just got to carry the bag of stakes around. We were surveying for the switchyard for the powerplant.

My maternal grandfather had taken me up to Grand Coulee one time, had taken the family, when I was about twelve years old. We went up there, and Grand Coulee was under construction, and you could look down over the abutments and see this work going on. So I had this sort of thing in my mind as I was growing up. When I got in the Army, I found ~~out, sort of~~ these basic philosophies that guide your life, I decided it was so much more difficult to build things than to destroy things, and that's why I got into the business of building things with the Bureau of Reclamation, and then because of the political rewards, in other words, it's a laudable undertaking to build ~~a~~ construction, things that will last and things that are productive.

Are we running?

Storey: Yeah, we're doing fine. I'll check it periodically throughout the conversation.

". . . it was more the psychological motivation than it was the money."

Ruud: So in later years I would learn these things as a manager, it was more the psychological motivation than it was the money.

". . . until the 1960s, you could always leave the government and earn more money somewhere else . . ."

For many, many years, until the 1960s, you could always leave the government and earn more money somewhere else, but Kennedy established the principle of comparability, where engineers that worked for the government got paid comparable wages to engineers in private industry. So that made things a lot different in the sixties.

But early on, why people used to work here because they loved it, and because they wouldn't work anywhere else. They were interested in building things *like* Grand Coulee, Hoover, the big irrigation projects in the Columbia Basin.

"These were social goals and psychological wages that people got from doing work that was really worthwhile . . ."

These were social goals and psychological wages that people got from doing work that was really worthwhile, versus going out and bombing some city or building weapons of mass destruction that you couldn't be terribly proud of doing—some people are, I'm sure.

Liked Being Able to Publish about the Work Done

Another thing that was interesting, and I found early on, was that people could publish, they could talk about what they were doing. As a matter of fact, it used to be quite a notable thing that people were very proud of the work that they were doing, and that was a great motivator to bring people to the Bureau of Reclamation.

"We effectively had 1 percent of the national budget in the Bureau of Reclamation. . . ."

I guess I always had those kinds of goals in my mind, and those kinds of motivations, because I would remind you, if you look back, you can get the numbers from anywhere, but get them out of *The World Almanac* or something, I looked one time, and I think it was in the 1950s, or maybe it was 1948, the Bureau of Reclamation had a $440 million budget, and the national budget was $44 billion. We effectively had 1 percent of the national budget in the Bureau of Reclamation.

". . . all these *huge* undertakings that were part of a great social and civil expansion, using the resources of the country after World War II. . . ."

We were building these irrigation projects in California, the Central Valley Project, the Central Missouri Project, the Columbia Basin Project, all these *huge* undertakings that were part of a great social and civil expansion, using the resources of the country after World War II.

"The Bureau of Reclamation established the standard for the world in this kind of work, and we put it into effect building things like Grand Coulee. . . ."

Because of that, it was a marvelous place to work. We had great, great support from the Congress. As far as the Bureau of Reclamation was concerned, Grand Coulee *was* the Bureau of Reclamation. There weren't a lot of things that had been built in the past. It's a little bit like when the Bureau of Reclamation's greater—first it was the Lahontan Project in Nevada, in the 1903–, 1910–, 1915. Then it became the Hoover Dam Project, or Boulder Canyon Project, as it was known at that time, and that was a tremendous part of the *great civil* engineering foundation of the activities in dam building all over the world. The Bureau of Reclamation established the standard for the world in this kind of work, and we put it into effect building things like Grand Coulee.

Started with Reclamation as an Engineer Trainee in 1948

I first started out in 1948 as a civil engineer trainee, and was one of those *few* of those people who persevered to make a career. Another one was Jim Brown, who was a former chief design engineer of the Bureau, and had worked his way up to that position. I started out as a civil engineer, but after one summer of—Jim Brown passed away several years ago, I mean three or four years ago, so he's no longer available to us. After one summer of working with concrete and surveying

and running around, why, I decided that I could be a mechanical engineer.

Decided He Wanted to Be a Mechanical Engineer

This is sort of personal dimensions in lots of ways. My old father-in-law used to tell me, when you're a civil engineer, you'll be the first man on the project. There won't be any houses, there won't be any ~~outdoor toilets, I mean, any~~ plumbing, but if you're a mechanical engineer, you'll have a home to live in, you'll work inside where it's nice and warm in the wintertime, and in the summertime it'll be cool. You have air-conditioning, you have houses to live in, you have plumbing and all that sort of thing. But a civil engineer, you'd be kicking the rabbits out of the sagebrush if you stay with that.

That summer, why, I kept that in mind, having newly married and listening to my father-in-law closely. But we would drive home in a dirty old rat-trap station wagon from out in the sagebrush, where you had to get it up to 60 miles an hour to blow the dust out of the car. I'd come home and here's a great big Woody Buick station wagon with a blonde secretary hauling electrical and mechanical engineers around, and they were working inside in a nice cool powerhouse all day long and here I'd been out sweating in the sagebrush with the ticks and the rattlesnakes and so forth.

One of the kickers toward the tail end of the summer, why, you had to climb down over the wall of [the] Grand Coulee to take a shortcut back to the car, and it was about 500 feet down from the prairie down to the floor of the Coulee, and come down there. I said, "This is not for me." I was a good athlete and a good climber and stuff, but I really thought I had a little bit more talent in mechanical engineering than I did in civil, because I had a talent to make machinery run; good hands, as we say in the business. So at the end of that first summer, I changed to mechanical engineering.

Second Summer, 1949, as a Trainee Worked in the Right Powerhouse

The next summer I came back, I worked in the powerhouse all summer long, a nice cool powerhouse. In 1949, I started out as what they call[ed] a SP-3, I think, the first summer, maybe a SP-4, and the second summer I was an SP-5. But then I came back in 1950. But in 1949 I worked in the Right Powerhouse, getting ready to get the first units started in the Right Powerhouse, and had a lot of fun, and got very well acquainted. I always wanted to work on water wheels.

"I considered myself a very, very lucky man, in that the Bureau of Reclamation gave me an opportunity to work on what I wanted to do as a life's profession . . ."

I considered myself a very, very lucky man, in that the Bureau of Reclamation gave me an opportunity to work on what I wanted to do as a life's profession, and I never really had to work a day in my life. I *loved* working *for* the Bureau. I loved working on the large hydroelectric units, every part of it from the very bottom piping to the—I ended up in my latest years being an expert, a start-up engineer.

That was marvelous.

But I worked all summer in '49, and then I went back to college and graduated in 1950 from Washington State College. At that time it was called Washington State. My wife had also graduated at the same time with a degree in psychology. Then we went back to Grand Coulee and started to work and started a family. My daughter was born in 1951 in Spokane, daughter Kathryn Rae. [Two sons were born later. Sylvan Oliver in 1954 and Eric Olin in 1957, here in Denver.] My wife's name is Sylvan Rae Hiatt. Her father had come to Grand Coulee on a construction job and stayed there, so the roots run pretty deep at Grand Coulee. We lived at Grand Coulee for two years.

Construction Inspection at Grand Coulee Dam

My first job, I came home from college, and my first job as a mechanical engineer was inspecting the rivets in the structural steel over the roof of the pumping plant. I'd scoot across these I-beams, I'd look down, it's about 200 feet down, and there was a rebar sticking out the side of the walls down there, and I must have wore out a pair of pants in two days scooting across these I-beams, checking the rivets, but I thought to myself, "And you wanted to be a mechanical engineer?"

"If it's made out of steel, it was ours [mechanical engineers'], except for rebar. . . ."

But it wasn't long and I began to do other things. It's like you've got to kiss a lot of frogs to meet a prince, but you've got to do a lot of yeoman work to build your base as a mechanical engineer. I inspected gates and piping and valves and water pipe and oil pipe, and all kinds of stuff that go into a power project, every bit. If it's made out of steel, it was ours, except for rebar. All pipe sleeves that go into the walls for construction, I located anchor bolts for the roof of the pumping plant. I worked in there.

Becomes Involved in Testing for Vibrations on Pumps at Grand Coulee Dam

I was working in the job in 1951 when they started up the first pump at Grand Coulee, one of the main pumps. There are two aspects of that are terribly important to me. One, they had all the jobs covered. I asked if I could come out and participate in the testing program, because they had a little vibration problem, and they said, "Well, no, we don't need you. You don't have time."

I said, "Well, could I come out and watch?"

They said, "Sure."

Well, coming out to the job, and I didn't have anything to do. So I'm, of course, down where the action is. This fellow came out from Denver— supposed to be an expert. You've got a vibration problem, here's this expert. Well, what's his name? Well, his name is Parmakian. He runs some test stuff back in Denver.

John Parmakian

So I started hanging around John Parmakian, watching what he did, and became, over a period of testing and several months, I became his primary assistant. I would pick him [up] at the airport in Spokane, and work with him all the time he was there, and carry his briefcase. I had a policy statement I started at that time, and I still say it, that I was very proud just to be able to carry Mr. Parmakian's briefcase. He retired as the associate chief engineer of the Bureau of Reclamation, and was an international consultant par excellence, my mentor, and a tremendous man and engineer.

Storey: How do you spell his name?

Special Assignment Section in the Dams Branch

Ruud: P-A-R-M-A-K-I-A-N, Parmakian. John had come to work for the Bureau of Reclamation in 1930. His first job was a similar test job down at Hoover Dam. He had done a lot of academic work. He wrote the Part 5 Bulletin 5 of the Boulder Canyon reports, which had to do with the stress analysis of the Boulder Canyon penstocks.[2] He was a head of a section here in Denver called Special Assignment Section in the Dams Branch at that time. But he did a lot of this troubleshooting work.

"He had some electronic instrumentation he used, and I was interested in that . . ."

He had some electronic instrumentation he used, and I was interested in that, because I had acquired these skills in the Army, of being able to handle communication instrumentation. So I became Mr. Parmakian's right-hand man on this job.

Subsequently, as a result of my work with him, he invited me to come to work for him in Denver, which I accepted. I came to Denver in October of 1952. That's when I started in the Denver office. Now, about that time, when we finally got the pumps running and got the little kinks straightened out, they had vibration of the discharge lines, that nobody had ever heard of, so there was a great study and it made Mr. Parmakian very famous. But I participated in that and some of the more fun things I do is—well, you couldn't test during the day because they needed the power, but they'd test at night. Sometimes the weather wasn't always good, a little bit of snowstorms, and a little bit of rain, and a little bit of that.

"But my claim to fame was running up and down those discharge pipes in the middle of the night carrying the test instrumentation . . ."

2. U.S. Department of the Interior, Bureau of Reclamation, *Boulder Canyon Project Final Reports: Part V—Technical Investigations. Bulletin 5. Penstock Analysis and Stiffener Design.* Denver, Colorado, 1940

But my claim to fame was running up and down those discharge pipes in the middle of the night carrying the test instrumentation, called accelerometers, to measure the vibration of the pipe for Mr. Parmakian. That's where I earned some of my spurs.

Michael Straus as Commissioner

Another thing that I had that I always look back upon as a marvelous experience, was the time that—Michael Strauss was Commissioner of Reclamation and came to Grand Coulee on the occasion of the official start-up of the pumping plant[3] that brought irrigation water to the huge irrigation project, made a speech to dedicate the job. Michael Strauss was a marvelous speaker. He was so effective that Congress cut off his salary at one time. This is all in the record. They cut off his salary because he wasn't an engineer. The Republican Congress didn't like Mike Strauss. But he said, "That's all right. I'm a multi-millionaire, I'll work for nothing." Harry Truman, President of the United States, told Mike Strauss that he [should] just go ahead, and anything that Bureau of Reclamation wanted, the Bureau of Reclamation got. And at that time, why, we had about 1 percent of the national budget. We had 19,000 people work[ing] for this organization. We were building huge projects all over the world. We had a huge foreign activities program. We had great projects going, and it was something that was—a man could be very, very proud to dedicate his life to working for this kind of organization. So that's what I decided that's what I was going to do, in spite of all of the times and troubles that we had later. I decided I was going to stick it out, and I did that.

Inspecting Gates and Valves at Grand Coulee Dam

So that sort of thing, about the end of my inspection tour at Grand Coulee, I did a lot of gates and valves, and things like that. As a little aside, they had a failure at Grand Coulee. They were going to paint some of the outlet tubes, and somehow, maybe the contractor got a little eager or something, and they went ahead and started to unbolt some of the manholes, but just left a couple of nuts on it, and then the operators were going to open the values, and they got mixed up as to which is upstream and which is downstream, and opened up the wrong gate.

Flooding of Portion of Interior of Grand Coulee Dam

My father-in-law used to tell me, "Never do three things wrong at the same time. You do one thing wrong, you might make one mistake, why, you might just have a problem. If you make two mistakes, you're in real trouble. If you make three mistakes, you're dead." Well, apparently there were at least two mistakes made simultaneously. The contractor or someone, *someone*, I don't think it was ever proved, because the evidence was blown away, but *someone* had unbolted this manhole.

3. Construction of the initial six pump units occurred 1946-1951. The remaining six pump/generating units were installed beginning in 1973.

Storey: Just one manhole?

Ruud: Yeah, just the lid. Left a couple of bolts on it. Then this next mistake is the operator forgot which is left and right, and he opened up the upstream gate instead of the downstream gate. The upstream gate put full pressure on this manhole and blew it off and flooded internal galleries of the dam.

I was sitting in the office, and some pipefitter walked in and said there's a lot of water coming in this particular opening into the powerhouse. I said, "What's that?"

"I don't know."

So we grabbed a couple of pipe wrenches and took off. I found it, walked right up to within fifty feet of where the outlet was coming, where all the controls were, and at that time I wasn't too courageous. I was just starting my career as far as, you know, bucking bureaucracy and things, and so the fellow who was with me was an older guy and so forth. I says, "Well, it looks like the operator's got a problem. It's not our problem, it's an operator's. They've got to get down here and close those valves."

Well, later on, why, it became like the fellows who did it, you came to appreciate that these troubles are everybody's troubles. You can't just back off and say it's somebody else's trouble. I can enlarge on that philosophically for the purposes that we have today in our government, but *all* our troubles are everybody's troubles. I mean, it's not something that just affects you.

Closing the Valves to Stop Flooding at Grand Coulee Dam

But it's an interesting aspect that my boss heard about it. His name was Norm Holmdahl. He got a couple of other guys to go with them, to help him, and he took a little bit different route in getting into these controls, but came down to the same place we had been and left. But they took their life in their hands. They used pencils or a stick and pushed the buttons. These electrical controls were flooded, but they did work. They had high voltage on them. They did work, and the motors ran, even though they were flooded, and they closed the valves, opened the proper valves, and saved Grand Coulee from being flooded.

As a result, Norm Holmdahl and his friends—Don McGregor was my boss, and Milton Berg, who was a co-worker of mine at the time and part-time supervisor, they all got the Gold Medal for Distinguished Service from the Department of the Interior for their courage. Technically, it took a lot of courage.

But one of the important things that I always remembered about that is that Norm Holmdahl had been the mechanical inspector that had installed those valves, and he was the only man on the project that knew exactly what to do. The rest of us would have had to learn it and find out and study it and determine in a bureaucratic fashion or some other logical fashion, but Norm had put them in and he knew

exactly what to do, so it saved many hours and days.

To let you know how important that was, the level of the water in the powerhouse came within twelve inches of the bottom of the main electrical circuit breaker that controlled all the power and all the power to the galleries, that included these valves. We would have had to turn them down in the total darkness by hand, with pipe wrenches and flashlights. Now, this water was 33 degrees temperature, and it would come up to your waist as we walked in there, and it was lapping at the terminals of 6,900-volt transformers as we walked by them. So even just getting in to look at it was something of a risk. So there were a lot of heroes, but Norm certainly deserved the accolades he got.

". . . it's easy to get overly familiar with these things and to forget what a tremendous amount of power is involved in these particular facilities . . ."

But that was my initial baptism about things that can happen when something really truly goes wrong on a Reclamation project. I was thinking this morning on the way down here, well, a lot of us work on very large turbines, with very large pipes, with very large amounts of water, and it's easy to get overly familiar with these things and to forget what a tremendous amount of power is involved in these particular facilities, you know. It's just *huge* amounts of power. That power, when unleashed in a destructive manner, can also destroy things.

So that's the sort of thing I was involved in in Grand Coulee. Fortunately, nobody got killed. It was only money, and they cleaned it up, and everything was okay. It had some potential for some truly great disaster. It would have filled the powerhouse up to where it ran out the front door before it ever stopped. It would have flooded out all the units on the right side of the powerhouse at Grand Coulee. The left powerhouse would have been totally flooded up to the—including the generator, you know, would have filled it up like a bathtub. But it was taken care of and we were very, very lucky.

Moved to Denver in 1952

But I came down here in 1952.

Storey: Before we move on, if we may, tell me about inspecting rivets. What do you look for?

Inspecting Rivets in Construction

Ruud: Oh, looseness. You tap them with a hammer. You tap them, and you can feel them. Tap one side and feel the other. I tried driving rivets one time during my time as inspection on the pumps. They had these big, old boiler makers in there, these guys had driven these red hot rivets, and one of them says, "Oh, you're in here to inspect rivets. Did you ever drive a rivet?"

I said, "No, I never drove a rivet."

"Well," he says, "here, I'm going to let you drive them." He says, "Put on these gloves."

Well, I had pretty good hands, big hands, and I put on these big old gloves this big old boiler maker had, and it's 120 pounds, it felt like, maybe only 80-pound riveting gun, pick it up, and they hollered, "Ready." And they sent this red hot rivet into the hole, and then, "Beat it down," you know. So I get on it and try to pound it down. It got cold before I could get it tight. He says, "Well, now you know how we have to drive a rivet."

I said, "Well, yeah, it's a learning experience, as far as I'm concerned." So you have to look to see that they're tight.

"You know, for many, many years, the Bureau of Reclamation built riveted pipes, riveted construction, riveted design, and riveted seams . . . and this was the state of the art before World War II. We [now] have the introduction of electric arc welding by Forney. . . ."

You know, for many, many years, the Bureau of Reclamation built riveted pipes, riveted construction, riveted design, and riveted seams was a great part of mechanical pipe design. Matter of fact, a lot of the penstocks at Hoover Dam are riveted design, and this was the state of the art before World War II. We have the introduction of electric arc welding by Forney. Forney was from Fort Collins and perfected electrical arc welding. Of course, the Forney Museum [in Denver] is a collection of his stuff that he used with his fortune to gather up. Before World War II, nearly all the pipes were riveted. There's a lot of riveted joints designs even at Grand Coulee. So we all learned to do these kinds of things. So that was one of my jobs, inspecting rivets and structural steel.

Storey: What happened when the rivet wasn't tight?

Ruud: You take it out.

Storey: Did you ever find any?

Contractors Sometimes Have Issues with Inspection on Reclamation Projects

Ruud: Oh, yeah. You mark them with a crayon, and they cut them out with a cutting torch and put another one in, and they do it all until they get them tight. It doesn't take—I mean, I suppose one in a hundred. The people, craftsmen, get very good at this stuff. Now, of course, why, we have inspection of welds, radiographic inspection, ultrasonic inspection, all kinds of inspection techniques, magnafluxing of welds, to find defects in welds. It's part of quality control in construction projects.

I might observe one of the lessons I learned. Some of the contractors used to say, "Well, the reason we can't make any money is because all of you inspectors are out here inspecting it."

We tell them, "Look, we don't want you to do anything that's not written down in a spec, but when it's in the specification, you're going to have to build it exactly the way it's shown in the specification."

"They'd bid it in dirt cheap, and then bid on the extras, which were, they claimed, extra compensation, because they didn't feel that they had to meet these standards. Nobody else did it that way except the Bureau of Reclamation."

Well, they would rebel at that, a lot of the people, and sometimes the contractors would have—they'd have a staff of engineers and lawyers that every day they'd file claims for extra work, because this is where they made their money, was on extra work. They'd bid it in dirt cheap, and then bid on the extras, which were, they claimed, extra compensation, because they didn't feel that they had to meet these standards. Nobody else did it that way except the Bureau of Reclamation. We said, "Well, the Bureau of Reclamation has projects that are there, and they're built for," I used to say hundreds of years.

". . . a great many of the facilities that are in there, will be there a long time, because they're built with quality control. . . ."

We used to say the useful life, financial life, you don't pay it off in fifty years and stuff, but you can believe that the Hoover Dam will be there a long time, and Grand Coulee, and Shasta, and all these other jobs, and a great many of the facilities that are in there, will be there a long time, because they're built with quality control.

There might have been a time when you could buy a Ford automobile, and at the end of 50,000 miles you'd sell it as worn out. Now our modern automobiles, including some domestic makes and foreign makes, will run 300,000 miles without having to have a new engine, and it's because of an emphasis on quality control. We have airplanes that fly, let's say the Boeing, what, 727, try a three-engine Boeing aircraft, has been flying a long time. It's still a very active airplane, and it's because of quality control and design.

". . . a lot of people would criticize the Bureau of Reclamation for 'gold plating.'"

A philosophy we used—a lot of people would criticize the Bureau of Reclamation for "gold plating." I even know a former commissioner that I sat in a meeting once with, and he said, "Well, that's the reason we have all this expense, is because you guys here in Denver gold-plate all your designs, and other people could build them cheaper."

". . . I might observe that there have been at least one failure that was due to a total lack of gold-plating . . ."

I said, "Well, I might observe that there have been at least one failure that was due to a total lack of gold-plating, and not putting in certain features that possibly should have been put in, *not* doing a proper inspection because of travel restrictions imposed by the commissioner's office, that the difficulty and the extent

of the difficulty was *not* discovered as a result of these problems, why, failures occur."

Storey: Are we talking about Teton?

Ruud: Possibly, yes.

Storey: And which commissioner are we talking about?

Ruud: Well, it's a small world. I'd say Ellis Armstrong was the commissioner at that time. There's always been an attitude. A lot of people come into management jobs—I remember a commissioner named Douglas McKay, happened to have a surname same as my mother.

Storey: The assistant secretary,[4] I think?

Ruud: Yeah. Assistant Secretary Douglas McKay for—

Storey: Right. You said commissioner.

Bias Against Research among Political Appointees

Ruud: Well, all right. He was in the [Dwight D.] Eisenhower administration. But he used to say, "Well, we want more work with less money. A dollar's work for a dollar's pay." Well, these are code words for what they call high cash flow management, and "We're not going to spend any money on research. What we want is production." You know, these type of things. I even remember after World War II, why, they said, "Well, this research and development might be a laudable undertaking, but what we really want is somebody who'll help us get our products out the door. But we'll give this guy a room upstairs and he can do a little research up there, and if he ever finds anything good, why, we might adopt it." Well, it turns out that most of the progress that's been made in the last fifty years is built on research and development. We're not building any 1942 Fords anymore, you know.

"I always considered my foundation in the construction inspection to be a *really good* basis for a lot of decisions that I made . . . through the next thirty years of my career. . . ."

I always considered my foundation in the construction inspection to be a *really good* basis for a lot of decisions that I made many, many [times,] ~~years,~~ through the next thirty years of my career. I started work in '48, and I came to Denver in '52. So I was only in construction inspection for about four years. But during that time I got a tremendous background in *all* the aspects of mechanical construction, because I worked at Grand Coulee. Grand Coulee had everything that

4. Douglas McKay was appointed Secretary of the Interior by Dwight D. Eisenhower, and he served in that position 1953–1956.

there was to do in the hydroelectric field, and it was *marvelous*. Switchyard work, some of the work that I did later on in transmission towers, ~~structural, steel structural, structural steel,~~ inspection of structural steel. They only had to move one anchor bolt in all the roof beams for the pumping plant. ~~that~~ I inspected the location of these anchor bolts. They only had to move *one*, and that's because the form got knocked off during the pouring of the concrete.

"So I was always very proud of that kind of standard of performance. . . ."

So I was always very proud of that kind of standard of performance. It's the things that you learn in that way. The Bureau of Reclamation was a quality organization and did quality work.

So that sort of brings me up to the time I transferred into Denver.

Construction Inspection at Grand Coulee Dam

Storey: Tell me more details about, for instance, inspecting gates, inspecting piping, inspecting valves, pipe sleeves, anchor bolts. What's involved there? To you, it's second nature. To people maybe from outside Reclamation or who didn't do that, it's not second nature.

Ruud: Well, I mean, it's very difficult. I used to use the "country boy" euphemism, you know, what our job is, is to make sure that it works like it's supposed to. That involves a great many things, because to understand that, you have to know what it's supposed to do and you have to know all the details of the design.

A pipe sleeve is merely a hole in the wall that you're going to run a pipe through, to go from one side of a concrete wall to another side of a concrete wall. But if you miss it, and everybody else is building a pipe and it comes up, nope, they're two inches short, how are they going to—and there have been occasions when we had to drill a hole through the wall four feet thick, to get a pipe through the wall that had to go there. But our job as construction inspectors was to make sure that they were located X, Y, and Z horizontally, vertically, and longitudinally, exactly where they had to be, in order to accommodate future piping. That way you had to have an intimate knowledge of all the piping that goes into the job.

Of course, we had drawings, and our people in Denver that worked on making up these drawings, and they had experience over the years of doing all this sort of thing. All the engineers in Bureau of Reclamation have a tremendous amount of respect for each other. So we *trusted* each other, because we had to, and we're going to do this.

Actually, to go back from pipe sleeves to gates, to make a jump, I had a job one time, and I guess one you—there's an old story, you know. What are you, three guys. What's one guy doing? "Well, I'm piling one rock on top of the other." The second one says, "Well, what am I doing? Well, I'm building a brick wall." The third one says, "Well, what are you doing?" "Well, I'm building a cathedral." They

call it superordinate goals. What are you really building? There's another story I have to tell you later on.

But I was the inspector on the main feeder canal gates. These are big radial gates that regulate the flow in the canal and shut the flow off as it goes into the equalizing reservoir of the Grand Coulee Irrigation Project. This is a reservoir about five miles wide and thirty miles long.

Storey: Banks Lake?

Music Note Seals on the Gates at the Entrance to Banks Lake

Ruud: Banks Lake now. I was the GS-7 construction inspector on putting those gates in, and the contractor says, well, you know, he knows how to do it, but he says, "Well, what do you want me to do?" We're going to put these things in, you have to locate the bolts, you have to locate the plates, the wearing plates on the sides, you have to make sure that the gate is installed plumb, square, and level, and that it operates free of any excess friction, binding, you can run it up and down. And it became a question about location of the music note seals on the sides of the gates and how do you locate music note seals on the side of a gate so that the gate doesn't leak. I'd seen other gates, but I could find ~~no~~ guidelines, not anywhere. I asked my supervisors and says, "Well, just bolt them on there."

I said, "Well, wait a minute. You know, there ought to be *some* guidelines somewhere."

So I did a little research and couldn't find any guidelines, from even asking my—supervisor's manuals. How do I locate these seals? No guidance. Well, I decided that I would invent the seal ~~guidance~~ [guidelines]. So the criteria for setting the seals. Well, I located the seals and I put them in there, and I had the contractor make it so there's a music note seal a couple of inches in diameter, the cylindrical side for the seal, like a big round music note side, and then put some compression in that seal so that actually the seals had some compression. They pressed against the sides of the walls, then about an eighth of an inch compression on each side of the gate, when the gate set free. Then I compressed the seals an eighth of an inch to the left, and the right seal I compressed an eighth of an inch to the right. Gee, when it got all done and the reservoir was filled with water, why, the seals didn't leak. Gee, that was a pretty good job. They really liked that.

Storey: These seals are rubber or something?

Ruud: Yeah, they're rubber. They're rubber. They look like a music note in cross section. That's why we call them music note seals. They come in a long continuous strip of rubber, but they're extruded, and they're extruded in the shape of a music-note. Then they bolt the flat side to the gate, and then you adjust it.

Storey: So the bulb of the musical note would be up against the sides.

Ruud: Pressed up against the side of the wall. But if you make it a little loose, the water will run through it. Then there's water pressure on the sides. So you have to adjust these a little bit.

Well, I had a friend that I had worked for that went to work for the Corps of Engineers at a nearby project, named Chief Joseph, and he worked his way up in the Corps of Engineers, and they had a lot of other jobs in the Corps of Engineers. Finally, they were having the same debate. One day he came over and he looked at the music-note seals and says, "You have these radial gates?"

"Yeah, our radial gates at the canals. We'll go out there."

Says, "Well, who put these in?"

"Well," he says, "Fred Ruud put these in."

He was a construction inspector. "Well, how did he set the seal clearances?"

Well, this is how he set them. Got out there and they measured how much compression there was in these seals. They could do this by moving the gate back and forth with hydraulic jacks. Now, spring it in a little, you know. And they discovered this, and lo and behold, all of the seal clearances on all of the dams on the Columbia River that are controlled by the Corps of Engineers and others, the PUDs, Douglas County, Chelan County PUD, Grand County PUD, and the Corps of Engineers down below, all of the radial gate seals are set using that criteria. So it's only a tiny detail, but they say you can't move the world, but in little ways, why, you can. And you have to have a consciousness of these sort of things. These kinds of things aren't just done by random, and I think, as an engineer, and then with some dedication ~~as to know~~ that you're building a project, rather than just slapping in some seals.

The technical details of doing all these things are really not so *complicated* as they are extremely fundamental.

END OF SIDE 1, TAPE 1. JANUARY 18, 1996.
BEGIN OF SIDE 2, TAPE 1. JANUARY 18, 1996.

Ruud: Okay.

Storey: Yeah, I think we're in now.

". . . the basic thing . . . when one does an inspection of gates and valves is to make sure they work like they're supposed to, and this involves the very fundamentals of the action of the particular equipment . . ."

Ruud: Okay. The problem with doing, or the basic thing one has to do when one does an inspection of gates and valves is to make sure they work like they're supposed to,

and this involves the very fundamentals of the action of the particular equipment, and knowing exactly what you're going to do and where you're supposed to go, or what the function of the particular pipe that you're working on, or the valve that you're inspecting will be in the bigger project.

There's a lot of work. The basic fundamental thing is called orientation. As an aside, I go to a strange city, my wife says, "How can you always find your way around when we go to these places?"

I says, "Well, I looked at the map three days ago." When you study your drawings and you know your work that you're trying to do, it's not very difficult to recognize sometimes when things are not being done properly.

Issue with the Feeder Canal for Banks Lake

I think construction inspection is a great education for anybody starting in the engineering effort. But I found it a foundation for my later work, and this one previous thing I talked about, about setting the seal clearances for the radial gates in the feeder canal, I have to come back to this subject, because at a much later time, why, we came very close to having another major failure of almost unimaginable proportions, that involved the main feeder canal at Grand Coulee. You may want to—well, I may refer back to this at a future time. But much later, in 1970s, before I retired, this was ~~thirty years after I left Grand Coulee--twenty years,~~ twenty years after I left Grand Coulee—I had come back up to Grand Coulee, and at this time those same pumps that I had worked on and walked up and down the pipes to put stiffener rings on and all that sort of thing, why, we were going to have pump-turbines at Grand Coulee, and one of the problems with pump-turbines is when they're working as a turbine and you shut them down, why, you have surges in the canal, because the water is flowing up the canal, and all of a sudden it stops dead, because it's no longer being taken away by the turbine. So you have a big bore wave that starts down the canal.

When you spoke of the unwritten history of the Bureau of Reclamation, of things that have happened, I'm always amused and amazed at the things that bureaucracy engenders. I was working there, and a young—not terribly young, but a younger engineer came up to me and he says, "You know, you're working on the canal, I understand, and you're having to measure some of the waves, bore waves, in the canal."

I said, "Yeah, we're going to convert some of these pumps to pump-turbines."

He said to me, "Well, if you'll look very closely up there," he says, "you'll notice that there's a problem up there."

I said, "Well, why don't you do something about it?"

"Well," he says, "if I open my mouth, I would get fired. They really don't

appreciate troublemakers around here. They tell you if you know too much, you can get in real trouble around here, and you have problems—[don't] cause anybody trouble."

I says, "Well, what's the problem?"

"Well," he says, "if you'll look when those waves go up and down, why, on the outside of the canal there, what they call coyote holes, they are holes that go down on the outside of the canal lining, and if you'll watch, why, when those waves go by, the water will go up and down in those coyote holes. That means the canal lining has got some big leaks."

I said, "Well, why don't you do something about it?"

He says, "I'd get fired. But they tell me that you're a big enough person, you won't get me in trouble and you might be able to do something about it."

I says, "You want me to use your name? I can make a hero out of you."

He says, "No." He says, "I don't want to have anything associated with me at all."

Well, being who I was, having my reputation, it was hard won, but I went up and I looked, and, sure enough, the water was going up and down the outside of the lining. What this means is that the dirt that held the canal in place [was] saturated, and the canal was built up on the side of a hill that's up above a lot of other things. It goes along the side of the hill and then dumps into the reservoir.

Having worked on those radial gates, why, I knew that the control cables for the operation of the radial gates [were] ~~was~~ on the downhill side of the canal, because that was the easiest place to put it was in the dirt. So that if anything happened, why, if that thing slid, why, the canal would tear out the cables.

The third thing that went wrong is that we were in a Zone Three earthquake country. Grand Coulee is prone, and the whole area east of the Cascades, is a high intensity earthquake country. The Cascades were still a young mountain range, geologically speaking. So that it *can* happen that you can have a very severe earthquake. Magnitude six or seven would not be unexpected there at all.

So with those three factors, I remembered my old father-in-law's sage advice about not doing three things wrong at the same time. So I went down to the telephone, the marvelous government telephone system, and called my boss, who was the chief design engineer at Bureau of Reclamation, my *big* boss. I had a couple of layers in between. But this guy was Jim Brown, and I knew him very well, the big boss. I said, "Jim, we got a problem."

He says, "Well, what have you done now?"

I said, "*Not me*." I said, "There's nothing happened *yet*." I said, "It's very important."

"Well," he says, "tell me. What's going on?"

So I explained this project to him. We had one thing wrong with the saturated embankment; secondly, we had the control cables; third, we had the earthquake exposure, and it wouldn't be prudent not to—you know, we ought to do something.

He said, "Well, what do you want me to do?"

I said, "Well, if I were chief design engineer and I had a report like this, I would load a Bureau plane full of canal designers and I'd get them up here as expeditiously as possible." I said, "I don't think that this is something we ought to *not* investigate." I said, "This thing bears investigation."

Well, later on I found out that there's a little bit of resentment in Denver, "Well, what's this guy doing blowing the whistle on us? Was this supposed to be a canal person?" Or all that stuff.

He said, "No, he just says come on up and look at it."

So they came up and looked at it. And to make a long story very short, why, they rebuilt the canal, $35 million reconstruction of the canal, and it's a disaster that never happened because someone recognized that it's possible that you could have an earthquake, the saturated embankment would slide, it would break the cables, you couldn't get the radial gates down, and all the water in Banks Lake would flood back through the town of Grand Coulee and over the roads, facilities, Bureau and so forth, and would be a major, major disaster. So we got a new canal that's hopefully watertight and everything is a lot better than it was.

". . . that's one of the duties that one has as . . . a government employee . . . that is if you see something wrong, why, you're required . . . to do your best job, and that includes a responsible warning. . . ."

So I think that's one of the duties that one has as an engineer, and especially a government employee, ~~has~~ incumbent on ~~just~~ accepting the position, and that is if you see something wrong, why, you're required, by virtue of your employment, to do your best job, and that includes a responsible warning. This was shortly after, this was not too long after Teton, and what we really didn't need is another Teton, another major failure.

Now, there wasn't anything vindictive about it. I could care less, I mean, but, you know, when you see something like this and you recognize the extent of the possible failure, why, it's a matter of conscience and a matter of professional ethics that you *have to* blow the whistle. There are a lot of people like the young man who came to me, who would just as soon tiptoe away, because they might get fired. Well, I met enough people in my career that were in very high positions, and

that can go as high up as United States senators who were in charge of the Interior and Insular Affairs Committee, Senator Henry Jackson, Senator Warren Magnuson, state of Washington, both of them, a couple of different Secretaries of the Interior, several commissioners that I knew, and others, that really big people really need all the very best help that they can get. They don't appreciate people that withhold information from them, no matter if it's for your own survival. I know it's fashionable to kill the messenger, but you've got to be strong enough *not* to get killed is the problem.

In Denver was assigned to "a special assignment section. They were known as the "brains bunch," and they handled technical problems that were too difficult or too dangerous for anybody else . . ."

But I would rather go back to my time when we started Grand Coulee. I just came down from Grand Coulee to Denver. It was October 1952. I had a young wife, an infant daughter, a year old, came into a Technical Engineering Analysis Section. I was just a country boy. I was a bachelor's degree from Washington State College at that time, and I knew that I could do numbers, but I was rather unsophisticated insofar as the major engineering skills of that particular organization. This was a special assignment section. They were known as the "brains bunch," and they handled technical problems that were too difficult or too dangerous for anybody else, and they had this fellow who ran this thing, named John Parmakian.

One Month after Arriving in the Denver Office a Reduction in Force Was Announced

To tell you some of the things that happened over the next few years, some of the things that was really interesting—when I came in in October 1952, it was just before the Eisenhower election, just before the November elections of 1952. They had the elections and a week later they announced the reduction in force. I had just been in the office a month, but I was a veteran, which had veterans' status. So my job was protected, whereas some people who had been in the office for years had to be transferred out because of their lack of retention points, if you want to call it, or preference, but I was able to keep my job. Right away, you know, that doesn't get you off on too good a start, but, you know, you work with the plate that's set to you.

Attended the University of Colorado Extension Center Working on a Master's Degree

I started this college, started Extension Center. They called it University of Colorado Extension Center in Denver. I started night school down there with the goal of getting an education in some new fields of structural engineering, mechanical engineering, mathematics, to work toward getting a master's degree in mechanical engineering. That's one of the reasons I came to Denver is to do that, and to do a more technically oriented work, because I was tired of inspecting pipe and pounding sand down rat holes, and things like that, so I wanted to go to college at night.

Received a Master's Degree in Mechanical Engineering in 1956

So for the next six years, I went [three] ~~two~~ nights [every week] to night school, from 5:45 to 10:20, and graduated from University of Colorado with a master's degree in mechanical engineering in 1956.

Became a Registered Engineer by Examination in Colorado in 1954

In between, I became a registered engineer in Colorado by examination. In 1954, I got my license. It was interesting, because we could have what we called grandfather, because you've been working so long, why, they would automatically give you a license. At some risk, I decided, "No, I'll take the exams." So I took the exams and, of course, passed the exams. I got my license, and then you can put "by examination." The secret of that is that if you go to another state and want to work there, why, they won't always allow you to work if you received your license by grandfather's clause in your home state. However, if you have received it by examination, *then* they would give you reciprocity in an adjacent state, or any other state pretty well, to work there. Even California will do that for anybody except structural engineers. Because of the earthquake exposure of the state of California, why, structural engineering work is very closely controlled, and you have to have a license by examination as a structural engineer in the state of California to do that kind of work.

Because of my work in night school, and because of working in this engineering analysis section, at one time I considered taking the structural examination for the state of California, and I had no worry about taking that risk of taking that examination, but I had never taken courses in soils and never taken courses in concrete, reinforced concrete. So I was not a reinforced concrete designer. It's kind of a specialty of itself. In order to take the structural engineer in California, you had to be a civil engineer in California, and to get the civil engineer, you had to have this knowledge of reinforced concrete and a knowledge of soils and foundations. I was *not* about to go back and get a doctorate just so I could take the structural exam for the state of California, especially when they already have structural engineers, as I found much later, in another area.

Specialty Was Troubleshooting Hydroelectric Problems

I jump ahead, but many years later I became a consulting engineer, and I always found that when I did work in California that they had structural engineers on their staff that could do all these functions. I didn't have to worry about it. I was very much at home in my own specialty, which I was *highly* qualified for, and that's troubleshooting of hydroelectric problems.

In 1952 Worked on Checking and Revising Formulas for Stress and Strain

The very first job I got, in 1952, in this technical engineering analysis section was to check a whole series of formulas in a book called Raymond Roark,

Formulas for Stress and Strain,[5] and had some pipe formulas in there for stresses and deflections in pipes under various loading conditions. I worked about a year checking those formulas and revising these, because they were very seriously needed.

There was a man that had been there on a study program and went back to Australia and built a pipeline using some of these formulas for this pipe, and had some failures, because the formulas were wrong. He wrote back and said, "Somebody ought to do something about this." So my boss put me to busy doing that.

People He Worked with

Unfortunately, nobody else could check it, and you had to learn to check them yourself. But that was a huge education. I had all these people around me who were very, very highly qualified people, who had master's degrees in civil engineering, who were members of this same section, who were extremely well-qualified engineers, people like William Evans, who later on left the Bureau of Reclamation in *another* reduction in force, because he was a non-veteran, and went to work for Boeing Aircraft Company and designed the landing gear for the Boeing 747. He was my mentor in structural engineering, so you can guess the quality of structural education *I* got. You've never heard of a landing gear collapsing on a Boeing 747, because William Ellsworth Evans designed it.

"I became something of an expert in stress analysis of hydraulic turbine parts. . . ."

Another boss of mine was Clair Crawford and, of course, John Parmakian himself was a expert in water hammer. So I learned an awful lot about hydraulic, mechanical, and structural engineering, and sort of put in my time developing formulas for stress analysis and different things. I became something of an expert in stress analysis of hydraulic turbine parts. I wrote a monograph called *Engineering Monograph Number 30 for Stress Analysis of Hydroelectric Turbine Parts*,[6] which becomes, and still is, more or less a working man's standard. I made it very simple so most people could use it and it would give adequate answers.

Worked and Published on Wye Branch Design

Another job that I worked on was the wye branch design. The Bureau of Reclamation was testing a wye branch, up at a big job called Palisades Dam, and one day it fractured under test. It came down to us in our section, and to me, and Mr. Clair Crawford, to study this, and come up and find out what's the matter. Well, gee, we didn't have anything but some very elementary methods to study this,

5. Raymond J. Roark, *Formulas for Stress and Strain* (New York and London: McGraw-Hill Books Company, Inc, 1938) and subsequent editions.
6. F. O. Ruud, "Stress Analysis of Hydraulic Turbine Parts," Engineering Monograph No. 30 (Denver: Bureau of Reclamation, 1962).

so I embarked on a method to do stress analysis of wye branches.

I worked on that for three or four years. But one of the problems that I had, to use some technical language, this became a theory of elasticity design— well, actually structural design, not theory of elasticity, a structural design using slope deflection equations for all the beams and rings and the shelves that go in to make up the design of a wye branch. Now, because wye branches come in symmetrical and non-symmetrical configurations, why, there are always some other problems, particularly in a non-symmetrical wye branch, where one leg sticks out at an angle, or both legs stick out at different angles. That gave me a lot of problem, because the symmetrical is easy, but the non-symmetrical is extremely difficult.

One day we had been to the drive-in, my wife and I and the little kids, and I came home and I got to thinking about some of the things called strike and dip in earthquake faults, and how these related to how I would equate the end moments and make the ends of the beams match up in what we call compatible deflections and rotations of the beams. So I started to work on that problem at midnight or eleven o'clock, and by four o'clock in the morning I had it solved, and I got up, I think at 7:30, and went to work and wrote it down formally, and I had the solution to that problem. But that's the way engineers do things sometimes, is they get an inspiration and they work on it and they can't let loose of it until they have the answer. But that was the breakthrough that finally enabled me to publish Monograph Number 32, called *Stress Analysis of Wye Branches*.[7]

Matter of fact, for people who are technically oriented, it's not very difficult, in a mathematician sense, it's not a difficult thing to do. It's tedious, but with a computer it can be done very easily. But nobody's ever gotten around to putting it on a computer, even myself, because one doesn't have very *many* of these designs, and even now in the Bureau of Reclamation, why, they use designs that they have used before and has tested before.

But this became rather famous as a really sophisticated method of doing the stress analysis of wye branches. That helped the old man's reputation, you know. At the time, Lord, what was this, about 1964. I was only forty years old, thirty-eight years old, and putting this stuff together, and worked a lot.

"In between, why, we're working on little jobs like what's the force on a piston that causes the link of a hydraulic turbine operating ring to get bent or something like this . . ."

In between, why, we're working on little jobs like what's the force on a piston that causes the link of a hydraulic turbine operating ring to get bent or something like this, all kinds of little problems that engineers constantly have that are fed to us from the field, but all of which rely on your *experience* that you

7. F. O. Ruud, "Stress Analysis of Wye Branches," *Engineering Monograph No. 32* (Denver: Bureau of Reclamation, 1964).

acquired during your construction inspection days, so that you're extremely familiar with these kinds of things.

Another thing that helps a great deal is the matter of communication with your engineers, and the use of the long-distance telephone system to talk to your friends on the project who are looking at it and can explain to you what happened or what their needs are, is a tremendous asset. It hasn't always been this way. There were times when you weren't supposed to communicate with somebody, you were supposed to get this job done. Well, sometimes what solution you provided would not have any relation to the problem in the field. The communication is equally important in problem resolution, as is the technical information. The right solution for the wrong problem doesn't get you anywhere, except perhaps dead.

"Then I began to work on . . . hydraulic turbine troubleshooting. . . ."

But I worked on these sorts of things, including hundreds of other things. Then I began to work on other kinds of jobs called hydraulic turbine troubleshooting.

An Early Field Job Had to Do with the Lower Molina Powerplant

One of my first field jobs to make a study on was at a place called Lower Molina, and it's in western Colorado, part of the upper Colorado River storage project.[8] There were two little Pelton[9] jobs called Upper and Lower Molina, very small. But they had some problems in governing because of a very long penstock and very high head, and, then, some specifications requirements that were written without regard to reality.

In specific, these specifications required that the units be non-water wasting, and this was interpreted so that, for an ordinary governing, why, we couldn't waste any water. But there are times when you operate that you cannot move your governor slow enough to prevent the penstock from responding. As a result, why, we got pressure oscillations in these pipelines. One pipeline was five miles long and the other was *eight* miles long. Then to try to govern this, try to vary the flow without causing pressure surges was an impossibility without water wasting by means—and the water wasting in this case was the placing of [a deflector] ~~an impeller~~ in the jet to regulate the amount of flow that would hit the water wheel.

"So there's a great amount of conflict, not the least of which had to do with whose job was it? . . ."

So the governors were modified, but there were some other problems.

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8. The Lower Molina Powerplant is part of the Collbran Project which was authorized in 1952. It is one of many projects in the Upper Colorado River Basin.
9. Pelton is a form of runner for a hydropower turbine. The Pelton Wheel is versatile and reliable in small to medium sizes. The Pelton was invented in California and patented in 1889.

These sort of problems involved the political and personal ramifications of other engineers in the office, the Denver office. Well, they said, "It's our job to do this. You have to make it run the way we've said."

I said, "Well, suppose that's not possible?"

"Well, then the manufacturer has to do it."

I said, "Well, this is not realistic. They *cannot* do this."

So there's a great amount of conflict, not the least of which had to do with whose job was it? These personal petty jealousies that run around, whose job is it, you know. "We're the turbine designers," they said. Some "adjective." But it turns out that performance was the name of the game, and he who can make them run wins the marbles in the poker game.

"The problem really becomes how can you win and let the other guy save face . . ."

The problem really becomes how can you win and let the other guy save face, and that became a very, very important aspect of most of the troubleshooting work that I did.

Ultimately, there was a workable solution established. Now, that workable solution might not have been to everybody's satisfaction, and still even I don't think to this day to my satisfaction, but since I retired from the Bureau of Reclamation, I keep my hands out of it. I went back and discussed with the responsible parties exactly what I felt had to be done, and told them exactly what I felt was required, and the amount of danger involved in not taking corrective action, and a word to the wise is sufficient, because I'm not going to let my blood pressure go up because of things that are not done, over which I have no control. So you have to know when to hold them, know when to fold them, and know when to walk away.

Hydroelectric Turbine-setting Criteria

~~I later on—that was the first job, I went to Grand—there.~~ ~~1962~~ [1964], I guess, I presented a couple of papers, I changed the world—hydroelectric turbine-setting criteria.[10] These are all papers that were written for the American Society of Mechanical Engineers. The Molina job was documented in a paper in 1964, and also I got involved in a thing called setting criteria.

Weir below Glen Canyon Dam

10. Frederick O. Ruud, "Hydraulic Turbine Setting Criteria," mimeographed paper prepared for the American Society of Mechanical Engineers, New York City, November 30-December 5, 1964. Printed in limited quantity by the Bureau of Reclamation, Denver, Colorado. Reference copy in Bureau of Reclamation Library, Denver Federal Center.

The story came into the Bureau of Reclamation [Denver Office] that says, "We have a weir that regulates the depth of the tailwater below Glen Canyon Dam, and it's right below the bridge. Now, the tourists are going to stop and look over the bridge, and they're going to look down and see this two-foot waterfall, the water riding over this weir, and they're going to ask why are you wasting that power." "Well, it's because the weir's there." Well, that's not a very acceptable answer.

All of this came about because before Glen Canyon Dam was built, why, the water used to run muddy and had rocks and stuff in it, and it maintained a certain level of the riverbed. After the dam was built, the water coming out of Glen Canyon Dam was nice and clean, and it didn't have what we call a saturated load of mud. So it would pick up mud from the riverbed, called scouring, and it would pick up mud, and ultimately, they say, it would pick up the relatively fine sands and gravels and mud, but leave the bigger rocks to armor the river bed. This is called armoring. Ultimately, this would settle down at a certain level and would no longer cause erosion of the riverbed. But during this process, why, the people at the project could see the level of the riverbed going down and they said, "Gee, if this is going to get down so far, we're going to have this waterfall. Now, what about this weir?"

Well, I got involved with other people whose job it was to determine what the proper tailwater elevation was for a hydraulic turbine, and what the elevation of the centerline was to be, and this is all of a criteria that had been established for, oh, twenty-five years. "So who are you, you whippersnapper, to doubt our word in this matter?"

Well, now wait a minute. They asked, "What about this? What's going to happen when this erosion occurs? Is it really necessary to have that weir?"

This is an interesting little subject, because I made a big study and we studied all of the history of the Bureau of Reclamation's projects and what problems we'd had with excessive submergence, and what problems we'd had with a thing called cavitation damage to water wheels, and all of the different troubles, and it turns out that all was not as it seemed to be, that there were vast differences in between the facts and the perceptions, and that there really was room for improvement. We did not have to set the tailwater elevation of the dam based on single-unit operation, as if just one unit were operating. ~~, the probability being that many of the units of~~ Glen Canyon has eight units, and the probability of only one unit being in operation is very, very low. So that the unit didn't have to be set so low, and the tailwater didn't have to be guaranteed so high that it was an absolute number that could not be moved.

So this resulted in my publication of what I considered the criteria for hydroelectric turbines—back up. The title of the paper was "Hydroelectric Turbine-Setting Criteria," published in the American Society of Mechanical Engineers in 1964. At that time it was not adopted as the Bureau policy, which, as you can tell, I'm beginning to push the boundaries of authority. (laughter) But anyway, later on, it did get adopted.

Sometimes you can't inherit the farm because Grandpa's still alive. After Grandpa dies or retires, then you get to inherit the farm and some of your friends can make some of these changes. I'm very proud that a lot of the things that I work on and have worked on during the time of my career were subsequently adopted. They might have been very controversial at the time, but after they stood the test of time and examination by other qualified people, that they became the standard criteria. So as a result, why, the criteria was changed.

But in the meantime, one day they had some outlet valves [operating] at Glen Canyon. These great big outlet tubular-type valves were operating to bypass the river during some construction stage or something like that. But they were to pass some floods because they didn't want the spillway to run, and these valves were all on one side of the river. So they opened them up one time, they had opened them up for a long time, and they circulate. *Big* flows were going down through this river, and then, by golly, would you believe it, they shut them off one day, and they looked out there, and the weir was gone. Of course, I couldn't have been more delighted, because my argument to lower the tailwater in Glen Canyon had been won for me by Mother Nature.

What had happened is that the circulating flow in the basin below Glen Canyon had washed the sand out from underneath the ~~river, or out from underneath the~~ weir, and the weir had sunk to the bottom. I mean, you know, washed a big cavity underneath the [weir] ~~sand~~ and broke it. The thing fell into the bottom of the river and it was gone. Well, it was down there someplace.

But the big meeting and chief engineer asked, "Well, how much did we pay to put that thing in there?"

"Oh, probably cost a quarter of a million dollars to put it in."

Says, "You think we ought to spend a quarter million dollars to put it back?"

Said, "Oh, we don't think so."

Next question was, "Do you think it was worth a quarter million dollars to put it in there in the first place?" (laughter) But we get our jollies where we can. As an engineer who was an advocate of lower tailwater levels to save on construction costs and to get more power out of our units, why, I couldn't have been more delighted that such a thing happened.

This takes me up to about 1964. I worked on a lot of stuff like that. ~~I have about twenty minutes. I'll go ahead.~~

Storey: Well, let me ask some questions, if that's all right.

Ruud: Yes. Sure.

Storey: When you were talking about working on the pipe formulary rights, and on the wye

branch paper that you wrote, it sounds like a very intellectual exercise where you just sat down at the table and you worked all this stuff out. Is that really what it is?

This Was Mathematical Research, Structural Research

Ruud: Yes. Actually, it's actually like mathematical research, structural research. You know, you have to derive the formulas, you have to check them. I had people who were rotation engineers who would come through working for me, and I'd have them work on certain specific problems to see how the method worked, if it all checked, if they could check and get the proper formula, did we leave out anything.

There are some technical terms called rib shortening and shear deflection. If you take an arch and you bend it, why, the centerline of the axis, of the arch, will shorten up a little bit. That's called rib shortening. Shear deflection, because of the shear forces, why, there's additional deflections as well as bending deflections. There are bending deflections, shear deflections, things like that. All of those factors have to be included in structural analysis.

Nowadays, why, we have computer programs that we simply plug the button in and push "enter" and the thing runs. But the man who wrote the formulas in the first place, who wrote the design of the program, has to include all of these factors, otherwise it's garbage in and garbage out. Those who are not sophisticated don't know that they have a wrong answer. They simply fly blind and put their trust in, "Well, it's in the computer, I guess it's okay." But those of us who were *inventing* these methods had to be fully aware of these.

Yeah, I would sit at a table literally and work for months on this sort of thing. You get up, you go to work, you work, you go to lunch, you converse with your friends, you go have a cup of coffee, but you sit down and it's the same tablet of paper and all you have is a pen and a pencil and a tablet of paper. They say, "Well, now produce us a new method of structural analysis for wye branches." And that's all you've got, plus your education, plus your night school work, plus, in addition to doing this all day, I was doing it at night, passing Statically Indeterminate Structures by a man named Chu Kai Wong, was one of the toughest instructors the University of Colorado ever had in their structural engineering department. I was taking courses from *him* at night, along with other courses in mathematics and calculus and whatever, to learn and sharpen up the tools. It's a very difficult task to form. I didn't do anything but go to school night and day for six years.

Storey: This man ~~Rause [unclear], was it--~~

~~Ruud: George Rause, yes.~~

~~Storey:~~ —who did the pipe book. His formulas weren't right.

Ruud: Some of them. Well, now this is not the same George Rouse pipe book. I'm not familiar. Oh, Roark.

Storey: Roark. Okay, Roark.

Ruud: George Rouse is another man that worked for the Bureau of Reclamation.

Storey: Okay, I'm sorry.

Ruud: Raymond Roark. Yeah, his formulas were in error. He published. I have second and third and fourth editions now of Roark, *Formulas for Stress and Strain*. I have followed this through my career of a lifetime, and checked more recent work of his against my checking of his original work.

Storey: But how do you know when *you're* right? That's what I'm confused about here.

Checking the Solutions to Problems

Ruud: Well, you have to be able to check it.

Storey: And, what does that involve?

Ruud: Well, first of all, in the ultimate, it involves field test. It's like the wye branches design, and you go out and you measure with gauges, electric strain gauges, you measure stresses with strain gauges, you measure deflections by putting a different reference system together to sort of survey how much the wye branch moves, to determine whether or not you're getting a reality check against your computations. I mean, take an airplane. If the damn thing doesn't fly, somebody's made a mistake someplace.

Storey: Where did you do that testing?

Ruud: Oh, there were others who did it for me. I did a lot of the testing on some of the pipes. I mean, people measured some of the pipe stressing. One of the big testing is they repaired the wye branch at Palisades and gave it the full pressure test and it held.

Runaway Generator at Palisades Powerplant

I can give you an anecdote of a different kind of job, that tells you how you test it. At the Palisades Dam we had some generators that had a particular winding in them called an amortisseur winding. Amortisseur, I think, is French for ~~a kill--~~to kill—mort—mort. But anyway, it was to kill the oscillations of the generator, torsional oscillations of the generator, and created electrical waves that are extraneous to the sixty cycle. These amortisseur windings had some connectors, physically. They were connected with heavy connectors. One day they had a runaway, a load rejection, the thing went to runaway, and threw these amortisseur windings loose and ruined the generator.

Well, now they had to rebuild the generator and the question was what kind of anchorage or what kind of connections are we going to put in there. "Well, send

this down to Fred Ruud and let him do the analysis of it." And I worked with the manufacturer and there were some meetings that determined whether or not we were going to really redo this, but those were administrative details. The amortisseur windings were rebuilt, and I had done the stress analysis to approve of the new amortisseur connectors, and they got them installed. Then [they] came up to the associate chief engineer, "Can we run the runaway test?"

At this time, the associate chief engineer was Mr. John Parmakian, my early boss. He says, "Who did the stress analysis on these? Who reviewed this?"

He says, "Well, Fred Ruud did the stress analysis on them. He says they're okay."

Parmakian says, "Run the runaway test." (laughter)

Storey: And we'll see.

Ruud: And we'll see if this guy knows what he's talking about. Well, they ran the runaway test. Nothing happened. Everything was just fine.

Ferber Schleif

Years later, why, they had another electrical engineer, named Ferber Schleif, who was a very interesting person you might want to also make sure you interview, if he's available. I'm not too sure he is. I haven't heard. It's the problem when you get to be seventy; your friends disappear. Ferber Schleif, S-C-H-L-E-I-F. But he's a tremendously talented electrical engineer. He was studying these electrical oscillations, and the question was, "Are these connections really necessary?" He went up and he measured this particular transient phenomenon, with electrical measurement instrumentation, and determined that the connections were not really necessary. They didn't really provide any benefit. So they removed those electrical connections from these generators. So the problem was physically removed, which always gives you a nice feeling, you know, that you don't live under jeopardy of so many things.

Earthquakes and the Intake Towers for Trinity Dam

Among other things, like earthquake analysis of the intake towers for Trinity Dam. It's in Northern California; it's in an earthquake-free zone. This is a big old concrete tower sits out in the middle of the reservoir.

Storey: Behind an earthen dam.

Ruud: Behind an earthen dam, but if they had an earthquake, why, the tower is submerged in water and what happens if the tower topples over when it's underwater, and this is the main outlet for the dam, you know.

END OF SIDE 2, TAPE 1. JANUARY 18, 1996.
BEGIN SIDE 1, TAPE 2. JANUARY 18, 1996.

Storey: This is tape two of an interview by Brit Storey with Frederick O. Ruud, on January 18, 1996.

Let's see, you were talking about the Trinity intake tower.

". . . I was building cathedrals for the entire time I was working for the Bureau of Reclamation. I had a *marvelous* job. . . ."

Ruud: Yeah. The intake towers for Trinity Dam. You work on so many of these very difficult problems for which there's no precedent, and, *to me*, that was tremendously motivating. I mean, I was building a cathedral, to go back to my original story, I was building cathedrals for the entire time I was working for the Bureau of Reclamation. I had a *marvelous* job. I was paid well to do a job I loved, and I had a lot of tremendously interesting work to do, and it became a lifetime love affair.

"If you want to achieve a certain level of success, you've got to be willing to pay the price . . ."

There are bad days. You know, like the guy says, you've got to move a lot of hay if you're going to ride the pony. But there's a lot of yeoman work that everyone has to do. You've got to do your own work. You've got to do engineering. You've got to get a degree. You've got to get qualified, otherwise you never get the chance. Technically and administratively and politically and managerially, it's called paying a price. If you want to achieve a certain level of success, you've got to be willing to pay the price, whatever that price might be. I know people that have paid the price of a ruined marriage, a ruined life, a ruined technical career, but they went to Washington, D.C., and became politically effective and active and politically successful in that environment. They were willing to pay the price. If you're going to become president of a corporation, you've got to be willing to pay the price. And if you're going to become technically qualified to do a lot of these other jobs and work on this kind of work, why, you have to pay the price. That price never ends, incidentally; there's always an aspect to it.

Storey: It sounds to me, though, as if your career in Reclamation was very different from the careers of, for instance, construction engineers and designing engineers. If I'm *hearing* this right, yours was sort of a theoretical engineering career.

Ruud: Well, you know, it could have been theoretical engineering, but like I said, if the plane doesn't fly, the theory isn't much good. If the penstock bursts, it's okay, I mean, you know, your theory isn't worth much.

Construction Engineers Have a Sense of Achievement

Construction engineers put into practice what other people design. They

have the tremendous sense of achievement of being able to build something that's tangible. They can look at what they built. They were the construction engineer for the Third Powerhouse at Grand Coulee. They were the construction engineer for an irrigation project. There's a lot of what we call power motivation that comes in this. "I have the power to order people to do these kinds of things. I have the contractor works for me." This kind of motivation.

Design Engineers Have a Different Motivation

A design engineer, he has a different motivation. He has the technical know-how to design a dam or to design an irrigation project.

Storey: A gate, for instance.

Ruud: Yeah, a gate. He knows all these things. So we all have different motivations—even political people. You can't do it unless the legislation's passed to authorize you to do it and the [money] ~~appropriations~~ is appropriated to authorize you to do it. These are higher motivations of people in other fields.

"My area I considered to be extremely exciting because it was the really important technical details that were crucial in making extremely important parts of the project viable. . . ."

My area I considered to be extremely exciting because it was the really important technical details that were crucial in making extremely important parts of the project viable. I was very, very proud to be able to do all these things. All of this sort of work, with the wye branches and the turbines, and I'm just about to come on to another aspect of my work, and I think what I would like to do is to defer that until we can have another session. But I worked on a lot of these things.

Work at Trinity Dam

Trinity Dam I worked on. In 1964, we went out to Trinity. We had vibration problems. That was my second, I think, field job, and in between, why, I had become—because of my work in the Army, I had all this hands-on ability with electronic equipment. I can make the radio play. I can make the recorders work, the amplifiers that measure the electrical signals from all the measurement instrumentation.

"I understood all the instrumentation . . . and knew how to . . . install them, so I'd get meaningful results that would prove what we're trying to demonstrate theoretically. . . ."

I understood all the instrumentation, stress analysis, strain gauges, pressure gauges, deflection gauges, all these kinds of things, and knew how to put them in and install them, so I'd get meaningful results that would prove what we're trying to demonstrate theoretically.

"The transition between theoretical work and practical work was not a problem for me in any way . . ."

The transition between theoretical work and practical work was not a problem for me in any way, because I was very familiar with both sides of it because of my farmboy background, my construction experience, construction inspection experience, and then my ~~almost~~ academic work.

"It was very, very close to academic work that we were doing, but it had a tremendous imperative to perform . . ."

It was very, very close to academic work that we were doing, but it had a tremendous imperative to perform, because what you had was a real problem that you were working on. If the earthquake design for the intake tower was not adequate, the damn thing was going to go down the first time they had a substantial earthquake.

"There wasn't a lot of help for you either, because there were no precedents to build on. . . . We had a lot of people who would come in and didn't like it. They would leave . . ."

There wasn't a lot of help for you either, because there were no precedents to build on. A lot of people would think that's terribly stressful, but I still take high blood pressure medicine, but it's not something that's not under control. We never got ulcers, we never hurt anybody. We had a lot of people who would come in and didn't like it. They would leave, and they would go back into some other field. Or they would go to work in the design section, instead of this group.

The designers have a fun thing, too. They design a lot of stuff that people put into effect. That's one of the problems I had. I worked in design. I worked in a staff function, analysis, as opposed to design. Not too many things that I actually put out that was ever built. Very few things that I designed that were built. There were a few little things. I actually signed a drawing once, but there are people who sign hundreds of thousands of drawings. Earth dams designers, penstock designers, all these people design a lot of that. That's also a very satisfying and tangible thing.

"But to me, the technical understanding and the career of being a resource person, if the construction man had a problem he couldn't solve, if the designer had a problem he couldn't solve, the technical analysis people were the court of last resort . . ."

But to me, the technical understanding and the career of being a resource person, if the construction man had a problem he couldn't solve, if the designer had a problem he couldn't solve, the technical analysis people were the court of last resort to come up with somehow a way to solve this problem.

Storey: But say when you were working on the pipe formula. Did you then go into the lab to do testing?

Ruud: Yeah, there were tests made. We built what we call plastic models in another part of our section, was a photo-elastic group, and they built plastic models and put strain gauges on these plastic models to check the stresses and deflections of the work that we had done to make sure, to verify, that we were correct.

Storey: So it was an intellectual as well as a testing process.

Consulting Job in Nebraska on a Wye Branch

Ruud: Yeah. Yeah. A few years ago, I had a consulting job, and they wanted me to come up and talk about a wye branch that they were building back in Nebraska. You always think about these things, and they can happen. They wrote into the specs that the method of stress analysis to be used on this wye branch shall be Monograph #32, as by Fred Ruud of the Bureau of Reclamation. They had to use my method to design this wye branch. So the consulting engineer got hold of me, said, "Can you come up and tell us how you do it?"

I said, "Okay."

"How much you going to charge?"

I said, "How about one day, you know, nominal one-day consulting fee, that's fine. I'm not greedy. I'll just show you how I do it, and then I'll let you do it. It's going to take more than one day to do it yourself, but all you've got to do is follow the leader." I walked him through this.

So I got a little letter back after a few months, and they said, "We have built that wye branch and we tested it and we found that the deflection—your computations had shown that the deflection would be one-quarter of an inch, it was actually only three-sixteenths of an inch." Now, this is a twenty-foot diameter pipe that had built up to 150 pounds per square inch internal pressure, so it stretches a little bit. But he said, "We found your analysis and your methods in your monograph to be eminently correct, and are pleased to report to you that we are extremely satisfied with the results."

Other people go back and if they use your monograph and they build one of them, and the pipe breaks, the steel, you know, it doesn't just decide to break. It could care less. Mother Nature is a jealous mistress. She will do a lot of things that you don't anticipate, and you'd better be aware of almost anything that she can do. So it's with those burdens that one, in this kind of analysis work, has to put up with.

I think the next time when I get started with you, I'll talk a little about—break right here, and then later on, why, we'll discuss—I went to Washington, D.C., on a managerial training program.

Storey: In '64?

Ruud: In '66.

Storey: Well, let me ask whether or not you're willing for researchers, both inside and outside Reclamation, to use the material on this tape and any resulting transcript.

Ruud: I think so. I mean, I'm very proud of my work in the non-failure of Grand Coulee feeder canal. There are other jobs that I worked on in analysis that might be a little sensitive, but we don't have any failures that I know of that are incipient. I hope that all the work that I've done was sufficiently checked, that we're not going to have anything blow up or fail or fall down.

"The Bureau of Reclamation is a organization of great eminence in the world. We're not terribly appreciated by modern people . . ."

The Bureau of Reclamation is a organization of great eminence in the world. We're not terribly appreciated by modern people who weren't born before 1950 and who can't appreciate that there was a time when people didn't have an environment that they could live in out in the desert. We had to earn a living. You had to grow your food and raise your animals and have some water to do this. We didn't build quarter-million dollar homes on the desert because we just had fresh air. Now, why, we've sort of changed the criteria for success, it seems. But a lot of this is the foundation of America, where we have food and we have places to go and lakes to swim in and all kinds of resources that are being used. And I'm very proud of the hydroelectric business, because hydroelectric is a renewable resource. As long as the wind blows and the rain falls, why, we don't have to worry about that.

Well, I'll see you later on.

Storey: Good. Thank you very much.

Ruud: Thank you.

END SIDE ONE, TAPE TWO. JANUARY 18, 1996.
BEGIN SIDE ONE, TAPE ONE. JANUARY 25, 1996.

Storey: This is Brit Allan Storey, Senior Historian of the Bureau of Reclamation, interviewing Frederick O. Ruud, on January 25, 1996, in Building 67, at the Denver Federal Center, at about nine o'clock in the morning. This is tape one.

Last time we were talking about your career in establishing hydraulic turbine-setting criteria in your work with the wye calculations.

Ruud: Wye branch connections, yes.

Storey: And that sort of thing. I think we'd gotten to about 1966 in your career.

Ruud: Yeah, approximately. Have I discussed Glen Canyon Dam?

Storey: No.

Engineering Monograph 32 on Wye Branches

Ruud: Here in 1963 and '64, I wrote *Engineering Monograph 32* on wye branches, as we talked about that, that it became sort of standard of the industry. I published another paper on hydraulic turbine-setting criteria which later on became the standard that's used by the industry which depends on what we call a plant cavitation factor where the majority of the turbines in a hydraulic turbine installation operating, rather than a single unit operating, which was the previous Bureau criteria, we looked upon our function in that Technical Engineering Analysis Section on the mechanical branch, and—

Storey: Oh—

Ruud: Go ahead. Are we on?

Storey: I'm on. You should be okay. Go ahead. This is why I have to keep checking the machine.

Ruud: Shall I go back?

Storey: No, you should be fine.

Ruud: Should have been fine?

Storey: Yeah, you were fine.

Ruud: Okay. That was what our function in these sort of research and analysis group was to try to look at things from an overall point of view with the largest goals in mind that you think of, and to provide standard operations or standard methods of operation to make it easy for the designers to do their work. That probably was our primary function, as well as troubleshooting of really special problems.

"Prediction and Control of Cooling Stresses in Concrete Block"

One of the problems that occurred in the area that we were working on was a rather large project that used a different kind of concrete and used different kinds of concrete blocks, a little bit longer and a little bit thicker for cooling, than had previously been used. Because of the difference in concrete, why, we had to revise the cooling procedures, because we had some problems with some of the blocks in cooling them, and as a result, I wrote a paper called "Prediction and Control of Cooling Stresses in Concrete Block," to yield to the English major that was editing my paper. "The plural of deer is deer, the plural of block, or a number of block, are block," said he. But anyway, it was published in the *American Concrete Institute Proceedings* in 1965.

Storey: Can you describe the problem?

Ruud: Well, the essential technical problem was that when they cool the concrete blocks,

why, they have to be cooled gently. You can't cool one single layer without cooling the adjacent layers somewhat.

The old chemistry students will tell you, if you heat a glass rod and dip it in a beaker of water, it'll fracture right at the boundary of the water and the air, because it cools too quickly and the discontinuity stresses where that temperature change is too abrupt. So when we adopted new cooling procedures, we cooled the entire columns and the entire layers more uniformly, so there would not be abrupt temperature discontinuities that would cause excessive tensile stresses in these concrete blocks.

One must understand that an arch dam consists of a series of cantilevers that are really free-standing columns—not totally free-standing, because actually they're held by the adjacent columns. But when you go to establish the arches in a concrete arch dam, you have to pump concrete in between the columns, and when you do this, you cool these columns and then you grout the concrete into the gaps between the columns. When the columns warm back up, they [build] ~~double~~ up compressive stresses and that makes a monolithic arch that supports the force of the water. So it's a very delicate arch, while it may seem that it's very crude, it's only because of the scale of things that it seems that way. Actually, it's a rather scientific procedure. Of course, when they changed the concrete mixes, now they have to do this and review this entire process. But that was a major leap forward in determining that temperature discontinuities are very important in the cooling of these cantilevers. So that was my contribution to that.

Storey: Did you mention when that article was published?

Ruud: 1965.

Storey: The one on hydraulic turbine-setting criteria, why was it important to move from having only one unit operating to having more than one unit operating?

Why Turbine Setting Criteria Are Important

Ruud: Well, for example, if you set a dam like Grand Coulee with the same criteria for only one unit, one hydraulic turbine at Grand Coulee in operation, the tailwater level would be abnormally low, and it would require a lot of extra excavation to lower the turbine in the river bed or at the dam, to set the dam lower with respect to the river bed, to ensure the unit centerline would be down at a sufficiently low elevation to prevent excessive cavitation damage.

This is rather unrealistic when you have, say at Grand Coulee you had eighteen original units planned at Grand Coulee. Now, that wasn't *exactly* the case at Grand Coulee, because there was some tempering of that criteria, but that *was* the formal criteria that was used.

Concern about a Weir below Glen Canyon Dam

The point came up during the design of Glen Canyon Dam, and shortly after the design of Glen Canyon Dam where there was a weir involved in the dam. The request came in that they were afraid that the degradation of the water tail level at Glen Canyon Dam would lower the river level to the point where there would be a falls over the downstream weir, which was immediately below the bridge. Visitors would stop on the bridge and look down and see this waterfall and worry about the wasted energy. So the question became, was their weir really necessary, and why did we have it. Well, it was said that the weir was necessary because it had to ensure the tailwater that was guaranteed in the purchase contract and if not, if we had cavitation damage, the turbine manufacturer would no longer be responsible, because we had not provided the guaranteed tailwater level.

Study of Turbine Setting Criteria

So in turn, the next question became, is this tailwater level really required. So I undertook a major study of the things that happened during the periods of the Bureau's history, going a long way back to the beginning of all of the turbines we'd had, and we'd had troubles with, and it turned out that on really studying these, that there were a number of hydraulic turbines that really had had major damage, that were not a part of this criteria.

For example, one unit in Wyoming where we'd had major cavitation damage had been set ten feet too low because of an error by the surveyors in establishing the benchmarks for construction of the powerhouse. They made a ten-foot error. So the units were set to ten foot too low, and that raised a flag.

So due consideration of *all* of the units that we'd had and where we'd had cavitation damage to the water wheels, and what measures had been taken, it was decided that certainly there was some room for improving the criteria by which we set the centerlines. Now, this involved a lot of money, because you have to do a lot of excavation to set the powerhouse down into the rock, and it's expensive excavation to take rock out, to replace it with concrete and hydraulic turbines. So it became quite an undertaking.

"There's always a conflict of interest between those who want to change and those who do not want to change. . . ."

I must add that because of various interests within the organization, there were those that certainly did not want to see the criteria change, and those who *did* want to see the criteria change. This was just a typical point that we got involved in in Technical Engineering Analysis. There's always a conflict of interest between those who want to change and those who do not want to change. So our way was always to use all of the engineering tools we could possibly find.

"When I first came to the Bureau of Reclamation . . . I was told once that, 'It doesn't pay to be too smart around here,' and when I finally ended up my career, I had over 200 hours of credit *far* beyond any master's or doctoral level of education, and I still wasn't smart enough to answer all their questions. . . ."

I must observe on a personal point of view. When I first came to the Bureau of Reclamation, being a bright young guy who kept asking a lot of foolish questions, I was told once that, "It doesn't pay to be too smart around here," and when I finally ended up my career, I had over 200 hours of credit, *far* beyond any master's or doctoral level of education, and I still wasn't smart enough to answer all their questions. (laughter) So it's a problem. That's what a research man is up against. He always doesn't know enough. He has a limited understanding of everything. That's why we have a job, because nobody knows all the answers.

Storey: Tell me where this office was located. Was it in the lab?

Ruud: We were in Building 53, which is like Building 56. We were over in Building 53 in the old ammunition factories.

Storey: But organizationally, I mean.

Organization in Denver When He Came to Work in 1952

Ruud: I first came to work in 1952 as part of the Special Assignments Sections in Dams Branch. That was headed by a man named Warren Simons, who was the Bureau of Reclamation's traditional grouting expert, had been with the Bureau many, many years. I worked with a lot of supervisors that had come to work in the thirties, and had gone through World War II and come back and had their jobs. These were people who had done marvelous things. ~~During this time,~~

". . . it seemed about every two years we'd have some kind of reduction in force and reorganization. . . ."

During the time we were working in that organization, one of many reorganizations that happened, it seemed about every two years we'd have some kind of reduction in force and reorganization.

Reorganization Soon after Arrival in Denver

At one time I had just come to work for the organization and they had a reduction in force, and one-half of our section got laid off—separated. I had only been in the group about two weeks. They said, "What about Ruud? He's only been here a little while." Well, he's a veteran. I was counseled to know that because you have been exposed to the possibility of being in combat as a veteran, you're at least endowed with all of the veterans' preference rights that every other veteran is endowed with, and I should not feel ashamed of the fact that I'd only been there two weeks and was retained, where some older people of non-veteran status were let go.

"The Bureau of Reclamation's always seemed to be a political football, and a lot of times when all of the shouting was done, why, there was a lot more shouting than there was action. There was not too much change, but it was always very upsetting . . ."

There's always a very big problem. The Bureau of Reclamation's always seemed to be a political football, and a lot of times when all of the shouting was done, why, there was a lot more shouting than there was action. There was not too much change, but it was always very upsetting, and it still is. Note the 1996 government shutdown from a political basis, just a struggle for power. It has nothing to do with what the government's trying to do, there's just struggle for power, as evidenced by appropriations, but as to who's going to be running the government. It's always been thus, probably always will.

". . . there was always a political overlay. . . ."

It seems like even though we were involved in a lot of highly technical *work*, there was always a political overlay.

Reclamation Has a Great Deal of Bipartisan Support

I must observe that the Bureau of Reclamation is one of those agencies that was founded by Republican administrations back in the early years of 1903, 1906, and have enjoyed, and apparently still does, a great deal of bipartisan support, even though we're the builders of Hoover or Grand Coulee, Shasta, Central Valley irrigation Project, Missouri River Irrigation Project, Columbia Basin irrigation Project.

". . . we're one of the few agencies that pays its way . . . irrigation is repaid without interest, and power revenues are repaid *with* interest. . . ."

All of those things were done with bipartisan support, because we're one of the few agencies that pays its way, with the exception of what we call non-reimbursable funds for fish and wildlife, other flood control, but irrigation is repaid without interest, and power revenues are repaid *with* interest. I believe those criteria still stand. I could be corrected, but I feel that that's one of the reasons why we always enjoyed a lot of bipartisan support.

". . . very conscious of the need to, certainly, engineer these large structures and their facilities with plenty of reserve factors of safety . . ."

We always worked with that very much in our consciousness. We realized that a lot of things we did had vital effect on some of the structures we were building. Teton Dam notwithstanding, a lot of failures were prevented by people like ourselves who were very, very astute and very, very conscious of the need to, certainly, engineer these large structures and their facilities with plenty of reserve factors of safety, so that when earthquakes happened, something goes wrong, they cheat a little on whether some contractor does this or that, why a structure will not fail.

Contractors and Enforcement of Specifications

We always got a lot of criticism from inspectors, from the contractor, from

the contractors' foremen, and from the contractors themselves. They would say, "When we bid on these jobs, we didn't *expect* that we'd have to do this."

We said, "Well, it was in the specifications."

"This is what we bid."

"[What] you bid on is the way it said in the specifications and all we're doing is enforcing what is in the Bureau of Reclamation's specifications, and you *will* build it that way."

So they always had people following you around and writing up extras. Every day they put in extra work requests to be paid, because they didn't consider that they had to do this, which a lot of times they didn't have to if they were working some other job. But the Bureau of Reclamation established a standard of performance that I think is evident in our structures and the performance of our power facilities and our irrigation facilities right now. I'm happy and very proud to say that I was a part *of* the establishment of some of those standards and enforcement of some of those standards.

I can wax at length with lots of war stories, because I've worked in a position where it was extremely sensitive, and I knew a lot about where the bodies were buried. But we did this.

During 1967 Participated in the Management Training Program

I worked in those areas until 1964. I wrote these papers and had some interesting experiences with vibrating turbines and that sort of thing, but because of my interest in what the organizational management people call superordinate goals, things that are bigger than all of us, and my constant activity in this regard where there were rather sensitive things going on, I was chosen to go back to Washington, D.C., in what they call the management training program for the Department of the Interior. So I went back there for a six-months' training program in January of 1967 through June of 1967.

During that time, I got acquainted with a lot of people in the Bureau of Reclamation Washington office, the Department of the Interior, Office of Water and Power, and had a chance to work on a number of projects for those people. Two of the people that I became acquainted with were Morgan Dubrow, who was Engineering Advisor for Assistant Secretary Holum, [Assistant] Secretary for Land and Water, and a man named Karl Lee, who was advisor to [Assistant] Secretary ~~Udall~~ [Holum], who worked for Secretary [Udall] ~~Holum~~ in the water area. Mr. Dubrow was his advisor for power, and Mr. Lee was his advisor for water. Working for these two people, I became intimately acquainted and a part of the effort to build the Third Powerplant at Grand Coulee.

Prepares Speech Idea Ultimately Used by the President on the Malthusian Theory of Population as Related to Water

With Mr. Lee, I became a speech writer. These stories are usually told back there, but we had to a lot of times—many times we would have a request from others outside the department to provide background material. So one day they called us into a little office, a private conference room back behind [Assistant] Secretary Holum's office. "We want to get a speech for the President of the United States on water."

I said, "Well, I've got an idea that I've been talking about a long time, thinking about, and it goes a little bit like this. We have a Malthusian Theory of Population that says population will be limited by war, pestilence, and starvation." A man named Thomas Malthus, an English philosopher, invented this thing or espoused his theory. I said, "You know, water is an essential part of this. People need to drink water to survive, they need to have water to grow crops, they need water to run their powerplants, and so water becomes a crucial good from an economic point of view, and I would like to see something done to prepare some work for the use of water as it applies to Malthusian Theory of Population."

My advisor said, "Well, you write it up in one page and give it to me and we'll see if we couldn't use it."

President's Speech at Summersville, West Virginia

Well, after I left this program, one day I came home, and lo and behold, the President of the United States gave a speech in Summersville, West Virginia, on the use of water and its international implications as regards the Malthusian Theory of Population, that people will *fight* for water if it's denied. Now we see these problems right now in the Middle East, in, of course, the Nile, between Egypt and Sudan, and the Euphrates River that originates in Turkey and goes into Iraq. We in the United States don't have many international rivers, but we have the Rio Grande [and the Columbia Rivers]. We have the ~~St. Lawrence Seaway River,~~ St. Lawrence River between us and Canada back east. These things have to be considered when you're having joint international negotiations for water. So it's with the idea of superordinate goals that I was always concerned about in this kind of thing.

Worked on Large Generating Units at Grand Coulee's Third Powerhouse

Among these things that I worked on back during that [time at the] department was the idea of using large units at Grand Coulee. I did a great deal of work during the six months that I was back there, and was always available to these two gentlemen when questions of the feasibility of using large units was discussed at Grand Coulee. One might consider some of these superordinate goals. Grand Coulee site was rather critical in the fact that we had the river that was available to run such units, there was a lot of work that had to be done because of large fluctuations in the flow, but it was a marvelous site.

Worked on Moving Hydropower from Baseload to Peak Load

Secondly, the move to using hydropower, move hydropower from base load to peaking load, coal plants run more efficiently when they operate a baseload, whereas hydropower projects are always available on a very few minutes', few seconds' notice, to provide a nearly full load for peaking. So hydro has a great deal of flexibility over coal in that regard. So that was a goal.

Senators Jackson and Magnuson of the State of Washington Wanted the Largest Possible Units in the Third Powerhouse

A third thing was a political consideration. Chief of the Senate Interior and Insular Affairs Committee was Senator Henry M. Jackson from the state of Washington, and the chief of the Appropriations Committee was Senator Warren Magnuson from the state of Washington. Both of those gentlemen were *adamantly* in favor of putting the largest units into Grand Coulee that could possibly be installed there, and much to their credit and the credit of Secretary Udall and a lot of people [who] advised them, but that decision was made to install 600 megawatts [units] at Grand Coulee, and I had a small part in it.

The head of the Hydraulic Machinery Branch eventually received the Department of Interior Gold Medal for Distinguished Service for his part in putting in those units. I thought that was a marvelous thing for Mr. Carlos Bates. He was a *fine* engineer. And while it may be difficult to get these things done, he did get that achieved.

Storey: But I understood that Barney Bellport *opposed* large units.

Ruud: Well, Barney Bellport wasn't the only one. Mr. Bates opposed them.

Storey: The man who got the gold medal? Is that what I'm hearing?

Ruud: Well, I think that to diplomatically say this, the people worked very hard to put these ideas into effect, and they really deserved a lot of credit for getting it done. I mean, the bride may be dragged screaming to the altar, but she probably provided a good home for most everyone. I think the Bureau of Reclamation achieved some very great goals when they put in the large units at Grand Coulee.

Worked on Installation of the 600 and 700 Megawatt Units at Grand Coulee's Third Powerhouse

I must add that a subsequent commissioner and a subsequent secretary and a subsequent chief engineer, I believe, ultimately put in 700-megawatt units for the second three of the six units at the Third Powerplant at Grand Coulee. I had a very large part in those. I was up there. I worked on the design of the penstocks, and I worked on the testing of the penstocks. I worked on the approval. I had not the final approval, but certainly the analysis of the spiral cases for these, through my papers and work on stress analysis of hydraulic turbine parts. I had a large part in the analysis of the turbine parts for those 600 megawatt units, and actually participated in field tests during the installation, and I was in the mechanical

instrumentation for the measurement of the testing on the start-up of the first 600-megawatt unit at Grand Coulee. That was a major achievement for the Bureau of Reclamation. It went very, very well, as a matter of fact.

Operation of the ". . . Grand Coulee installation has been changed so that the large units provide the baseload, and the greater number of much smaller and far more flexible units [in the Left Powerhouse and Right Powerhouse] provide peaking power. . . ."

I must add that *now*, while the Third Powerplant was originally installed as a peaking plant, its operational characteristics were really not amenable to peaking operation, and that subsequent to the installation, the operation of the entire Grand Coulee installation has been changed so that the large units provide the baseload, and the greater number of much smaller and far more flexible units provide peaking power.

Storey: That's powerhouses one and two?

Ruud: Well, yeah, powerhouses one and two. The first eighteen units, we called them the Left Powerhouse, the Right Powerhouse, and the Third Powerhouse. Now they call them G-1 through G-24, generator number one through generator twenty-four. But generators one through eighteen provide the peaking power, and nineteen through, I believe it's twenty-four—nineteen, twenty, twenty-one, twenty-two, twenty-three, twenty-four. Yeah, nineteen through twenty-four provide baseload.

I used to say that there are smaller troubles that we have had in the past that we have overlooked, that we have never known we had, that would give us major troubles on the big units because of the size of this. There were many little details that occurred that were just a part of the mundane, ordinary, everyday engineering that we all encounter when we're trying to put something new to work. It was a very interesting project.

This whole process took from 1966, it was approved in '68, the start-up occurred in '76, and possibly the last unit was put in in the Third Powerhouse probably about 1984 or '85. I don't remember. I was not involved in it at that time.

Dos Amigos Pumping Plant Variable-pitch Units

During this time, right after I came back from Washington, D.C., I became involved in another project in central California. That was called the Dos Amigos Pumping Plant. It was part of the Central Valley Project, part of the California Aqueduct. Dos Amigos consisted of three variable-pitch units and three fixed-blade pumps. They had a great deal of trouble with the variable-pitch units. It was a extremely interesting problem. Ordinarily they start the pump up and they let it run back. They tried to get it started, but they filled the pump discharge line with water—

END OF SIDE 1, TAPE 1. JANUARY 25, 1996.
BEGIN SIDE 2, TAPE 1. JANUARY 25, 1996.

Storey: You had started to talk about Dos Amigos pumping plant.

Ruud: Yes. On the initial start-up of the first variable-pitch unit, they filled up the discharge line and then cut the power and let the unit coast backwards. The shaft came to a standstill and started to vibrate and then it kept right on vibrating, stand there and chatter and not rotate in a reverse direction as was normal. Of course, this was a major, major problem. There was a lot of wailing and gnashing of teeth.

Storey: Why was it a problem?

Ruud: Well, ultimately I was sent out to start testing the unit. Clair Crawford and I, my supervisor and I, ultimately, after others had tried for a couple of months, we were sent out to do some instrumentation work and see if we couldn't figure out what was wrong. Ultimately, we provided a solution to the vibration problem. That was one of our specialties in testing of these pumps and turbines. If there were operation, vibration problems, we tried to test them and tried to find out what was wrong and correct these matters. I wrote a paper on that, "Vibration of the Deriaz Pumps at the Dos Amigos Pumping Plant,"[11] and actually it took 'til 1976 to get a final resolution. It started in 1967, and it took something like six or seven years, with all the bureaucratic wrangling about what's a proper solution and shouldn't we do this and shouldn't we do that. There was also a lot of inter-organizational problem because the state of California had a 50 percent interest in the Dos Amigos pumping plant. In other words, they were providing 50 percent of the money, but the Bureau did all the work as the design. But they had a lot of administrative input. They wanted to be involved in all the testing, what have you. So we had quite a bit of exchange of information with the state of California, and I guess I waited to write the paper, to make sure the resolution of the problem had been achieved and that everybody was happy.

Storey: When did you write it and where?

Ruud: Well, it was '76, for the American Society of Mechanical Engineers.

But the thing that happened, the turbines, the pumps, the pump impellers, because they were variable pitch and they were designed quite differently than the ordinary pump, it had twice the overhang and twice the weight, which made it very susceptible to what we call a whirling phenomenon, and the pump would just whirl inside the bearing clearances and inside the shaft clearances, and it would actually roll inside the clearances. That's why it would not go into a reverse rotation, because it was rolling inside the seal clearances.

11. Frederick O. Ruud, "Vibration of Deriaz Pumps at Dos Amigos Pumping Plant," *Transactions of the American Society of Mechanical Engineers, Journal of Fluids Engineering*, Vol. 98, Series 1, No. 4, December 1976, pp. 674-80.

The solution to the problem ultimately boiled down to something very simple, and that is that we would simply use compressed air to blow the water off the top of the head cover and remove the source of the energy for vibration. I must say that it took three or four years to get acceptance of such a simple solution. Everybody likes to pin the tail on the manufacturer and cause them to do this, but the question becomes how much money are you willing to cost them. To paraphrase Barney Bellport, "We are not in the business of breaking our manufacturers. We're not in the business to bankrupt our contractors. We're in the business to build projects and get them to run, and we're going to provide as much help and assistance as the Bureau possibly can, to assist the contractor in doing *his* job and for us to assist each other in making these projects run. This is not a process by which we promote and keep these problems going forever. We have a high need for achievement to get it done and get out, and get an acceptable solution that operates." That's an overriding philosophy that you'll find throughout the engineers in the Bureau of Reclamation. They are very much achievement oriented.

Went to Professional Meeting in Leningrad

That was one of the more extremely interesting projects that I worked on. I did write another paper of a technical nature later on about the initial operation of the 600-megawatt units at the Grand Coulee Third Powerplant. That was presented at the Eighth International Association for Hydraulic Research Symposium on Hydraulic Machinery in Leningrad, U.S.S.R., 1976.[12] One of the things you could do, you could get a trip overseas to these meetings if you'd write a paper, so those of us that were entrepreneurial decided, "Well, if I want to go to Russia, I'll write a paper, and then I can go to Russia." So I got a chance to go over there and visit Leningrad. That's the only time I was ever in Russia.

Attended Professional Meeting in Tokyo

I wrote another paper one time about *Vibration Criteria for Hydroelectric Units*[13] for Tokyo, and I went there in 1972, and sent a follow-up. I went there in '72 on a proposed vibration criteria paper, and then I, eight years later, wrote what I considered to be a final paper on the criteria.[14] I didn't make that meeting to attend it, but I sort of declined to go. I said I had been to Tokyo, and I really wasn't interested in spending a lot of the government's money just to go over there and present the paper this time, because I'd already written that paper.

12. Frederick O. Ruud, "Initial Operation of 600 mW Turbines at Grand Coulee Third Powerplant," *8th International Association on Hydraulic Engineering and Research Symposium on Hydraulic Machinery*, Leningrad, U.S.S.R., 1976.
13. Frederic O. Ruud, "Proposed Vibration Criteria for Transient Operation of Hydroelectric Units," *The Second International Japanese Society of Mechanical Engineers Symposium on Fluid Machinery and Fluidics*, Tokyo, September 1972.
14. Frederick O. Ruud, "Vibration Criteria for Transient Operation of Hydroelectric Units," 10th *International Association on Hydraulic Engineering and Research Symposium on Hydraulic Machinery*, Tokyo, 1980.

Later on I wrote another paper, in 1991, for American Society of Civil Engineers. It was for a meeting called the *Proceedings of the International Conference on Hydropower*, in 1991, here in Denver. Colloquially we called it "Water Power '91." It's held on odd-numbered years. The title of that paper was *The Vibration of Penstocks in Hydroelectric Installations*.[15] It was largely based on some original work that had been done by John Parmakian, and a paper that he wrote concerning the vibration of the Grand Coulee penstocks, but it was a follow-up, because there had been a lot of development work, and a lot of practice in putting on these stiffener rings, and especially at places like Grand Coulee where you have very large pipes that the pumps pump into and the pipes are exposed that causes the pipe to vibrate, the metal will fatigue, you know, you get some cracks sometimes.

Havasu Pumping Plant Work

We had used this in many other places, and a job came up that I was working on as a consulting engineering. As a matter of fact, it turned out to be a Bureau project called—the name escapes me. Things happen with your memory. Pumps for the Central—Havasu. Havasu Pumping Plant[16] pumps water out of the Colorado River for the [Central] Arizona [Project] aqueduct.[17] It's the first pumps, a very high head, very high speed unit, and the purpose of the investigation, of course, was a tremendous noise problem they were having. It turned out that the units had been designed by the Bureau and worked with along by the manufacturer, but the shaft diameter had been specified by another fellow who had worked with me, so that there was not a vibration problem with the particular pumps, but they generated a lot of noise, like a siren in water. That had to do with the number of blades and the number of fixed vanes in the pumps. That's a problem that had been bothering me for many years, and I'd been working on it. I had never arrived at a resolution. So I studied this problem of the Bureau pumps, and this is as a consultant for the water district. It was [as] a consultant for the Central Arizona Water District.[18]

Storey: This was after you retired?

Ruud: It was after I retired. I came up with a general theory for the number of blades and the number of vanes, and the frequencies by which these would vibrate. So this paper involved the publication of that theory, and its practice, and then also a formal publication of some work that I had done to provide some simple charts to determine penstock vibration frequencies. So I combined those two to make a pretty good little paper. As a result, that's the last of my publications, ~~was~~ in 1991.

15. Frederick O. Ruud, "Vibration of Penstocks in Hydroelectric Installations," *Proceedings of the International Conference on Hydropower*, American Society of Civil Engineers, Denver, 1991, pp. 2214-23.
16. Now known as the Mark Wilmer Pumping Plant.
17. The Central Arizona Project Aqueduct has now been named in three reaches starting at the Mark Wilmer Pumping Plant—the Hayden-Rhodes Aqueduct, the Fannin-McFarland Aqueduct, and the Tucson Aqueduct.
18. Central Arizona Water Conservation District (CAWCD), now known as the Central Arizona Project.

That was ten years after I retired.

I think the Grand Coulee Third Powerplant was probably one of the peak things I'd worked on. I was very proud of that. I became section head following that, and about the same time as I became section head—

Becomes Head of Technical Engineering Analysis Section in 1976

Storey: Section head for—

Ruud: In the Technical Engineering Analysis Section. By now this whole section as a unit had been assigned to Mechanical Branch in 1976 or so. About 1972- or '3 or '4, we got reorganized again in yet another reorganization. The man who was section head, named George Johnson, retired in 1976, and I applied and got the job. So I then became section head for the last four years of my career.

"I worked at some length on the possibility of putting in additional units at Hoover Dam, but even as of today, that has not been done. . . ."

About this time, we began to see that we were not going to build Bridge Canyon Dam, we were not going to build Marble Canyon Dam, and that the conversion of the Bureau of Reclamation hydroelectric installations to peaking power would not necessarily provide additional units or larger installations. There were some instances where this could be done. I worked at some length on the possibility of putting in additional units at Hoover Dam, but even as of today, that has not been done. There's been a lot of effort to put in hydroelectric power at existing Bureau of Reclamation installations, and I even wrote a paper on that at one time,[19] and we did this.

Reclamation Moves into Experimental Wind Power Installation

But along about 1976, we began to wonder what the future of the Bureau might involve. Reclamation is a marvelous word. People say, "Well, what do you reclaim?" Originally we started out to reclaim the desert by planning irrigation projects to establish homes for people in the West. That was the initial goal of the Bureau of Reclamation, and it's so stated. It's on that initial authorizing legislation that most of the Bureau was founded. In order to come up with a new way of trying to have an organization, an engineering organization to do this, we decided that perhaps we should reclaim renewable resources, and what are renewable resources other than timber? So how about wind power? That's a renewable resource. And solar, that's a renewable resource, at least within the foreseeable future for a couple of billion years, they tell me.

19. Frederic O. Ruud, "Pump Storage Potential at Existing Hydroelectric Sites of the Bureau of Reclamation," *National Engineering Foundation Symposium*, Rindge, New Hampshire, 1974.

"Wind power . . . [is] highly intermittent and not particularly reliable. But coupled with the water power installation, why it becomes a very nearly ideal marriage . . ."

So we started in 1976 to establish some experimental wind power installations. Wind power has a peculiar characteristic, in that it's highly intermittent and not particularly reliable. But coupled with the water power installation, why it becomes a very nearly ideal marriage, because the water power installations can make up for the time, but provide power on very few seconds' notice during the time the wind power is not being utilized. Contrary, the wind power can be used whenever it is available, and we can shut down our water power facilities. This was the grand goal, to provide a marriage between wind power and water power.

In 1983 We Had Two Operational Wind Turbines at Medicine Bow, Wyoming

So with that, a young man that I had hired to come to work for me, named Stan Hightower, he and I started out from just two people beside the desk in 1976, to having $14 million, and seven years later we had two fully operational wind turbines going up at Medicine Bow, Wyoming. One was a Boeing unit, possibly two megawatts, and one was a Hamilton Standard unit of approximately four and a half megawatts. Later on, because of changes, once again, in political philosophy and some engineering problems, these units, one was abandoned and taken down, and the other one was sold for surplus.

Thrust Bearings on the Wind Turbines

There's a couple of interesting stories about that. One would think that—in our thrust bearings for our hydro units, we always designed these—the design of thrust bearings for hydro units is legendary. They were designed for very long life, and we have *major* thrust bearings in our *major* units that have been running for forty and fifty years, without *any* damage or rehabilitation. They run forever. On occasion, accidents would happen, but generally a Kingsbury thrust bearing runs nearly forever.

Storey: Kingsbury?

Ruud: Kingsbury, K-I-N-G-S-B-U-R-Y. It's the name of a company.

Storey: That's a brand name.

Ruud: It's a brand name. The man patented it. Now there are two kinds of these major thrust bearings. One of them we call the Kingsbury type, which was solid, and another one was a General Electric type. General Electric Company invented a new type. They put it on a bed of springs so that the springs would adjust so that the shoes underneath the big collar would adjust for the rotation of the [thrust] ~~major~~ collar over the load-carrying part. But they both are pretty good bearings and they run quite well.

Now, the problem became with the Boeing unit in that the major thrust bearing for the propeller was a bearing that had only been designed for a year's usable life. Would you believe that it ran not much more than a year and the bearing went out. Now, there are some extenuating factors involved here, but all of the sudden we discovered that it would cost $2 million to lower the propeller to the ground, take the weight off the shaft, then replace the bearing and put the propeller back on so we could use the unit. It was not economically feasible to do this. That was the determination of the Bureau of Reclamation under the [Ronald] Reagan administration.

Reclamation Decided to Scrap the Boeing Wind Turbine When the Thrust Bearing Failed

As a matter of fact, others, namely NASA, NASA being the National Aeronautics and Space Administration who had provided some technical support to us in the wind turbine area, NASA and the manufacturer had proposed to pick up 80 percent, and all it would have cost the Bureau is $200,000 to replace the bearing. The Bureau declined to provide the $200,000 to replace the bearing, so they cut it down one day with a cutting torch and sold it for scrap.

The Hamilton Standard Wind Turbine Was Damaged by a Loose Bolt and Was Sold to a Person Who Rehabilitated it

The Hamilton Standard unit had a typical problem. One day somebody left a loose bolt laying somewhere that got into the windings and destroyed some of the electrical connections, or the windings inside the generator. This had happened, in my knowledge, several times. I can't give you a number, but I know it had happened a number of times in my experience inside the Bureau with hydro units. We used to have to go over them with a fine-tooth comb by hand over every square inch of the surface in the generator, to make sure nobody had left a tool behind, or a screwdriver, or a bolt, or a nut, or any piece of metal, or *anything* that could damage the winding when the unit started to rotate. Well, it happened with a wind turbine.

After a couple of years just sitting there and not being repaired, they finally decided to sell it for surplus. Well, a man working up there who'd worked on these all his life took his entire retirement and bid on the wind turbine and got it. Then he spent the next four or five years repairing these windings, because he was an electrical inspector and knew how to repair these windings. He finally got the windings repaired, and got a power contract, and put the unit in operation, and now I understand he's making money with this unit in operation.

". . . the wind farm . . . *did* show that it was quite feasible and very successful to integrate the production of wind energy with a hydroelectric system . . ."

That is about the last of the projects I worked on, but the wind farm did provide the experience that *did* show that it was quite feasible and very successful to integrate the production of wind energy with a hydroelectric system, and as far as those of us who were involved in the engineering is concerned, why, this was a

resounding success from a program point of view. The fact that politically we're in favor of private power versus public power, an ancient argument at the moment, does not detract from the fact that ultimately we'll probably rely on wind and solar power after the coal is gone.

". . . I'm very happy to have said for *Who's Who in Engineering* that I was involved in the planning, design, construction, and operation of the largest wind turbines and the largest hydraulic turbines in the world. . . ."

They say we have 1,000 years of coal left. Well, my friends, 1,000 years may go by before any of us will know it. In fact, we won't know it, but one day there will be no coal left to burn. Then what are we going to do? There will be no natural gas, and there will be no oil left to burn. They say, "Well, we have 200 years of oil in the United States." Well, 200 years, my great-great-grandchildren may see 200 years. Ultimately we're going to be back to wind and solar and water power, and I'm very happy to have said for *Who's Who in Engineering* that I was involved in the planning, design, construction, and operation of the largest wind turbines and the largest hydraulic turbines in the world.

Storey: Did we do anything with solar power?

Work with Solar Power

Ruud: Oh, yes. Yeah, Mr. Hightower and Mr. Harry Reemers put in some solar power installations and what they call solar *pond* installations. We have followed that rather closely, at least during the last several years I was with the Bureau, from about 1978 to about 1980. And afterward, these two gentlemen, Hightower and Reemers, they followed the installation of solar projects by the Bureau of Reclamation as demonstration projects, to show that solar power could be used in sufficient quantities to pump water for irrigation projects, and that it was feasible to do this.

When the Cheap Coal Is Gone We Will Have to Rely on Hydropower, Solar, and Wind Power

Now, beyond that, we have another problem. There has been so much coal development in the United States, and especially the western United States, that for the last fifteen to twenty years we have had a *glut* of cheap energy available, so that from an economic point of view, wind and solar energy installations are *not* particularly feasible, except in extremely special conditions. But ultimately, when all the cheap coal is gone, this nation *will* rely on its water power, and its solar, and its wind power, and, at that time, perhaps nuclear energy will be available, but there are other ways that that might be handled.

"One of the new ideas . . . is that there are . . . many very large rivers in the world in areas where there is no apparent or present need for hydroelectric power. One of the ideas . . . suggested is that . . . projects be built and . . . used to generate hydrogen from water and to liquify the hydrogen and to ship the hydrogen to . . . this country, perhaps,

and to use it as fuel for automobiles, aircraft. It's about the same as liquid propane . . ."

One of the new ideas that's been talked around, and talk about superordinate goals, is that there are very, very many very large rivers in the world in areas where there is no apparent or present need for hydroelectric power. One of the ideas that has been suggested is that these projects be built and that those energies be used to generate hydrogen from water and to liquify the hydrogen and to ship the hydrogen to a market, namely this country, perhaps, and to use it as fuel for automobiles, aircraft. It's about the same as liquid propane, and could be used in almost any installation where liquid propane is being used. This would be a way to use totally renewable resources for those kinds of installations. Of course, if you travel to Europe, you find electric trains used rather widely, electric cars are being talked about for development. If we can charge the batteries with hydroelectric power, maybe we could find a market.

But I think that ultimately these kind of goals for an organization that one devotes one's life to are very satisfying to see some of these things be placed into operation. I worked with the Bureau for thirty-four years. I've known of the Bureau from the time I was twelve to the present time, about sixty years. That's well over half the life of the Bureau of Reclamation so far, from, say, 1934 to 1994, and you take thirty years off that, that's two-thirds of the life of the Bureau of Reclamation.

So I've gone from the days when my father would put the car up on blocks when it snowed, and we'd ride around on bobsled and horses, to the point where we now commute around the world on jet planes. I barely missed, one time, a ride on the supersonic jet from London to Washington, D.C. I was fifteen minutes late, or British Airways would have sent me complimentary, because of missed connections, they would have sent me on a complimentary ride. In lieu of my regular ride, they would have sent me on a supersonic jet.

I think it's been a marvelous, marvelous time in the history of people of this nation to have been involved in a program way, with a lot of highly respected, highly motivated, extremely sincere people who are working for the common goals and the common good of the people of the United States. It sounds a little trite perhaps to some, but I think the "me generation," the "now generation," the emphasis on selfish motivation, I think that that hasn't altogether added to the quality of life in the United States. We have got a lot of great projects that a lot of us can be proud of.

I might go back and say, one day we were discussing earthquake criteria as it applies to our dams. They said, "Well, out in California we do this," or "Over here we do this."

I raised the question, "Well, this is only a ten-year history or a thirty-year history. What about a 300-year history for the earthquakes, and how does that apply to our major dams and irrigation facilities?"

". . . every major city, every major dam, every major hydroelectric installation could ultimately be exposed to a major earthquake during a 300- to 500-year life. . . ."

The ultimate reply was that every major city, every major dam, every major hydroelectric installation could ultimately be exposed to a major earthquake during a 300- to 500-year life. Grand Coulee, I'm sure, will last as long as the Pyramids. So it's with that kind of perspective that we build these projects.

Storey: Were you ever involved in any designing for earthquakes?

Ruud: Oh, yeah.

Storey: Tell me about it.

Involved in Design for Earthquakes

Ruud: I was involved in the earthquake design of the intake tower for Trinity Dam in California, reviewed a few others. I wrote at one time earthquake criteria for the mechanical equipment.

We who deal in steel mechanical equipment have a particular advantage because steel has a very large *yielding* curve. In other words, it has a huge energy-absorbing characteristic, so that most of our hydroelectric units and our penstocks are designed for vibration and earthquake, and when they do hit these ultimate loads that they will deform, and it's this deformation that absorbs a great deal of energy from an earthquake. Now we have had some experience most recently in earthquakes where we have structural steel buildings, and the beams have cracked due to earthquake exposure, but those are largely tension failures where these beams have cracked.

". . . how much insurance do you put in in extra cost for a building . . ." [to protect against earthquake]

I find earthquake design to be fascinating. One of the things is you're working with an unknown and unpredictable opponent. There are game theories that go to this. You have to be prepared to some degree. Well, how far do you go? How much life insurance do you purchase? You can give your own estimation of your own intrinsic worth from whatever yardstick you wish, but how much life insurance do you buy? From an engineering point of view, how much insurance do you put in in extra cost for a building in downtown Denver where there's not been a major earthquake in recorded history? Yet we know there's a huge fault on the eastern side of the Rocky Mountains that cause the uplift, that was part of the uplift of the Rocky Mountains, but how much money do you put into earthquake design for such a skyscraper, knowing that ultimately—

END OF SIDE 2, TAPE 1. JANUARY 25, 1996.
BEGIN SIDE 1, TAPE 2. JANUARY 25, 1996.

Storey: This is tape two of an interview by Brit Storey with Frederick O. Ruud, on January the 25th, 1996.

Ruud: We were talking about the earthquake criteria and sort of the long-term implications of earthquake criteria. If one designs a building that is deficient for earthquake design and at any future time it fails, certainly the designer will be *blamed*.

I have a famous little cartoon—it's hardly famous—it's famous in *my* world. But these two Roman engineers are standing in northern Italy, and they're looking at this tower they're putting up, and one's got the scroll in his hand and he turns to the other engineer and he said, "I cheated a little bit on the foundation, but nobody'll ever know it." Of course, the name of the town is Pisa, and it's a foundation failure, you see, that ultimately they say will bring the structure down. Matter of fact, I believe that there's a program right now to reinforce the foundation of the tower.

I think that engineers who worked for Bureau of Reclamation projects, and who have worked for a lifetime at it, recognize that while the financial life of some of these projects may have been arbitrarily set at fifty years, that the physical life of the project is going to be substantially longer, and that the structural life should be designed accordingly, and that we should have a very long perspective in the view of what may happen to some of our projects in the future.

I think it's been a great life. As I said in the beginning of the interview, I started out as a child playing in the creek on my father's farm. In retrospect, in looking back, I had chances to work. I had chances to stay in the military, possibly because of some, if I compliment myself, I was able to do math problems. I could have well become an officer. I might even have gone very far as a military person, because I had a lot of military in my background that I didn't know about, but the apple doesn't fall too far from the tree when one speaks of heredity, and some of my ancestors were generals two-, three hundred years ago. I don't think of any other career that I could have done for any other agency, and that includes working for the Defense Department.

Its Easier to Destroy than to Build

One time when I was in the Army, we worked for a couple of weeks to build a little concrete block house, and they were going to have a firepower demonstration, and I was told go out and build this place. So we put it up and doorway and all that stuff and everything, roof. During the firepower demonstration, pulled up a tank and some other eighteen-year-old kid looked through the bore and flipped a shell into this rifle and blew that little block house to smithereens with one shell. That taught me a lifetime's object lesson: it's so much easier to destroy than it is to build, so much easier to destroy careers than it is to build careers, so much easier to destroy physical facilities than it is to build, so much easier to destroy organizations than it is to build ~~from~~ [them]. Those who would destroy the Bureau of Reclamation because they don't happen to agree with its goals.

I know that the one project that they do speak of superordinate goals, they adopted the Navajo powerplant in lieu of Marble Canyon Dam. Now we have air pollution downstream from Navajo *coal* plant. Of course, it brings the Navajo tribe in a lot of revenue from mining of coal on their reservation, but it adds to the air pollution for hundreds of miles downstream. There is no free lunch. So there's a lot of ways a man's career can go. But I'm very proud to have been with this organization for my career.

Storey: Were you involved at Auburn at all?

Ruud: I did some work on Auburn, not very much. See, Auburn was never built. It was probably the most expensive dam foundation that has ever been constructed anywhere in the world. I have friends that worked at Auburn. I have friends that are still out there. But I have never been involved in Auburn. I was involved close by.

Storey: What about other big projects like Flaming Gorge and Yellowtail?

Transformers at Yellowtail

Ruud: Well, I did some—I don't remember doing anything on Flaming Gorge. I worked on Yellowtail to some degree in that one of the problems I worked on had to do with cooling of transformers. Once again, it had to do particularly with the problem of cooling of transformers for Grand Coulee. Now, these are for the 600-megawatt units. The transformers were very large and, of course, you could get them for, to use a number, you could get them $50 cheaper if they were air-cooled transformers versus being water-cooled. They said, "After all, we have air-cooled transformers at these other jobs," and one of them was at Yellowtail. There was a very small amount of space between the powerhouse and the dam at Yellowtail, and they'd had problems with overheating of transformers, I believe.

But we did a huge study at the Grand Coulee. Well, a huge study, me and another fellow worked for about two or three weeks, to try to justify that we should use water-cooled transformers in Grand Coulee because we had water. They said, "Well, we use air-cooled transformers out in the Four Corners area, that job out there, they had a big substation, they have these big air-cooled transformers out in the desert and they worked just fine." Well, you don't have any water in the desert, you've got lots of air, and they put big fans on them, and that cools them.

But one of the problems of working in a largely bureaucratic, militaristic organization that someone told me described the Bureau, the problem working in our organization, it's the art of the possible. You do what is possible, not what is perfect. Even at this moment we have a huge debate going on within the United States government about where the government should spent its money. In just the last few days it's become the art of the possible rather than the art of the perfect. The two opposing factions of the government, the Democrat versus the Republican, both have very different goals, but the compromise becomes the art of the possible.

So with the Grand Coulee transformers it became the art of the possible, and when it became possible that they *could* provide water-cooling, or could provide water-cooler radiators for the air in the future, that's when I capitulated and went ahead and abandoned the fight for water-cooled transformers. After twenty years of operation up there—'96, okay, '76—why, apparently the air-cooled transformers operate with reasonable success.

I have not heard of difficulties on very hot days, but if we had a 100-degree day and a slight wind from the west and we get a roll of hot air between the third powerhouse and the canyon wall, well, we might have to shut the powerplant down for a few hours because of excessive transformer heat. But if that comes to pass, well, then they would put fire hoses in there and cool the air. It's always possible. That's what engineers work on, the art of the possible.

Storey: What did you do after you retired?

Activity after Retirement

Ruud: Well, as a matter of philosophy, the feeling of retirement is an intense feel of freedom. I didn't have such an intense feel of freedom since the time I was out of the Army, twenty-one years old, coming home from the Army, discharged from the military, and was going to start back to school and start a new life and a new career. I got through World War II and I was alive and embarking on my career.

Went to Work for the World Bank in Egypt and China

When I left the Bureau, I embarked to become a consulting engineer. I got a job to work on with the World Bank, I went to Egypt on a program for rehabilitation of all the irrigation stations in the country of Egypt, and this involved something like $50 worth of rehabilitation of over 1,000 pumping stations for the irrigation of Egypt. Following that, I went to China for the World Bank again, on a major irrigation project near a place called Xian, China, which is known as the Dong Li Part Two Irrigation Project, to use the Yellow River water to irrigate some areas in China.

Storey: Can you spell these names for me?

Ruud: Xain is—

Storey: C-H-I-A-N?

Ruud: It sounds like C-H-I-A-N, but it's X-I-A-N, the city in China. It's the ancient capital in China.

Storey: Yeah, it's where they found the huge figures, isn't it?

Ruud: They took me out there, some of my friends, for $30 American money, hauled me out to take a look at these statues. I was actually in the building. My brother tells

me that they actually also found a set of these statues that's not been excavated yet, on the other three points of the compass. This set was all facing east, but they've found some, I believe, on the other three points of the compass around this huge tomb. It's a pyramid. It looks like a great big earth mountain, but they built it as a tomb for an ancient ruler.

Pumping Muddy Water

But yeah, I got to go there. Technically, it was a very interesting job, because they irrigate with water that's 10 percent silt by weight, and when you design pumps, why, you have to make some special provisions. I tried to keep it as elementary as possible so that it could be done by the Chinese, and done on a continuing basis. Once again, maintenance becomes a problem, because you have a highly technical installation, the muddy water will eat it up. We tried to make simple pumps that would have a little well over to the side that would provide clean water for all of the bearing surfaces and all of the seal surfaces in the pumps so that it would be filtered clean water, but it would still pump the muddy water for the irrigation.

Some of these things are never easy, and when you work in the areas that I work in, why, you only get called if there's a disaster pending in one way or another sometimes. So I've been very fortunate as a consultant. I worked on a major turbine failure that, I am under rules of confidentiality, that I cannot discuss, but it had to do with a turbine is about, oh, as big a turbine as I've ever worked on almost. Not nearly as big as Grand Coulee Third [Powerhouse].

Camp Far West Hydroelectric Station

But I worked a lot of different places. First of all, I worked on a Bureau project down at Havasu pumping plant. I worked on a job at a Bureau of Reclamation project in California called Camp Far West, where we put in a small hydroelectric station at an existing project. Some of that project is owned by the South Sutter ~~Southern~~ Water District, which is one of the small projects jobs that was under one of those federal loan programs, involved a Bureau project. Not very many.

Minimum Flows Through High Altitude Dam Outlet Works

I've worked on ~~an~~other jobs, but just most recently up in the Continental Divide, elevation 9,500 feet, and the government is always into it. I guess the Forest Service wanted to provide minimum flows for the streams, one cubic foot per second, and three cubic feet per second, but the dam is at 9,500 feet in Colorado and it gets kind of cold up there in the wintertime. So the question became, how in the world can we have an outlet run through the dam and not have the whole thing freeze up on us. Once again, if you are of an analytical nature, you perhaps can come up with the right questions to ask. So we were only one of a preferred list of four of five people, short list, who were bidding on the job. But I asked the question, "You have a valve or gate in there now, don't you?"

The man said, "Yes."

I said, "Well, does it leak?"

He said, "Well, yeah, there's a little water. None of these ~~stopwell~~ gates, regulating gates is perfect, there's always a little water leakage on these."

I said, "Well, what happens to that leakage now?"

He said, "Oh, it runs through the dam and runs right on out into the creek and runs under the ice. It doesn't freeze."

I said, "Well, back on the farm, my daddy always used to say, he said colloquially, 'Just leave the valve open a little bit and then the water pipes will not freeze up.' We always did and we never froze up our water pipes." I said, "I think that on this job in Joe Wright Dam, if we just let it continue to run, why, there's enough intrinsic heat in the water that the water passages in the water pipe will not freeze up."

We went ahead, we got the bid, we designed it, and I've not been involved in a losing job yet. We bid so that we can do it within the price we bid. That's an achievement, too, you know. So those are the kind of jobs I like to work on. There have been many of these, they're just little things that happen.

Proposed 210 Megawatt Project to Sacramento Municipal Utility District

One other time I worked—one of my others that didn't get built, but is typical of the work what I've been doing, out in California there was a project called Garden Bar. They wanted to build a little 15 or 20-megawatt hydroelectric turbine there, and I suggested that this be reevaluated to build a 210-megawatt pump storage project. That was very much feasible, but unfortunately, the customer, Sacramento Municipal Utility District, and they were burdened with a nuclear plant called El Rancho Seco that was at least a hundred times as expensive as the project we were asking to build, and so far they have not seen fit to fund our project. In the meantime, they've got a huge financial burden with having shut down El Rancho Seco nuclear plant, and maybe someday we will get back to hydroelectric water power as a viable energy source.

Towaoc Project near Cortez, Colorado

Another project I worked on involved a Bureau of Reclamation area. You know, this not a way of life, it just sort of happens that way because of your area of expertise, but the Bureau of Reclamation as a part of their Dolores Project, promised the Ute Mountain Ute Tribe that they would build them an irrigation project. This went out for private bid, and I was a part of the team that bid and was selected, the company that was bid and selected to design the Towaoc Project, over by Cortez, Colorado. I'm not a canals designer, but I did work on what we called the energy dissipator.

We have a lot of energy to dissipate from the amount of irrigation water that comes down the hill from the feeder canal at that project, and this turned out, this will and is in operation and has been successfully operated. It is the largest energy dissipator of its kind to be built in the world. It is based on a project by the Bureau of Reclamation, and uses some of the Bureau of Reclamation art in the design of the valves, called jet flow gates, to shoot the water into the energy dissipation chamber. But it's sort of a landmark project.

"We're always breaking new ground, and I think that's the most exciting part of engineering. . . ."

We're always breaking new ground, and I think that's the most exciting part of engineering. In a nutshell, to be imminently practical, I don't do drawings and I don't do windows. (laughter) I'd rather work where there's a lot more excitement, I'm afraid.

Storey: I've got a little out of sequence. I didn't ask you *why* you retired.

Retired to Go into Consulting

Ruud: Why I retired. Well, it's a highly personal story. When we were first married, about to graduate from college, I got married when I was a sophomore in college. My wife and I graduated together, and about a week before graduation ceremony I asked my wife where she'd like for us to go to work. She says, "Oh, I don't care, anywhere you want to go."

I said, "Well, I'd like to work for Morrison and Knudsen, Peter Kiewit Sons, a huge construction organization with projects all over the world. I could become their lead mechanical installation engineer for this big construction company, travel all over the world, see a lot of places, live a lot of places."

Wanted to Travel the World

My wife told me, she said, "Well, I don't want to live that way." She said, "My father did that work. He was a mechanical installation engineer, and he went all over the world and all over the United States." She said, "I didn't have any friends for a very long period of time. I had to live in lots of different places," and she said, "I don't want to live that way and I don't want my children to be raised that way."

Well, I had an offer I couldn't refuse. I said, "Well, do you like the Bureau?" [She] ǂ said, "I like the Bureau." [I said, "I want to go work for the Bureau, too. I like that kind of work—hydroelectric work. We might not move very often, but when we do this, then I would like that work."

She said, "Well, that's fine. Let's go back up to Grand Coulee and go to work up there."

I said, "That's great."

Moved to Grand Coulee Dam in 1950

So I went to Grand Coulee in 1950, and I moved once to Denver, and then I moved within the Denver area twice, but that's just within the Denver area. We kept all of our old friends and all of our associates here in the Denver area. So we only made one move, and that was from Grand Coulee to Denver.

"Well, I'll go to Grand Coulee, . . . but when the time comes for me to retire, then I'm going to do that kind of work—travel around the world, travel everywhere I can . . ."

But at that time when we decided to go to Grand Coulee, I told her, "Well, I'll go to Grand Coulee, and we'll work for the Bureau, but when the time comes for me to retire, then I'm going to do that kind of work—travel around the world, travel everywhere I can, see all these different installations on all kinds of different projects, and I want to do that."

She said, "All right, that's fine with me."

"So I waited a whole pay period past my fifty-fifth birthday, that was two weeks after my fifty-fifth birthday, to retire . . ."

So I waited a whole pay period past my fifty-fifth birthday, that was two weeks after my fifty-fifth birthday, to retire, and to take up that new life of being a consulting engineer. It was a lifelong goal. I set very long perspective, very much life goals in doing my work. So I'm very proud of the achievements that the Bureau has done. I'm very proud of my part in doing the achievements. A lot of places I saved the Bureau a lot of money, I won a lot of battles. I don't have a single regret. Everybody would like to be a millionaire, but I'm pretty well taken care of in my retirement.

Storey: Well, I appreciate your going through this. Now what I would like to do is go back and start all over and go through it again. (laughter)

Ruud: (laughter) Well, it's only 10:30, maybe we could do it.

Storey: Well, we can come back again if it's necessary.

Ruud: I must say a couple of things.

Storey: Sure.

John Parmakian

Ruud: There are some people that I worked for that had achievements at least as great as mine, and certainly greater than mine in many respects. One of them I worked for was a man named John Parmakian. Mr. Parmakian was my supervisor when I first

came to work for the Bureau. He had been a test engineer in the start-up of the pumps at Grand Coulee, and he was a marvelous supervisor and a genius in his work. He was the author of many papers, and he was a *marvelous* man to work for and a marvelous mentor. All my life I appreciated the things that he did for me and the guidance he gave me. He was one of the greatest engineers in the world in the work that he's done. He's passed away now.

Francis Swain and IBM

Another that is gone is a man named Francis Swain. One of the particular stories I could tell you about Francis Swain—International Business Machine company had some computers that were in our bookkeeping department. They added up sacks of wheat, and yards of concrete, and payroll hours, and multiplied the payroll hours by the time of the rate per hour, and they'd come up and print out payroll checks or some such lists of stuff. So Mr. Swain began asking questions, if they could do that kind of multiplication, maybe they could multiply four times five. It doesn't make any difference whether it's four hours at $5 an hour or 4,000 cubic yards of concrete at $50 a cubic yard. If they could multiply, they can multiply. The inverse of that is to divide, and all that multiplication is, if you multiply a thing by five you add it up five times, so it can add and subtract and divide and multiply.

So he started using this old IBM machine for engineering problems, and it was a lot of work to program it, but he started programming it kind of like for fun. Pretty soon, he, being a very intelligent engineer, was solving a lot of engineering problems on this computer. IBM heard about it. Every week there would be a different team of people show up from IBM to review his work, and one day they said, "We have a new machine we'd like to have you try in your organization." So they go up to the front office and they get a couple million bucks and put in this new machine, and away we went.

I would like to suggest that we had some small part in the development of the major huge computers that became useful in the engineering work of the United States. Of course, the man that invented the transistor enabled us to make these computers so you can put them in your vest pocket rather than haul them in on a train. That was one man I worked for.

Fred Cornwell

Also, one of my supervisors was a man named Fred Cornwell, who was a mathematician, and his wife was a mathematician, and he taught me a great deal on engineering and research, and how to arrive at problems, arrive at solutions, by using some of the resources we had available within the Bureau.

Clair Crawford

I had another supervisor, named Clair Crawford who was a fine supervisor, a very, very astute technical person, and I still see on many occasions, and I was

very fortunate.

Louis Puls

I had a supervisor at one time when we were involved in the question of the tailwater at Glen Canyon, named Louie Puls. I later became intimately associated with Louie Puls after he and I had both retired and he was a neighbor of mine. He used to say, "There are sure a lot of swell fellows work out there." If I could paraphrase Louie's words, there sure are a lot of swell fellows work for the Bureau of Reclamation, and a lot of *extremely* intelligent, hard-working engineers.

Well, I think our works show it. I think the endurance, the safety, the capability of all the works that the Bureau of Reclamation put together, are a tribute to the caliber of the kind of people that worked for this organization.

That's about it. I'm enjoying my retirement. I'm hail and happy at seventy. I have a life expectancy now of at least twenty-five years. (laughter) So hopefully when bigger and better fiascos are built, why, I'll have a part in it. Our latest model fiasco is yet to be designed. I'm kidding, but we build great things.

Failure of Teton Dam

Storey: Do you remember when you heard the news about Teton Dam?

Ruud: Yeah. I can talk about Teton a little bit. Yes, I was at home and I heard it on the radio. I didn't know anything about it, of course, and I went to work the next day and slowly the news began to come out. Later on, I realized that there's huge amounts of investigation and a lot of recriminations of all kinds. A and B plus and minus doesn't make any matter to me. But it's like the two engineers and the leaning tower of Pisa, they cheat a little bit on the foundation, but nobody'll ever know it. It seems that when the dirt all washed away, they found this slabbed rock on the abutment of Teton Dam, and if they tried to pack dirt in that and hold water, all it does it run around the end of wherever they packed the dirt.

". . . nobody ever sent anybody up to look at what was the problem. . . ."

The young lady, Shirley Pitlak, who complained because there was no limit to the amount of grout that the grout holes were taking on the abutment was right. The only problem is that nobody ever sent anybody up to look at what was the problem. The problem of being on an extremely limited budget with no investigation of the kid that cries wolf, you know, he could be right.

I have my own story to tell in that regards. I forget if I told it before. I was at Grand Coulee and I was doing some checking of bore waves in the canal at Grand Coulee, because we were going to convert some of the pumps at Grand Coulee pumping plant to pump storage.

Storey: You did tell me about this.

Ruud: Did I tell you about that?

Storey: About the water in the holes?

Ruud: The water in the holes and that the washing up and down. Now, I cried wolf to my boss, and I was not a GS-7 field inspector, I was a GS-14 who knew the top people in the organization. So I was effective in raising the alarm and effective in getting this problem rectified. But you know the lessons therefrom—I have done it—on other small occasions, I was sitting on an airplane and I looked out on the wing, and there's this oil stain on the wing. I called the pilot back, says, "What's that? That looks like hydraulic fluid to me. Why don't you have them take a look at it." They took a look at it and found out ~~that the level in the hydraulic~~—

END OF SIDE 1, TAPE 2. JANUARY 25, 1996.
BEGIN SIDE 2, TAPE 2. JANUARY 25, 1996.

Ruud: —the little things that can go wrong, I think that one of the problems you have is to listen to the people who are observant in this regard. It doesn't make any difference who they are or what they do, their wife, the engineer inspector, the pilot, the hostess on the airplane, anybody who is intelligent enough to see that there's something unusual about the leak in the dam, or the hydraulic fluid or some unusual occurrence. And I might suggest that socially and politically the same philosophy has some application, that great oaks from little acorns grow and great problems from little problems grow. It's the life of our nations and our people and individuals. A lot of times these result from the unintended consequences. You say, "We didn't really mean for it to happen that way, but that's the way it came out." Well, I can philosophically wax on a lot of those things, but all I can say is that with a lot of planning and a lot of hard work, that's the projects of the Bureau of Reclamation come out, and most of them come out the way we plan them.

Anchor Dam and Its Sinkholes

We have some problems—unknown. There's one called Anchor Dam that had some huge sink holes. They built upon porous limestone and it was supposed to be a power dam. The problem is that it was full, they went out one morning and the reservoir was empty. It had opened up a sinkhole in the reservoir. They plugged that one, but then they found another sinkhole, and another one. But we used to say, well, maybe what we should say, this is a flood control dam, and it takes the flood and it drinks it. But as far as holding water for a long period of time, Anchor Dam, to my knowledge, has never been a successful installation.

Issues at the Mojave Project

There are a few others that we had that nobody's ever come up with good solutions for. One is the Mojave Project in the southern Arizona border that was built to supply Mexico, and it had extremely heavy iron-laded water and would eat the impellers up. Very heavy, chemically, stuff. We kind of changed some of that.

Senator Wash Project Designed to Prevent Wasting Water Released for Mexico's Use

They built the Senator Wash Project that would grab the flood water and store it temporarily. It was a political installation. The Mexicans would order water, and then after they ordered it, they'd release it and then all of a sudden they had a window they could cancel it. So the problem was how could we save the water we've already released. So they built just north of the Mexican border. They build a Senator Wash Pump-Storage Project. Doesn't give the Mexicans the window of opportunity to refuse their water. When they want water, they get it. (laughter)

"When I first came to work for the United States Bureau of Reclamation, we had 1 percent of the national budget. . . ."

So there's all these dimensions that go into the operation of a major agency. I suggest some things. When I first came to work for the United States Bureau of Reclamation, we had 1 percent of the national budget. Our budget was $440 million a year and the national budget was $44 *billion*. You could go to *The World Almanac* and look the numbers up. Can you imagine what this organization would do today with 1 percent of the national budget? One percent of $1.2 trillion is what, $12 billion? Isn't that about right?

Storey: I don't know. It's a lot of money.

Ruud: Well, one times ten to the ninth, and 1 percent of that would be one times ten to the seventh. It seems to me that that's about—well, a trillion is twelve [hundred] billion. You know, you see the politicians talking, "Boy, we can save $10 million." They have a hard time distinguishing between millions and billions. Like [Senator] Everett Dirksen, it adds up.[20] But $1.2 trillion dollars is 1.2 times ten to the twelfth, and you take two zeroes off that, that's 1.2 times ten to the tenth, and that is $12 billion a year. Can you imagine what this agency could do—

Storey: It's a lot of money.

Ruud: —with $12 billion a year?

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20. Refering to a quote often attributed to Dirksen: "A billion here, a billion there, pretty soon, you're talking real money." At http://en.wikiquote.org/wiki/Everett_Dirksen on May 30, 2007, at 5:30 p.m. it says of this quotation:

> Although often quoted, it seems Dirksen never actually said this. The Dirksen Congressional Research Center made an extensive search when fully 25% of enquiries to them were about the quotation. They could find Dirksen did say "a billion here, a billion there", and things close to that, but not the "pretty soon you're talking real money" part. They had one gentleman report to them he had asked Dirksen about it on an airflight and got the reply,
>
> "Oh, I never said that. A newspaper fella misquoted me once, and I thought it sounded so go [sic] that I never bothered to deny it."

Storey: It's more than we had invested to 1992.

Ruud: That's just about right. When you put that sort of thing into physical resources to develop the resources of the western United States, we could walk streets of gold and not go lower.

Failure of Teton Dam

Storey: Getting back to Teton, how did the other people here react when the news reached here?

Ruud: Oh, it was not a particular thing. It was sort of a lot of worry, but, you know, as engineers, why, we get up and get on it and find out what happened. There have been many investigations, most of which I was not privy to, because I was never involved in earth dams.

Work on Earthquakes and Earth Dams

I had done some studies on earth dams, like natural frequencies due to earthquake, which is strictly a two-dimensional shearing problem, is the only one I was able to solve. There were some people that worked on three-dimensional evaluations of the shearing of earth dams. I was never quite that good a mathematician, and that's about as far as I ever went with earth dams. I know a little bit about the design.

Problem at Fontenelle Dam

But I can tell you that there were some things involved. There'd been a previous very near failure, and it was called Fontenelle. The only reason Fontenelle did not fail is the outlet of the water went through a solid rock portion of the abutment, that everything downstream from the point where that water exited the rock was washed away. But upstream of that point, we had approximately thirty feet of highly compacted earth that held a pressure of thirty feet of water, and that that portion of the abutment did not fail, and that saved Fontenelle Dam.

But the lesson was there, and it has been known in antiquity, that once you get water flowing or going through earth dams, that it washes out rather rapidly, and you cannot tolerate leakage that you could measure. Now, you always get seepage through any of these. There's nothing that's ever perfect. But they have a lot of factors of safety and a lot of facilities that they use to improve that sort of thing. But I'm not familiar with that particular part of the design.

I can tell you that one of the things that saved Fontenelle Dam is that the outlets in Fontenelle Dam were approximately three times as large as the minimum required, because the engineer that designed the outlet decided that the flow required for the outlet works was more substantial and he went ahead and had specified a rather large outlet works for Fontenelle. Because of the fact that that was available, they were able to draw the surface of Fontenelle down very, very

rapidly, and eventually, probably [those outlets] were very instrumental in saving Fontenelle Dam.

The outlet works at Teton were not yet in operation, and once again, it's because of the nail, the shoe was lost, because of the shoe, the horse was lost, because of the horse, the rider was lost, because of the loss of the person, the war was lost. Little details. They used to have a sign on the door of the room in World War II, the fighter ready room, "What you don't know won't hurt you, it'll kill you." It's this obsession with detail and ever-present awareness that you've got to be as smart as you possibly can to know all these details, to try to make sure that everything is programmed and is ready to go, and you haven't overlooked anything that's going to come back and be a fatal surprise. I think it was something that had to do with the painting of the outlet pipes and they weren't ready, so that the gates weren't ready, so that the outlet pipes weren't ready. So that there's a map, but in any case, the outlet works at Teton were not ready, and also I don't think that they were overdesigned to use. One of our commissioners had said, "The problem with you people in Denver, you tend to gold-plate your engineering."

Storey: Who was that?

". . . a little gold-plating goes a long ways when it goes to save a dam or to provide thrust bearings that will run for seventy-five or a hundred years, or to provide the quality of steel that's in the penstocks at . . . Hoover . . . Dam . . ."

Ruud: Well, I'd rather not say. He's still active in the business. He's out there. But I would say that a little gold-plating goes a long ways when it goes to save a dam or to provide thrust bearings that will run for seventy-five or a hundred years, or to provide the quality of steel that's in the penstocks at Boulder Canyon or Hoover Canyon Dam, that's just as good as the day it was installed. I think that when you're building structures such as we built, it's very well to spend a little extra money on the engineering and ensure that the foundation of the tower is adequate.

Storey: Did you see any effects of the failure of Teton on Reclamation?

Ruud: Oh, on the organization?

Storey: Yes.

Ruud: I think it ruined us.

Storey: Why?

"Everything we did was suspect. Every time we go for appropriations, we're remembered as the people who had the failure named Teton Dam. I think that it was a *huge* failure organizationally, politically. . . ."

Ruud: Everything we did was suspect. Every time we go for appropriations, we're remembered as the people who had the failure named Teton Dam. I think that it

was a *huge* failure organizationally, politically. The technical details they probably should have put what they call a pulvino on the abutment of the dam where they had the fractured rocks, so that we would make damn sure that we had no leakage.

I know a dam in Washington called Rocky Reach Dam that was built on sand, but there's more concrete under the ground in the gravel abutment than there is exposed in the main concrete portion of the dam. They put in a *huge* amount of concrete and grouting.

Storey: That's a Corps dam, I think.

Ruud: That's owned by the Chelan County Public Utility District. My father was the son of one of the original homesteaders and pioneers in Douglas County, Washington, and one of his childhood friends became the man who headed up, in fact, the man started the Chelan County PUD. At one time Mr. Kirby Billingsly and his wife were the only two employees of the Chelan County PUD. Now Chelan County, with its two or three major dams, has assets of perhaps a billion dollars or more. My father grew up as a childhood friend of Kirby Billingsly and was very closely acquainted with Kirby.

Also, independently of that, I heard of the design of the Rocky Reach Dam. Certainly the particular details of the young lady [at Teton] who complained that the gravels never seemed to fill up, there was something wrong down there, and she wrote a letter to that effect. Well, you know, you got to sensitize your ears so you hear.

Now, I'm sure that the organizational changes for safety of dams, the entire safety of dams program of the United States is founded on the findings of Teton. Out of some failures always comes a lot of good. I'm sure that there's a lot of people that are a lot more conscious of a lot of these problems, and we may inadvertently save a lot more money and a lot more lives by factors of hundreds or thousands than were lost at ~~Grand~~ Teton.

". . . we worked our way out of a job. . . ."

But as the effect on the organization that, and secondly, the amount of irrigation projects that are available in the United States for construction and the amount of power projects and dams that are available for construction were pretty well achieved. You see, we worked our way out of a job. We did a good job. They are built. They do last. We don't have to go back and rebuild these places every five or ten years.

Maintenance Is Underfunded

There's a lot of maintenance. I might suggest that the use of maintenance and the funding of maintenance is vastly underfunded and should be given a great deal more attention. If you were to take the present worth, as of this date, of all of the hydroelectric installations of the Bureau of Reclamation and the present worth

of the irrigation facilities, if you're go out and going to buy a farm on Reclamation projects, consider what you'd have to pay. Multiply that by *all* of the farms that are supplied irrigation water, by *all* the people of the United States that receive electric power, by all the people that pay income taxes in all the cities in the western United States. But those things are primarily supported by the agricultural community and the recreation community. Phoenix, Arizona, is a great place to live. It got that way because there was water supplied by the Bureau of Reclamation and electric power for running their air-conditioners. If you added that up and then you spend 1 percent of that amount per year for maintenance, you very likely would come close to your $12 billion budget.

So you see there are very large stakes involved, but this is a great organization that's done a lot of great work. So I think they're deeply underappreciated by the "me generation" and the "X generation" and all of these people. We also have had three generations of people in the United States that's never seen a depression. I must also admit that the Bureau of Reclamation's great program was a Depression-based program to develop the resources of the United States for the benefit of its people, and that the development largely occurred after World War II, because it became an increasing consciousness to develop these facilities for places to live and for the economic resources that the large power installations provided.

Storey: The period when you were working for Reclamation, really.

Ruud: Oh, yeah.

Storey: Back in '49, I believe it was, you said that you were working to get the Right Powerhouse working.

Ruud: Oh, yeah. 1949.

Storey: Tell me what that meant in detail. What kind of work were you doing? This was after your summer out in the field as an engineer trainee.

Working in the Right Powerhouse at Grand Coulee Dam

Ruud: Oh. Well, I worked in the Right Powerhouse. We called it left and right. Of course, my initial [work] had been to carry the bag of stakes at the right switchyard at Grand Coulee.

Storey: Right, spelled R-I-G-H-T.

In the Late 1940s-early 1950s, Reclamation Was Aware Another Powerhouse at Grand Coulee "would be a good idea"

Ruud: R-I-G-H-T, yeah. And that was subsequently torn out and all the dirt dug out to make the place for the Third Powerhouse at Grand Coulee. That's where the thing is. The right switchyard is gone. But I was working in the Right Powerplant at that

time, calibrating instruments and stuff. We were aware, even at that time—now, that's twenty years before it happened—but we were very much aware of the fact that sooner or later it would be a good idea to put that kind of an installation in. My father-in-law, in fact, was working on a little facility there that I had worked on, namely the caisson that was used to replace the spillway bucket, and a number of other things that were—I worked as a mechanical inspector in that area for a long time.

Began Working on Third Powerhouse about 1966

The true work, other than just studying the problem, the true work really began about 1966. There has been lots of talk in Washington, but Mr. Morgan Dubrow and I were rather intimately involved in the work.

Storey: This is the Third Powerhouse.

Ruud: For the Third Powerplant at Grand Coulee.

Storey: Ted Mermel was involved in that, too, wasn't he?

Thaddeus (Ted) Mermel

Ruud: Yes, he was. Ted Mermel was involved in that. Ted and I are old friends. I know him extremely well. Mr. Mermel is still alive, *and* a consultant to the World Bank, and still working for World Bank. Ted must be ninety years old now. I don't know exactly how old he is. But he used to work in the Denver office. He always had a great interest in the Denver office. So anybody come to Washington who was an engineer, why, Ted would always take him under a wing and want to know what's going on in Denver.

Emil Lindseth

We also had a man here named Emil Lindseth, who had been—gee, what are the names?

Senator Gordon Allott

Gordon—the senator, Gordon Allott, I think he and Gordon Allott were roommates in college or something, but they were intimately acquainted.

Storey: Lindseth or Mermel?

Ruud: Lindseth. So there was a lot of personal and political communication back and forth. Now, these people had a very interesting political relationship. They were Democrats and Republicans, but they were all engineers and they had this common language and common goals. There was not a lot of charity thinking as far as this is just a make-work job to put engineers to work. We were going to get some substantive results on behalf of the people of the United States for the money that

was *invested* in our projects, and it was because of people like Gordon Allott.

Senator Eugene Milliken

Then there was a Senator Milliken at one time, very famous senator from the state of Colorado. Eugene Milliken, M-I-L-L-I-K-E-N or A-N.

Storey: K-E-N.

Ruud: Yeah. And he was also a very astute person. So these were people who were involved at the time I first came to work here in the fifties.

But the Bureau of Reclamation always had a long lead time on its planning and a long lead time on its foresight and its goals that many of these jobs had been in the planning stages for thirty and forty years before they were ever built. There was a great appreciation of the amount of time it took to plan these projects and the detail of work that was involved, the completeness with which it's done, the quality of the design and the quality of the construction and the quality of the performance of the project following its construction. I would suggest, to follow this up, that the quality of *maintenance* ought to be commensurate with the intrinsic value of these projects, because we don't need any more failures.

Storey: We sure don't.

Ruud: We don't need any more failures of pipes. We don't need any more failures of transmission lines.

I was very fortunate. I hit the whole spectrum, but always where there was trouble, because I didn't have time to waste making drawings. (laughter) Pounding sand in rat holes, right? I was more or less—well, I was proud to be what I considered *one of* the ace troubleshooters in the United States Bureau of Reclamation, and I guess you could say, my wife the behavioral psychologist, will say that those were psychological wages that you get for working for this organization. They can't pay you in money, but they can sure pay you in prestige and pay you in influence and pay you in achievement. I was very lucky. I still consider myself one of the luckiest people that ever was on this earth. The work is such a—superordinate goals with a great organization, with great people.

Storey: You mentioned a couple of times pounding sand down rat holes. Is that a Reclamation expression or is that a farmboy expression?

Ruud: That's a farmboy expression. But it's sort of useless activity, make-work activity. A great cartoon, this guy's drilling holes, says, "Why you digging this hole?"

"Well, to get dirt to fill up that other hole."

He said, "Well, what you trying to do, you know? Seems you'd get something better to do."

The guy digging the hole says, "You're just jealous because I have a steady job."

But we try to get something measurable, that is, something you can look back and tell your grandchildren. That's another psychological wage I have found to be very, very helpful to myself, and that is that I can talk about the things that I've done. There may be people who worked in nuclear projects, and who worked in defense contracts, and who worked in great political undertakings and things like that, that can't talk about the work they did. But we in the Bureau of Reclamation can talk about it. That's worth a great deal. And to be able to pass this experience and knowledge along to other people.

Reclamation Has a Good International Reputation

One of the things that we have in the Bureau of Reclamation was they have a *tremendous* international reputation. When they look for the standard of performance of power and irrigation projects throughout the world—China, Turkey, Egypt, Africa, South America, anyplace—the question that they ask is, "What does the Bureau do on this kind of a project, on this kind of a problem? What does the Bureau do?" Those of us who have worked in the Bureau, who have been kind of experienced, are in somewhat of demand of these kind of projects. The problem is, we're all getting old. When they try to shut down the organization because of really a minor thing, but not minor to the people that were damaged, but certainly minor—

Storey: We're talking about Teton now?

Ruud: Well, when you're talking about $1 billion, $200 billion of expenditures in the present United States' budget, some of these things take on kind of a minor perspective. We have to keep our eye on the main goal, what kind of a country we want to have and what kind of communities we want to have.

One of the things that you find if you travel throughout the western United States is that irrigation communities and farming communities and power communities that are adjacent to projects, you will find that they are very, very good places to live, and they are very well governed, and people there have a lot of jobs and they have a future and they have a past and they have a heritage, and are very, very proud of all of it. It's this kind of motivation that makes a great country. I don't think we promote enough of that. I think we're too busy making handguns, nuclear bombs, weapons of mass destruction wherever they may be, and political entities whose function it is and goal it is to destroy. I'm very proud that I worked on construction. And I'll leave it at that.

Storey: Well, I appreciate your coming in today. We're out of time again. I'd like to ask whether you're willing for the information on these tapes and any resulting transcripts to be used by researchers.

Ruud: By all means. By all means.

Storey: Good. Thank you very much.

Ruud: I hope they follow my counsel. (laughter)

Storey: Thank you.

END SIDE TWO, TAPE TWO. JANUARY 25, 1996.
BEGIN SIDE ONE, TAPE ONE. FEBRUARY 1, 1996.

Storey: This is Brit Allan Storey, Senior Historian of the Bureau of Reclamation, interviewing Frederick O. Ruud, a former employee of the Bureau of Reclamation, on February the 1st, 1996, at about nine o'clock in the morning. This is tape one. We are at the Denver Federal Center in Building 67.

Could you tell me about the first commissioner that you remember and met and had an opinion about, or had an opinion about?

Liked to Study Elwood Mead as Commissioner

Ruud: Well, if we get to have an opinion about, later on when I started doing research on the Bureau's leadership and things got into this management area, about 1966 or so, I went back to D.C. I began to be interested in this sort of thing, and I was always interested in it, really, but I began to study the life and times of Elwood Mead, which was one of the first commissioners. Elwood Mead started, I believe, about 1923, and he was commissioner for over ten years.

Storey: '24 to '36.

Ruud: Yeah, '24 to '36, and when you look at the management style of Elwood Mead and the way he got things done, you have to recognize that that sort of thing, really, the things that he did built the Bureau of Reclamation, laid the foundation for its tremendous influence and achievement in the western United States. I believe of all the commissioners I've ever known, I think that Elwood Mead probably was the most outstanding leader of any government organization that I could remember or designate.

I've also looked into the work that David Lilienthal did with TVA, too, and he was a very, very effective person.

First Commissioner He Ever Saw Was Michael Straus at the Dedication of the Pumping Plant at Grand Coulee Dam

But the first commissioner that I ever saw live and in person was in 1950 or '51, I guess, when we had the dedication of the pumping plant in Grand Coulee. I had come in '48 and worked on the pumps and the dams and the stuff that was involved with the pumping plant and the irrigation project, and I had a lot of romance associated with it. I mean, this is a great thing that saved the Depression, the Northwest, the huge installation, bring irrigation water to the Columbia Basin.

My grandfather was a pioneer out there in 1883, and lived out in the sagebrush with rabbits and no water. But we were always looking at this. When I was growing up, my grandfather—my other grandfather, my maternal grandfather—was a land loan examiner for the Old National Bank in Spokane, and every summer, in order to get me out of my mother's hair, I think, but he used to take me with his annual field trip down through the Columbia Basin. So I covered the Columbia Basin from Pasco to Grand Coulee, and every stinking swimming hole that there was in that whole area, but I also saw a tremendous number of farms, and lots of travel out in that Columbia Basin. So I was very familiar with it. So between my two grandfathers, I had a pretty good heritage in getting started.

So I worked up there, and, of course, working in '48, '49, on the pumps, then worked on the start-up of the pumps where we had our vibration problems, and I met my future boss and mentor, John Parmakian. But one day they had a dedication of the pumps, and one of my sisters was one of the—they had pretty girls from every town in the Pacific Northwest come with a jug of water to dump into the—they'd dump over the headworks into the canal, as the water from the Columbia was pumped up to the top, and my sister was among those. But I sat and I listened to Mike Straus give the dedication speech, and I thought that here is a man that is truly, truly a tremendous leader. I began to study at that time, be very much conscious of and study very carefully, the leadership styles of the commissioners as they came and went.

I always thought Mike Straus was pretty good. He was awfully effective. Mike Straus' mission right after World War II, in '46, '47, '48, and '49, whenever he got appointed, but Mike Straus was a very close associate and friend of Harry Truman, and the effort of the Bureau of Reclamation was to build all these projects in the West and take up the slack in the economy so that we would not have a post-World War II recession.

Congress Passed a Law Forbidding Payment of Salary to Any Commissioner of Reclamation Who Was Not an Engineer (Mike Straus)

Mike Straus did that pretty good, but the Congress got on his case and, of course, they passed a law that I read an excerpt out of, that no man who was not an engineer could receive a salary as a commissioner of the Bureau of Reclamation. That didn't bother Mike Straus. He said, "I'll be commissioner anyway," and in spite of the fact Congress cut off his salary, Harry Truman kept him on as commissioner until the end of Harry Truman's regime, as I recall, 1952. But I heard him speak, and I thought this is really an inspirational speaker.

Leslie N. McClellan, Chief Engineer

Then I came to Denver about that time, and at that time, when I came to Denver in 1952, why, my boss, Mr. Parmakian, suggested I go up and introduce myself to Mr. McClellan. Leslie McClellan was chief engineer at that time. There was a different agenda that I didn't know anything about, but I went up and I was all dressed up in a nice bright green sports coat, lime green slacks and tie and shirt, and

everything. Boy, I was a really good-looking young guy, so I go waltzing into Mr. McClellan's office and introduced myself as the young engineer that Mr. Parmakian had brought down from Grand Coulee to work for him. Well, unknown to me, I walked out of the office, and he got his secretary and said, "Where the heck did this guy come from, and find out," because he had banned any transfers into the Denver office, but that had occurred *after* he had signed my transfer, and he didn't remember having signed my transfer. So there was a lot of minor storm over that, but when the dust all cleared, he accepted the fact that he had signed the transfer, but because of political things subsequently followed, I was the last guy to transfer into the Denver office from the field for a long time, maybe five years, maybe ten. I don't know.

Reduction in Force Soon after Arrival in Denver

Storey: This was when the RIF occurred.

Ruud: Well, I came into Denver office in October 1952, just before the Eisenhower election and, of course, the week before the election they sent out a memo, "All these rumors about a reduction in force really disturbed me," said the chief engineer, Mr. McClellan. And they had the election, and a week later they announced a reduction in force in the Denver office. So, so much for your lessons in political activities, you see.

Well, there was a lot of jealousy. Here I was just in ~~from~~ the Denver office, and, by golly, non-veterans in our group got laid off, got reduced, and "How come Ruud?" Well, I was a veteran, and I've previously talked about veterans' preference. But that was Mr. McClellan.

I listened to a man named McKay, I think Douglas McKay was his name. He was the secretary [of the interior] under Eisenhower in the beginning, but he didn't last too long. Then the commissioners at the time I was there, during the time I was in the Denver office, well, we used to go back and forth and eat lunch over in Building 53 with Mr. Parmakian. Of course, all the engineers sat together and all the people got acquainted, and I was kind of an ambitious guy, so I was quite sensitive to getting to know these kind of people.

Met Wilbur Dexheimer in the Denver Office

One of the people I got to know was Wilbur Dexheimer, who was appointed commissioner, Bureau of Reclamation, under Douglas McKay, Secretary McKay, I think, as I recall. Well, Dexheimer was a construction engineer, and a very good engineer, very fine man. He had been roommate to Senator Gordon Allott in college, up at Fort Collins—good old boys. So this is the way she goes.

Storey: Is the light bothering you?

Ruud: No, not at all. I just was sitting here watching the traffic.

So Dexheimer did a pretty good job, and we all knew him, but he looked a lot like Eisenhower. As a matter of fact, one time they said that when Dexheimer was in the military, he arrived at an air base someplace where they were expecting Eisenhower, and stood there and took one of these big salutes for the general, a twenty-one gun salute, I guess, or something like that. He looked a lot like Eisenhower himself. He got to meet Eisenhower. I heard that story.

Grant Bloodgood

Later on, Dexheimer had this fellow working for him, and about this same time, later on, Grant Bloodgood became our chief engineer, when Mr. McClellan retired. ~~Now I never knew Wallace [phonetic].~~ I never knew Mr. Walters.

Storey: Ray [Raymond F.] Walter?

Raymond F. Walter, Sinclair O. Harper, and Decisions Made in Denver

Ruud: No, I didn't know him. I never met him. I heard a lot about him and [Sinclair O.] Harper, and there's some kind of story that just after the end of World War II, there was some political turmoil, and was a man named Bob Stark, who was a legal man, headed the legal office here, solicitor's office, came out from Washington to sort of get the [Denver] ~~Washington~~ office under control. There used to be a time that a lot of the administrative decisions and stuff was centralized in Washington, D.C., and a lot of the engineering approval was out of Washington, D.C., and this office as an entity unto itself, the Denver office, being the head of all the engineering for the Bureau.

Storey: You mean the decisions were made independently out of Denver?

Ruud: Later on. I mean, early on, all the power was concentrated in Washington, but after World War II, they started to make this Denver Engineering Center a center of power, and there was a lot of political turmoil. It was explained to me once by a man named Bob Stark, who's dead now. He came out to sort of work on some of the problems associated with that. Mr. Walters and Mr. Harper were very much involved in that, and I didn't know anything about those problems. At that time I was a twenty-one-year-old boy, and just trying to—twenty-two, twenty-three, twenty-five. I was born in 1925, so I was only twenty-three.

Wilbur Dexheimer in Washington, D.C.

So I came to the Denver office, I was twenty-seven, and I got acquainted with those people. But when Dexheimer was in Washington, he was not terribly politically astute. He was a good engineer and a nice guy and able to get a lot of things done, and he operated in the traditional way that Bureau of Reclamation engineers would operate.

Floyd E. Dominy

He had a fellow working for him named Floyd Dominy.[21] Floyd was an agricultural economist, started out in Washington, D.C. Started out in Nebraska at—I forget the name of the project, but everybody in the world came from that project in Nebraska. He was from Wyoming.

Frederick A. Seaton and Floyd Dominy

When there was a change when Douglas McKay left the Department of Interior, Secretary McKay and another new secretary named Fred [Frederick A.] Seaton was appointed to be secretary (1956). Lo and behold, *his* college roommate was Floyd Dominy. Very shortly after that, Floyd was promoted in. He was assistant commissioner for something. Now, these were GS-11, -12, -13, -14, -15. Floyd went up pretty fast from the project in Nebraska to the regional office to Washington, D.C. About this time he was a 15, got promoted to assistant commissioner, probably a 16, GS-16, and then pretty soon things began to happen, and Mr. Dexheimer said, "How did this happen?" Dominy would say, "Well, that was taken care of at this other meeting, where I was at this meeting, so we agreed that this is the way it's going to be done." It was sort of a business of usurping power. It was a power game. I mean, those who play it know how it's done, and it's "the business."

Dexheimer Decides to Retire

Well, it wasn't too long before Mr. Dexheimer announced that he was going to retire. He didn't really have the stomach for the political infighting and cutthroat work that is involved in this sort of thing. Shortly after then, Floyd Dominy became commissioner.

"Sponsorship" in Washington, D.C.

Now, one of the secrets of success in Washington, as explained to me, is that you don't have just one sponsor. The thing that you do is you enlarge your sponsorship. Some of our current troubles with the travel office, this is 1995, some of our current troubles with the [Bill] Clinton regime in the travel office comes, I'm sure, from the fact that the travel people had been in there for twelve years under a Republican administration. The Democrats take over. They know every guy in that Washington White House [travel] office has got a political sponsor, and if they've been in there fifteen years, it was a Republican political sponsors, so that running a Democratic travel office may not have anything to do with it. There might be some dimensions there.

But anyway, every person who is reasonably successful in the Washington scheme has got a political sponsor, and the thing that you have to do to ensure your continuity is to enlarge your sponsorships to get as many people as you can to like you and admire your work and to be on their team, too. Well, Floyd Dominy very

21. The Bureau of Reclamation history program has done oral history with Floyd Dominy.

quickly became intimately acquainted and the friend of Senator Carl Hayden of [Arizona.] ~~New Mexico.~~ Senator Carl Hayden was Floyd's chief sponsor.

Storey: Of Arizona, I think.

Ruud: Yeah, Hayden of Arizona. Senator Hayden had been the territorial representative for Arizona before Arizona became a state, and even at the time that it became a state, or very early on, the establishment of the Grand Canyon National Parks, Congressman Hayden wrote in reservation for the dam site at Bridge Canyon and Marble Canyon, into the [Grand] Glen Canyon National Parks Act.

Storey: The Grand Canyon.

Ruud: The Grand Canyon National Parks Act, so that these sites would be reserved, all of which went for naught later on, but, nonetheless, Carl Hayden was Floyd's chief sponsor and Floyd could do no wrong. He did a lot of great things.

"I did a lot of things under Mr. Bellport's sponsorship . . ."

At this time, of course, Grant Bloodgood is our chief engineer. Very intimately, as I grew and came up in this organization, I became very closely acquainted with Mr. Barney Bellport. I did a lot of things under Mr. Bellport's sponsorship that indicated that I was, you know, somebody that he could rely on and somebody that could be counted on to really produce when times are tough.

Denver Office Becomes Involved in St. Louis Arch Design

Oh, for example, there's a story about the St. Louis Arch. Mr. Dominy was in the secretary's office one day and they were talking about the troubles they were having with the St. Louis Arch.[22] Mr. Dominy said, "Well, our engineering office in Denver could sure help solve those problems." Well, sure enough, bang, our engineering office in Denver, and some of my close associates were involved in studying the St. Louis Arch and the problems with the arch and its structural design. Later on, there was some story about, "Well, what's going to happen when the wind blows? Is this arch going to shake?" So my boss, Clair Crawford, was slated to go back to a meeting in St. Louis about the wind-induced vibration of St. Louis Arch, but suddenly he got a call to go to the [Air Force] reserves in Alabama, and on a day's notice or so, I was drafted to go to the meeting in St. Louis on the St. Louis Arch.

Well, I had known that we had been involved in the stress analysis and the design of the arch quite deeply. I stopped by Mr. Bellport's office, and as I was a good friend by now and on sort of personal communication terms, and while extremely respectful, why, we were rather close. I said, "Well, Mr. Bellport, is

22. This is the Gateway Arch at the Jefferson National Expansion Memorial which is managed by the National Park Service.

there anything about this St. Louis Arch? What can I really do back there that might be helpful to the Bureau?"

He kind of growled at me and he said, "One thing you can do is get us out of that job." He says, "I'd like to get rid of that job."

I said, "All right, if there's anyway I can do it, I'll do it."

Well, I flew back to St. Louis, walked into the National Park Service regional office back there, where some man named Brown was the local administrator, and here was someone that I didn't know was going to be there. It was a man named—it may come to me in a minute. He was the fellow who had done the analysis and the investigation of the failure of the Tacoma Narrows Bridge. There's an internationally known consulting engineer. It'll come to me perhaps. I'll supply it later for the record. But he was in there. We sat and talked a little bit about the problems with the arch and about the capability of the Bureau, and this man was at the point—he was a consultant to the Bureau of Public Roads. So I began to lead him on to discuss with him what the capabilities of the Bureau of Public Roads were, and it turns out that they had a—Farquarson, Farquarson. Try to remember that name out of the clear blue. Farquarson. He was a—

Storey: Do you know how to spell it?

Ruud: I sure don't. Well, yeah. Yeah. F-A-R-Q-U-A-R-S-O-N, I think, Farquarson. I think that is the name.

Anyway, he told me about the Bureau of ~~Reclamation~~ [Public Roads which] had the wind tunnels, and they had all these people who were capable of doing model studies of this bridge—

Storey: The Bureau of Roads?

Bureau of Public Roads Takes on St. Louis Arch Work

Ruud: The Bureau of Public Roads had this wind tunnel in D.C. That's where he was based, and he had a good staff back there working with that, how they could do all these studies of the arch, and a model study. I suggested, well, it might be very convenient for those same people from that same office to do field installation of the instruments necessary to measure the wind-induced vibration of the arch, that really the wind-induced vibration was not a design problem or structural problem at least, that the Bureau of Reclamation had done structural review of this job, and that it would be far more convenient if he and the Bureau of Public Roads and all their staff did both the field studies and the model studies, so that they could coordinate and correlate this. We, the Bureau of Reclamation, would not be involved in this sort of thing, and there wouldn't be these travel and transportation and coordination problems, so that it could be under a single agency, and it would be far more convenient to do that.

Then he said he thought that would be really good, and he thought it would be just fine, and the commissioner, the man who was head of the office, Mr. Brown, said, "Well, that's all right with me. I think that would be just great." He said, "Well, would you like to go up on the arch?"

I said, "Yeah, I would."

So I went out and we went up on the arch, and even then we rode up on a squirrel cage on the outside of an I-beam, 400 feet up in the air on the unfinished arch. I took about two, three rolls of pictures of all of the things that I could—anything I could see that anybody might be interested.

I came down off the arch and he said, "Well, you want to stick around? You want to have any more meetings?"

I said, "No, I think I'll just go on back to Denver. I've seen about everything I need to see."

I was out standing in line to get on the plane and my knees were going like castanets. I wondered why they were doing that, then I remembered where I'd been. I'd been up on the arch walking around. I'd never been up that high before, and all they had were sort of two-by-four guardrails around the outside of this thing. I was kind of spooked walking around looking at the particular details.

But I got out to Denver and I came into the office, seven o'clock in the morning with three rolls of film, and I told these people in the labs to develop these quick, I needed the slides for a meeting at nine o'clock, and I held a big meeting in one of the conference rooms, and sort of a big show-and-tell for the chief engineer and all the structural people involved in this, and I went up to see Mr. Bellport. I said, "I don't know that it's terribly final yet, but from all indications I've known in the meeting, we're out of the St. Louis Arch. We're done. All this wind-induced vibration problem has been turned over to the Bureau of Public Roads. We are out of it. We're completely out of it so far as anything we're going to do with it. It's all now Park Service and Bureau of Public Roads."

". . . I was increasingly called on to work in problems and areas that had some political implications. . . ."

And that's the way it came to pass. Because of my ability to do this kind of stuff, I was increasingly called on to work in problems and areas that had some political implications. So Mr. Bellport was very, very kind to me in that regard and he sent me a lot of places, did a lot of jobs that involved great political problems.

Running the Pumps at Dos Amigos Pumping Plant

In 1968, we had the Dos Amigos Pumping Plant. We had a vibration problem with some variable-pitch pumps that would not run very well, and I've previously discussed this.

Storey: Yeah, you have.

Ruud: But I went out one day and I said, "Well, we've got to start the centrifugals."

The designers said, "Well, we can't run those, we've got to start this because that's what the contract says."

"Well," I says, "is centrifugal ready to go?"

He said, "Yeah."

"Well," I said, "let's run it."

So they made the arrangements, everybody did all the necessary things, the operators were ready to go, and we started the centrifugals and tested them with instrumentation, got them to pumping water, and met the legal contract requirement to deliver water for irrigation in the canal by one week. We were held up. They had us over a barrel, because until we got the variable-pitch pumps to go, we couldn't fill the canal. Well, I started the *other* set of pumps. They were just normal everyday run-of-the-mill pumps, and we filled the canal and met our water commitments. This became the standard performance, of course, then, for the variable pitch. When we could bring the variable pitch pumps to the same level, then standard performance of the fixed-blade pumps, we were done with the job.

But this involved a tremendous political question. I mean, if the Bureau failed to meet its water contract commitments, there were other problems we'd have. But I used my weight and insisted we start these and then run them. It's those kind of things that earned me my spurs with Mr. Bellport.

Management Training in Washington, D.C.

I went back to Washington in '66 on the managerial training program, and at that time Dominy was commissioner. I learned a lot of things, met a lot of people, and subsequently we got the Third Powerplant started because of some of those activities.

"Floyd Dominy was number one, and the Bureau of Reclamation was just a vehicle that got him there . . ."

Mr. Dominy was quite a commissioner. He was really rather famous and we had a lot of achievements, but like a lot of great people, we all have our blemishes. Mr. Dominy had one that was a tremendous Achilles heel, but somehow he didn't recognize it, and I guess maybe all of us have this same problem, but he became identified, himself, with the Bureau of Reclamation. This is none of the things that you find in the study of Elwood Mead's activities. No matter how great he was, he was not greater than the organization. The organization was always greater than Elwood Mead. He got a strong staff around him, and he promoted his staff, and he promoted his projects, and it was achievements that made Elwood Mead. Floyd

Dominy was number one, and the Bureau of Reclamation was just a vehicle that got him there, and anybody that didn't owe 100 percent allegiance to Floyd Dominy didn't do too well. Floyd became "Mr. Reclamation." Well, because of some of the things he tried to do as a strong leader, he made some strong enemies. Now, the tactics of these enemies I will disagree with today. But nonetheless, because of the nearsightedness of the commissioner, the attack on the Bureau was an attack on Floyd, and an attack on Floyd as an attack on the Bureau, and it was not separable. Because of that, we went into all of this tremendous turmoil about the Bridge and Marble Canyon Dams.

In the meantime, we built Glen Canyon, and even today it holds water. We built Ruedi Dam, and today it holds water. Both of them are fine dams. But Floyd, Mr. Dominy, became increasingly vulnerable because of the enemies that he incurred that were enemies that decided that they were going to destroy the Bureau of Reclamation by one trick or another.

Now, one day as I was in Denver, we were wondering about what was going on, and we heard that the Congress had passed a law authorizing the Central Arizona Project. Carl Hayden was ninety-two, was in his last term, and the question was whether Carl Hayden was going to run again or die in office. The Congress passed the law authorizing the Central Arizona Project. I told my wife, "It's all over for Floyd." I said, "He'll be out of there very shortly." Sure enough, shortly thereafter, he departed from the Bureau of Reclamation.

Storey: Why is that?

Ruud: Why?

Storey: Why do you think?

END SIDE 1, TAPE 1. FEBRUARY 1, 1996.
BEGIN SIDE 2, TAPE 1. FEBRUARY 1, 1996.

Storey: I'd asked you why you thought that Mr. Dominy would be gone soon.

". . . when Carl Hayden announced his departure, why, Mr. Dominy lost his chief sponsor. . . ."

Ruud: Well, by this time, Floyd had built, of course, and a couple thousand other people and $500 million, had built the Glen Canyon Dam. Senator Carl Hayden of Arizona was very near to that, but when Carl Hayden announced his departure, why, Mr. Dominy lost his chief sponsor. He had others, and he didn't go easily, but he did go. He, I guess, lives up in the Shenandoah Valley, or at least did. I believe he's still alive. I don't know.

Storey: Yes, he is.

Ruud: He has done some international consulting work in various areas, but he was no

longer active in the government.

Ellis Armstrong

About that time, Grant Bloodgood resigned and retired as chief engineer, and Barney Bellport was in, but now Bellport was our chief engineer here in Denver, and then Ellis Armstrong ~~became our chief engineer. I mean Ellis Armstrong~~ became our commissioner.

Simultaneously, I was rising a little bit. I got promoted 12, 13, and 14, and I was doing increasingly better work. Some would argue with that, but increasingly more political work on occasion, and things that involved political projects. I made a point to get acquainted with Ellis Armstrong and we began to start this thing about goals of the Bureau of Reclamation. We had lots of little panels that were formed, and once in a while we'd set up a meeting with the commissioner or assistant commissioners who would come to town, and because of my tour in Washington, I had become acquainted with some of those people. So I had their names and phone numbers and could converse with them, and began to develop a little bit of political sponsorship of my own. So we would have meetings.

". . .'That's the trouble with you guys, you just gold-plate everything too much.'"

I can give you one of the personal experiences. We had a meeting in our oak table conference office. There were a lot of nice people around there, creative people, and Mr. Armstrong was sitting there, and he says, "Well, one of the problems you people got to do out here, you've got to build projects more economically." He said, "That's the trouble with you guys, you just gold-plate everything too much."

". . . you see what you do is you fudge on the factors of safety of structures or whatever it is you're doing, until you lose, and, unfortunately, we lost Teton Dam. Maybe if it had been gold-plated a little bit, it might not have been lost . . ."

Well, gold-plating or not, we've got a pretty good record, and you see what you do is you fudge on the factors of safety of structures or whatever it is you're doing, until you lose, and, unfortunately, we lost Teton Dam. Maybe if it had been gold-plated a little bit, it might not have been lost, or if it had had bigger factors of safety or some other features had been included, just for safe purposes, rather than overriding edicts that were not going to change the wheels because we don't have money for new wheels. For example, on an airplane with cracked wheels. But everybody does as well as they can.

Ellis departed, and for a while, there was another commissioner.

Storey: Gil [Gilbert G.] Stamm.

Ruud: Gil Stamm. Thank you for reminding me. I thought of his name this morning when I was thinking about this. I knew Gill Stamm as an assistant commissioner. There

was Assistant Commissioner [James J.] O'Brien for all of planning.

Now we get up to about 1976, or '72s. I don't recall any great things happening during this period of time that I had. Of course, we were in the process of *building* Grand Coulee Third, and I was intimately involved in the hydraulic turbine planning, design, construction, and initial operation of those turbines. I was very close to everybody that was involved in this, both from a political and an engineering point of view.

Storey: Now we're talking about during Stamm's term?

Ruud: I think this about the time.

Storey: Yeah, that would have been about '77.

Ruud: '72 to '77?

Storey: No, he was '77 to '81.

Ruud: Stamm?

Storey: Yes. Ellis was '73 to '77.

Ruud: When was Higginson?

Storey: Keith [Higginson] was '81 to '84, after Stamm.

Ruud: Higginson. Higginson was commissioner before I retired.

Storey: Wait. Oh, I'm sorry. I'm reading down the line. Stamm is '73 to '77, and Keith was '77 to '81 under Jimmy Carter.

Third Powerhouse

Ruud: All right. Okay. Well, back up a little bit. The authorization of the Third Powerplant, the decision to build Third Powerplant with 600-megawatt units was made about 1968. That's when Mr. Dominy and Mr. Bellport were involved in the decision with Secretary Udall.

Storey: And Ted Mermel, I think.

Ruud: And Ted Mermel, and Morgan Dubrow were all involved in this, *and* Assistant Secretary Holum. These people were all involved in that. Ellis Armstrong then became commissioner after the election of 1968. Everybody has their political sponsorship, and if Humphrey-Muskie had been elected in 1968, things might have been somewhat different. But that was the turning point, is the election of '68.

Then Ellis Armstrong became commissioner, and that was during the time

some changes were made ~~for the second and third units~~, about 1972, for the second three of the six units at Grand Coulee. Then Stamm was involved, and I was at this time traveling in and out of Washington from other reasons, when I met Stamm, and I knew him quite well, and I knew O'Brien at the time. But then we became involved in this thing with the new ideas and groups and people around. What are we going to do in the Bureau of Reclamation for work? Because most of the major dam sites had been constructed. Is there some new problem? Everybody used to say to Reclamation, "What do you reclaim?"

"Well, we reclaim the desert."

"What do you do?"

"We reclaim the desert by using water to build homes and that sort of thing. There are whole projects around that particular core idea."

Wind Power and Solar Power

But then we say, well, let's reclaim energy from the wind. Another fellow and I, named Stan Hightower here, Stan and I began to talk about wind power and solar energy. That's after I hired Hightower. He was working for Martin[23] at the time, but I hired him. He was looking for a more permanent position. He came to work with me on another project, not terribly significant. But we began to talk about new energy sources and new programs.

So at that time, there was a man named Mr. Ted Curtis, who was an assistant to Higginson, a temporary assistant. They're allowed a temporary assistant to assist them in getting started, in transition activities, when a new commissioner takes over. So because of my contacts now with the assistant commissioners, and my previous contact with Stamm, other people, my contacts with Ted Mermel, I worked with Ted and he suggested that I call Dr. Curtis. So I visited with Dr. Curtis and talked about the wind power idea, and Dr. Curtis visited with Secretary Andrus and Keith Higginson about the Bureau of Reclamation getting into wind power a little bit. Ultimately it was authorized, and we put up some experimental turbines in Wyoming to investigate the feasibility of integrating wind power with our hydroelectric system, by use of these wind turbines up in Medicine Bow in Wyoming. Those were authorized and placed into operation about this time.

I met many times with Keith Higginson here in Denver, and once in a while in Washington, why, I would see Dr. Curtis and Higginson and Ted Mermel. Lots of ideas are talked around about "what are we going to do to stay in business and keep an active agency." We can be of a constructive force in the energy picture or

23. This refers to "Martin Marietta Corporation was founded in 1961 through the merger of The Martin Company and American-Marietta Corporation. The combined company became a leader in aggregates, cement, chemicals, aerospace, and electronics." Source is http://en.wikipedia.org/wiki/Martin_Marietta accessed on June 1, 2007, at 4:35 P.M.

water picture for the western United States.

Commissioner Robert N. Broadbent

They had this election, I guess, in 1980, and Mr. Higginson departed and Mr. Broadbent became commissioner, and I knew him very, very briefly. I never had a great deal to do with Mr. Broadbent, except that I had a conversation with him at the dedication of the wind turbine up in Wyoming. I went up to the dedication. It was open to the public, so I put on my father-in-law's famous straw hat and went to the wind power dedication. Stan Hightower and I were there with each other. Stan and I were the people who had made it and *knew* what this project was. Between the two of us, we went from two guys beside a desk just like you and I are here at this moment, to a $14 million project that was completed in seven years, and that subsequently operated very well, I might add.

". . . wind power in Wyoming is an entirely feasible undertaking and does produce the energy . . . on a schedule during the day . . ."

It did prove that wind power in Wyoming is an entirely feasible undertaking and does produce the energy that it was said to produce and on a schedule during the day that it was said to produce. In other words, it produces a majority of its power at peak—power demands. That's from nine o'clock in the morning til three o'clock in the afternoon. After sundown, the wind goes down and stays down until about nine o'clock the next morning. Then it comes up just like clockwork.

I met Mr. Broadbent at the Bureau of Reclamation dinner in Cheyenne, and we all journeyed out to the—well, maybe it was in Laramie, I don't recall, probably in Laramie—and we all went out to Medicine Bow to the start-up.

Bob (Robert A.) Olson

I knew Bob [Robert A.] Olson, who was acting for quite a while in the Reagan administration. I met Bob when he was a GS-9 down in Hoover, down at Boulder Canyon Project at Boulder City, and he was a power engineer. I went down there to do some turbine testing work because of vibration and noise some of the Hoover turbines were making that was objected to, and I went down to evaluate this and give a learned opinion.

As an aside, I almost became known as the guy that flooded Hoover Dam. They had some manholes that were over an energy dissipation thing for the bypass valves, and I couldn't get good pressure readings. I asked if I could bleed the air bubble out of the top of this column, and they said, "Sure. It's been done before." So I did this, ran a test, and blew the gasket out from under the manhole. I looked around the corner and here's a gusher of water a couple of feet high coming out of the floor. Well, we got it fixed, we got the gates down and controlled the water flow, but subsequent to that we made some modifications to make sure that that would never happen again to anybody. No more of this, "Oh, it'll be all right until next time" stuff. Made some modifications of instrumentation and compressed air

that that bubble always will be there. That's going to be in the operating criteria for the unit, that everybody would know about it, and what its function was. In other words, to reduce some of these things that are not written, put them down in what we now call documentation, so that everybody knows what the play is and nobody makes these mistakes.

I also met Bob Olson when he was commissioner again. I've been in touch with him, and I met him, stopped by Washington one time during my World Bank activities. Of course, I retired from the Bureau in 1980, and that was before Mr. Broadbent become commissioner, and since that time, I knew of Cliff [Clifford I.] Barrett. I didn't know him very well. I had met him once or twice when he was assistant commissioner in Washington during the sixties and seventies.

But lots of these people have been involved for long careers in Washington, and they all have their contacts and sponsors, and the name of the game is politics, and the name of the game is getting something done. Achievement is the primary motivation of all of these people. It's very, very interesting to review the careers of these leaders to determine how it is that they actually succeed. There used to be a song about, "You've got to have the old ace in the hole." Well, what is their ace in the hole? How is it that this man came to the position that he does have? What did he do and what price did he have to pay? I must say that in many of the activities that we watch, we see people who are in these positions, and occasionally they have a tremendous price they have to pay, both personally as well as professionally. So it's a very difficult business.

I knew Ted Mermel in the Washington office for years and years. As a matter of fact, I still know Ted. He's still alive and he's still very active. He worked for the World Bank. He was a source of many consulting jobs through the World Bank for other people. Ted always knew a lot of people everywhere, and he was quite willing to recommend you for some work for the World Bank.

I enjoyed all of my work for the Bureau. Matter of fact, even now, as I suggest in my previous interviews, the Bureau of Reclamation activities set the standard for a great many activities, a great amount of work, in the world. I want to know how does the Bureau do it. Your experience from that point of view lends you in good stead.

"The designs of some of the later dams are a lot better than the design of earlier dams. . . ."

I also must add that the amount of willingness to move forward and to design new things comes from one's experience with the Bureau, because, well, it's looked upon by others as a rather staid militaristic agency that is inflexible and doesn't get much done. As a matter of fact, because of the consequences of the things that we work with, we have to be very careful, but we do move forward in our designs. The designs of some of the later dams are a lot better than the design of earlier dams. We know so much more about them that we reduce our factor of safety. We used to call it a factor of ignorance; that's been replaced by a factor of

knowledge because of so many young people that are so much better educated and so much research work that's gone into the construction operation of our projects.

Still, ~~as a matter of~~ in closing, I travel around the country, I'm retired, I'm seventy years old, and I travel all over the western United States and it's always a tremendous source of pride to visit any Reclamation project, and anywhere I go, especially the projects that I worked on, of course, now I have this old grey man says, "Well, I worked on this a long time ago."

Storey: You mentioned during one of the prior interviews that you established standards and enforced them, and that you had some more stories about those. Are there some you would like to talk about?

Ruud: Well, I wrote the monographs for the wye branches, and that became a method that's followed, but mostly by people who are interested in a more sophisticated design of wye branches. I think I talked about that.

Storey: Yes, you did.

Ruud: But now they have gone back to more simple methods.

Then one of the other things that we have, when you build so many valves and so many pieces of pipe and so forth, it's a lot easier to take the old design and use it at a slightly lower pressure, for example, than it is to create an entirely new design. The engineering work has become so much more expensive than it used to be. We used to be able to do an awful lot of engineering and use a little material, and now, why, they can't afford to spend a lot of time in engineering because the material and the fabrication is a little bit cheaper than the engineering costs.

Engineering Costs Have Risen over the Years

The engineering costs have gone from—well, for example, I don't know what entering engineer—I entered the Bureau of Reclamation with a college degree at $1.50 an hour—$3,100 a year. Now the entering level of GS-5, I don't have a late schedule, but it's probably something in the order of $25,000 a year, or maybe knocking on $30,000. But GS-12 now makes $70,000 a year, and GS-13 and 14 makes $70,000 a year.[24] So that the salary structure has made engineering costs a lot higher.

I did write, also, Monograph Number 30, which is *Stress Analysis of Hydraulic Turbine Parts*.[25] That became a standard pretty much for everybody in the country. What we tried to do is just simply write down what we were doing so

24. Salary costs in 1996 in Denver were: GS-5-Step 1-$20,291; GS-12-Step1-$44,584; GS-13-Step 1-$53,017; GS-14-Step 1-$62,650. On top of this there is an additional Special Salary Rate for some classes of engineers in order for the Federal pay scale to remain competitive with pay in the private sector.
25. See Footnote 6.

that other people could use it. It was a pretty wide seller, although highly specialized.

Responsibilities as Federal Engineers to Distribute Knowledge

All the papers that I wrote, my mentor Mr. Parmakian used to believe, and tell us, and insist that we, as engineers for the United States Government and the Bureau of Reclamation, had a duty incumbent upon us to spread our knowledge around so that everybody could use it. We don't have trade secrets, and so when we would have a lot of achievements, make some new discoveries, why, we tried to write papers to be published by the American Society of Mechanical Engineers, the American Society of Civil Engineers, others, whoever could publish them, so as to disseminate the knowledge of our experience in the Bureau of Reclamation, so other people could use it. That's part of our salary. That's one of the things we're paid to do, not to keep all of this as a trade secret to ourselves, because I can suggest that I have worked on two or three projects that while they're rather unique in our own experience, upon research, why, I would find that other people had done them, too. No one stands alone. We're all on each other's shoulders.

The library. If I could put a plug in for the Bureau of Reclamation Library, the Bureau of Reclamation Library is one of the outstanding examples of a technical library and water resources and all the aspects of water resources that exists that I know of in the world. The Department of the Interior Library in Washington, D.C., is also quite unique in the possession of a lot of materials on our Western public lands over and above hydroelectric engineering. Hydroelectric engineering is a great part of it, but also the Park Service, the Bureau of Mines, a lot of these other agencies, the Bureau of Land Management, a lot of these other agencies, the Bureau of Indian Affairs, a tremendous library on early history of the Indian tribes in the United States.

I must add that I have a special interest. My wife is maybe a thirty-second Cherokee, and we have always been interested in Indian history. They were here twenty times as long as the existence of Christianity in the world. They were here in North America. They covered it all on foot until the last 1,000 years. So it's interesting.

Storey: What did you do in your management training course? How long were you in Washington?

Management Training Course

Ruud: I was only in Washington six months. We rented a little house and lived out in Virginia, out in Arlington. It was sort of a rotation program. We went to work for different people within the organization, worked for different folks in all the different parts of the Bureau of Reclamation. You could just really name your own program. You had to manage yourself, and you could go anywhere you wanted to, anywhere you could talk somebody into putting up with you, or moving in an extra desk, or giving you something to do, you could go to work for them. It was totally

free and unstructured. There were some structures of it. We did have meetings that we had to go to. We had a guest speaker or program that all these people from different parts of the government would come to speak.

Working for Assistant Secretary Kenneth Holum

Two of my assignments that I especially valued is working for Assistant Secretary Holum, as I have previously described, and working for his engineering advisors, Morgan Dubrow, who was his advisor for water, and Karl Lee, who was his advisor—pardon me. Mr. Dubrow was his engineering advisor for power, and Karl Lee was his advisor for water. Other than that, I worked in the public affairs office, I worked in [the] power division, I worked in the planning sector. I tried to get a job working in Senator Jackson's office up on the Hill, but I don't believe I ever worked up there.

Creates Agenda for Water for Peace Program

One of the things that I did do, Mr. Karl Lee was part of an interagency task force that was to prepare an agenda for the Water for Peace Program. We had one meeting. I went with him. He says, "Well, you want to see how this stuff works, you come with me." We went to this meeting and all of these representative were there from all over the Cabinet agencies. There was a Water for Peace Program that had been started by somebody who suggested that, "Wouldn't it be great if we had a Water for Peace Conference." We were having other something, and it was really a very casual suggestion that somebody picked up on and said, "Hey, that sounds like a good idea. Now you're going to have a Water for Peace Program, you come up with an agenda."

Well, I went to a meeting where the purpose was to establish the agenda. A lot of people had all these ideas. He said, "Will you give them to me?" said Mr. Lee. Since the Department of Interior had suggested that the Department of Interior was the coordinating agency and responsible for it, well, Mr. Lee handed his stack of papers to me, and he said, "Fred, *next week* you go back to the meeting with an agenda for the Water for Peace Program. I've got to go to Ohio." (laughter) Well, a little sweat, a little blood for about a week, but I wrote the agenda for the Water for Peace Program conference in Washington, D.C. It was published. It was adopted. Then I had to defend that same agenda. I took this back and by now I had Xeroxed copies, handed out all these copies to all these fifteen different people from fifteen or twenty different water agencies in the United States government, and I had to defend this agenda against all comers, you know, political negotiation. You say, "Well, what do you want? Well, is that covered here? If we cover this, are we going to have enough room for other people? Is this going to cover the waterfront, so to speak?" So I negotiated this thing out, and we finaled it out and it went very well. I was always very happy about that. I'd sort of forgotten about that.

Outlined Speech Later Used by President Lyndon B. Johnson

Another thing we did, and as I believe that I mentioned this before, but one day—well, I listened to President [Lyndon B.] Johnson speak on the occasion of a ceremony honoring the widow of Woody Guthrie. Woody Guthrie was one folk singer that became an employee of the United States Government to write songs to publicize the Reclamation efforts and the efforts of the Department of the Interior in the western United States. Of course, the most famous song that he wrote, as an employee of the Department of the Interior, was "This Land is My Land, This Land is Your Land, This Land is Made for You and Me." That's one of the songs. He wrote a lot of others. "Roll on Columbia, Roll on" was another. And a lot of others that *I* don't know of. But I went to listen to a speech by Lyndon Johnson at that time. As I mentioned before, ultimately one day I outlined a speech that provided the core idea for a speech that was given by the president at Summersville, West Virginia, at a Corps of Engineers dam.[26]

Storey: Well, now, you were there when Floyd Dominy was commissioner.

Ruud: Oh, yeah.

Storey: How did he deal with people? What kind of an appearance did he put on?

Sat in on Program Conference with Commissioner Floyd E. Dominy

Ruud: Well, Floyd was a consummate politician. He did pretty good. He had a pretty high opinion of himself, but he was good dealing with people. I watched a lot of times. He sure knew who was higher than he was, and, consequently, also knew who was lower than he was in the hierarchy. Floyd was very much interested in the power game, and I mean political power, not electrical power. Floyd was very, very astute at the political power business. I sat in on what they called the Washington Program Conference, where all the regional directors would come. They would present their pro—

END OF SIDE 2, TAPE 1. FEBRUARY 1, 1996.
BEGIN SIDE 1, TAPE 2. FEBRUARY 1, 1996.

Storey: This is tape two of an interview of Brit Storey with Frederick O. Ruud, on February 1, 1996.

Ruud: When I sat in these programming conferences, we were kind of sworn to secrecy. We were not going to go out and publicize the things that were discussed in there, but it was for our own experience to learn how these things were done within the Bureau. I got to watch the Commissioner Dominy and the regional directors in a give-and-take, one-on-one, or one-against-the-group basis at this high level, I consider that really a great education in learning how to get things done in that kind of a highly politically charged in some ways. It was internal politics about whose program is going to succeed. It's this regional director's program versus that

26. See page 42.

regional director's program, and all of the political sponsors behind each one of these people, and there has to be some tradeoffs made.

But I thought Floyd was pretty good at doing that sort of thing. He did very well. I have seen a little bit of it since that time, but on an independent judgment with no other one to compare to, I thought that Floyd did a pretty good job of handling that bunch. I mean, they are pretty powerful people with hundreds of millions of dollars worth of projects that they're responsible for. I thought he did pretty good. Floyd had a few other personal defects, but I don't care to enlarge on that kind of stuff, because we all have our warts. I mean, everybody's got some defects, it's just that some people's are more obvious, and some people's are more irresistible than others. Floyd was a good man. As I said, as far as I'm concerned, he only had this one great defect in that it was impossible to separate Reclamation from Dominy. Now, that's the good news and bad news. The good news is you got a heck of a strong man, and the bad news is that you attract all the strong enemies.

Chief Engineer Leslie McClellan

Storey: Tell me about McClellan. What did he look like? How did he deal with people?

Ruud: McClellan was a very quiet fellow, very tall—not very tall—he was six foot or so, six foot-one, about my height. He dealt with people very kindly. He was a consummate gentleman in all his activities, so far as I know. I never heard anything about McClellan. I had some conversations with him away from the Bureau on other occasions. He was electrical engineer. He was head of electrical *and* mechanical during an earlier period before he became chief engineer, and was always a very fine gentleman to work for by all accounts that I ever heard. Even in spite of this incident that I tell you, where I was supposedly the intruder against his edict, I had other occasions to visit with him subsequent to my meeting him the first time, and he not once ever held that against me in any way that I could even remotely sense. It was done. I was in there working hard for him, and I was one of the men. I consider Mr. McClellan to be a truly fine gentleman. He lost his wife at one time because of cancer, I believe, and he had to spend a great deal of time with her, and this was while he was chief engineer, I believe. Grant Bloodgood was his assistant and others.

Chief Engineer Grant Bloodgood

Storey: Tell me about Grant Bloodgood. Same question. What did he look like and how did he deal with people?

Ruud: Grant Bloodgood looked like my father a little bit. Grant Bloodgood was about 5'10". He was kind of coarse-featured, had the nice skinny bald head, nice bald head that I have. He dealt with people very straightforward. He was a very good man.

Grant Bloodgood and Harry Morrison

I have some interesting history about Grant Bloodgood. Grant Bloodgood loaned Harry Morrison money to buy a team of horses so that Harry Morrison could bid on a Bureau of Reclamation contract, and he lost his shirt. Subsequently, Grant Bloodgood loaned him some more money, and he bought two teams of horses, and he bid on another Bureau of Reclamation project, and he made some money, all of which Harry Morrison gave Grant Bloodgood stock in Morrison-Knudsen Engineering Company.

At one time during the fifties, there was a big uproar about people that owned stock or people that had outside financial interests. Grant Bloodgood was associate chief engineer at that time, and he told them that he'd resign as assistant chief engineer before he'd relinquish his stock in the Morrison-Knudsen Construction Company.

I went to a speech one time, and Harry Morrison had had some vocal chord problems, I don't remember, but he had to talk in a whisper, and he sat in front of the microphone, but he could talk in this whisper. I listened to his speech. All the engineers heard the word one day, "Come over to Building 56. Harry Morrison's going to talk." So we went over, and here was all the big wheels from Morrison-Knudsen and Grant Bloodgood up there as chief engineer, had a little bit of a talk and ceremony, and he said, "We've invited Mr. Harry Morrison here to tell us about the Morrison-Knudsen Company and about his experience with the Bureau." They told all these stories about this thing, and Grant Bloodgood gave that talk.

I liked Grant Bloodgood. He wore suits and ties and stuff, but he looked a lot like a baggy-pants farmer. We used to say, "an honest-to-God dirt farmer," as my mother would say.

He'd started out in his very first job, I believe, as an assistant engineer, field engineer, in Owyhee Dam in Idaho,[27] where Harry Morrison got his start. They became friends, stayed friends for life. Grant Bloodgood is a very good man. He was a little bit gruff in his approach as compared to McClellan. McClellan was very smooth and very, very quiet. Grant was kind of loud and kind of gruff, but the construction people knew who they were dealing with and there was no mistake about it.

Kenneth Keener, Oscar Rice, Bill Wolf

With all of these people, almost without exception—not almost, I can say *without* exception, unqualified—the people that I knew who were chief engineers and division chiefs, chief of design division, Kenneth Keener. Oscar Rice became chief of design division, was a dams engineer. Bill Wolf had been in structure and architectural. I used to laugh. He was just the oldest GS-13. He was a GS-13 for sixteen years, and he got promoted to assistant structural, for the assistant chief design engineer for structural, and then architectural, then he became associate

27. Owyhee Dam is actually in eastern Oregon, close to the Idaho border.

chief engineer. Bill died. He had a heart attack. He had had rheumatic fever when he was a young man and child. One day he flopped over of a heart attack very unexpectedly. It was a rather a tragic thing for the Bureau. But without exception, all of these people represented the Bureau of Reclamation with a great deal of integrity and a great deal of enthusiasm. They were company men.

Storey: What did Barney Bellport look like, and how did he deal with people?

Barney Bellport

Ruud: Well, Barney was a taller fellow. He was about six foot tall. I never met Barney before he came to the Denver office, he was a regional engineer in California, and some of my friends I met in California had known him when he was a regional engineer out there.

Storey: Regional director, I think.

Ruud: Well, he was a regional engineer, then he became a regional director. See, a lot of us who were in the Bureau a long time, we had a long history of working on all different projects all over the Bureau, so we knew a lot of people, we knew a lot about a lot of things that went on. Barney Bellport was no exception.

Conductor Trouble on a South Dakota Transmission Line

Tall, grey-haired, iron grey, black and iron, a mustache. He was very straightforward in dealing with people. He had no problem in getting work done. I dealt with Mr. Bellport on many occasions, and there's one area that I guess maybe it's a little vain to be a little proud, but I'd helped Mr. Bellport out a lot, and we had a lot of projects that we'd worked on, besides the St. Louis Arch thing. But one day there was a problem up in ~~North Dakota—not North Dakota,~~ South Dakota. There was a transmission line that goes from Fort Thompson, South Dakota, to Grand Island, Nebraska, called the Fort Thompson-Grand Island Transmission Line, built by the Bureau about the time they were building a project dam up near Fort Thompson, and I can't really think of it, but ~~I can think of it.~~ I was up there just recently. But they were building this transmission line and they had trouble with the conductor.

Have I told this story about the conductor?

Storey: No, I don't think so.

Ruud: They used [to] ~~a~~ bush-up and birdcage, and they were after the root cause of this, so Mr. Bellport asked that I be included on the team that was going up there. So we went up there one time, and it was not in the middle of the winter, but it was pretty cold. We went out all over this thing and got some look at the transmission wire at various places, and it was *loose*. The outside strands were loose.

So I started doing some investigation in this technical engineering analysis

work. I finally determined that the outside strands were loose and there had to be some cause to it. I had dug into it and dug into it. Well, we had this big meeting, and the manufacturer was here, and the construction contractor was here, and little old GS-13 Fred Ruud was included in this group because I've been up there doing some studies and they wanted me up there for my input. By this time I knew all of these guys and knew the lawyers and so forth. The conduct of the meeting was of interest, but finally I knew I had something hot, so I kept my mouth shut, and finally, at the very end of the morning session, Mr. Bellport was sitting at the far end of the table. He looks at me and he says, "Well, gentlemen," he says, "We've heard from everybody in this room except one," and he said, "He's sitting down at the other end of the table looking at me right now, and I want you to meet what I consider the smartest man in the Bureau of Reclamation, Mr. Fred Ruud." He says, "Now, Fred, would you tell these people what you found?"

I always considered that a compliment of a lifetime, when it comes from a chief engineer of the United States Bureau of Reclamation. But incidentally, what I found is that on a statistical basis, they had been required to send in samples of the wire, [to permit Reclamation to check the] ~~for~~ diameter of the wires of the different cables that they had furnished, the different reels of cable. I had done a statistical analysis of this using a totally outside program, not something that we had written, but totally outside. I told them that there was only one chance in a million that the samples that they had submitted [matched] ~~were~~ samples [taken] from the wire. I didn't know why this was, but I would say that the computer program says there's only one chance in a million that what we got is what was submitted. "Well," he says, "let's break for lunch." Well, they broke for lunch and they never called me back. They never called any of us back.

The wire supplier sent out a fleet of flatbed trucks and picked up every reel of wire on the job, and bought replacement cable from their competitor to complete the job, $4 million worth of electrical conductor. I like to think that maybe I had something to do with that. I later concluded that it had been mismanufactured and they thought they could palm it off on the United States government. They underestimated us. We enforce our specifications. It's like the very first job I was on as an inspector. We mean what we say when we write these specifications, that's why we write them. And it's because of that kind of conduct that the Bureau of Reclamation has its engineering reputation in the industry and in the world.

Bellport was a very good man, and he was kind to me.

Storey: I've been told that he liked to embarrass people and chew them out in front of other people.

Ruud: Oh, he may have on occasion. I would say that of all the people that you'll ever talk to, Mr. Bellport had more reason to crucify me than any person that he ever dealt with because of the problems with the size of the units at Grand Coulee, Third Powerplant, but Mr. Bellport respected me and he treated me fine, and I never, ever can give you an instance where he ever spoke to me in anything but the kindest most respectful terms. I thought he was a marvelous man.

Harold Arthur

Storey: Okay. How about Harold [G.] Arthur?

Ellis Armstrong, Jack Hilf, Harold Arthur

Ruud: Oh, Harold and I were buddies. Harold's a good man. Harold and Ellis Armstrong and Jack Hilf and a couple of others all worked together as a little clique in earth dams. When Ellis Armstrong became commissioner of Bureau of Reclamation, of course, everybody has their friends, and Harold Arthur by this time had risen to be chief design engineer and was also a chief engineer, I think, about this time, at least under Ellis.

Storey: Yes, he was chief engineer from '72 to '77.

Ruud: Yeah. Harold Arthur and I were always the closest of personal friends. I can tell you a story, old associations of the very first day or two I was in the Denver office. I was walking down the hallway in Building 53 and this man comes up, shakes my hand, he says, "You Fred Ruud?"

I says, "Yeah."

He says, "I understand you just came in here from Grand Coulee [to] work for Parmakian."

I said, "Yeah, that's right." I said, "Who are you?"

He says, "My name's Harold Arthur. I work down here in earth dams."

From that beginning, we were always rather close on a rather professional plane. Didn't have a lot of personal activities together, except as associated with the Bureau of Reclamation's work, and then we had a lot of meetings and did a lot of work together on this sort of thing. I liked Harold and I still do. He's a very good man, a very good reputation.

He had to take some of the fall for Teton Dam, because it was on his watch, but there are things you can control and things that you can't control, and you have to negotiate your way in until one of the things you do is either you succeed or you're willing to pay the price of resignation and leave, if you don't like it. *Or* you can do what some others might have done, and that's to find a different way to fight. There are all kinds of ways to succeed. All you've got to do is be willing to pay the price.

Storey: Would you say the way he dealt with you was the way he normally dealt with people?

Ruud: Oh, I think so. I think so. Harold was always—I never heard any stories about him being anything but entirely professional and ethical in his treatment of people.

Bill Wolf

One of them that I liked so much was Bill Wolf. Bill and I were pretty close. One day Bill gave me a personal assignment. He said, "I want you to do a stress analysis of Morrow Point Dam, the powerhouse at Morrow Point.[28] What's going to happen to that? What do you think the stresses are going to be?" Just a really kind of broad instruction. And with that, I discovered the science of rheology, which means that all that we live on here is sort of a liquid that floats on top of the magma of the earth, and that even granite, on the short term, may appear to be rather brittle, in the long term, why, all the things have plastic flow, and that the powerhouse at Morrow Point is not an exception. But over a long period of time, the stresses in the walls of Morrow Point Powerplant will be about what they predicted.

[Another story about my relationship with Bill Wolf concerns the use of bell signals in the office. We used to have the bell ring at 7:30 A.M. and at 4:00 P.M. signaling starting and quitting time for work. When we moved into the new building, 67, I asked Bill Wolf if we couldn't get rid of the bells. He took it up with Chief Engineer Bellport. It was agreed that the bells would be dispensed with, but the building would be wired in case we had to start using them. They were never used again!]

I liked all of these people. I have always a great admiration for people in leadership positions and studied them very carefully.

Storey: Excuse me. How do you spell rheology?

Ruud: R-H-E-O-L-O-G-Y. It has to do with the plastic flow of the earth and material.

Storey: Well, there's one last chief engineer at that time the title was director of design and construction with whom you must have worked, Robert [B.] Jansen.

Robert B. Jansen

Ruud: Oh, yeah.

Storey: Harold Arthur's successor.

Ruud: Yes. Yes. Bob Jansen.

Storey: He's a faceless man. Could you tell me something about him?

Ruud: Well, first of all, Bob Jansen was one of those people that the success of the organization was more paramount than the success of Bob Jansen. He was a good leader. Bob Jansen was working, or had been working, or had *retired* from, the

28. The powerhouse at Morrow Point Dam in hollowed into the canyon wall and is underground.

state of California, and he knew all about the Bureau of Reclamation. When the Teton failure occurred, Mr. Jansen volunteered, got hold of somebody, whoever that was, and volunteered to head up the investigation commission on the Teton Dam. It's because of his work there that he was subsequently appointed director of design and construction here. I met him at the time he came in here and perhaps some examples of how he operated would shed some light.

He invited a lot of people from different parts of the organization to come up for orientation sessions, we would call it, to have a show-and-tell in his conference room, which by now, of course, is old hat to guys like myself. We spent a lot of time in those conference rooms as we get further up in the organization. I liked him very much, but we all put together little programs to tell what it was we did in his organization. So we did a little show-and-tell about the Technical Engineering Analysis Section and Mechanical Branch. By this time we were part of mechanical. See, as a staff position, it's entirely expendable. We didn't make drawings, we didn't have to design the penstocks, but we had to have penstocks, we had to have valves. "Who needs your work?" You know? We served strictly in a staff position, and it's by the virtue of our knowledge and the virtue of our expertise and our technical resources and our ability to get answers where everybody else runs and hides, that we were retained by the Bureau as an organization, and retained as individuals. So we had to do show-and-tell for Mr. Jansen to show what we did and the projects we were involved in, some of the things that we had achieved to help the Bureau of Reclamation solve its more pressing problems.

So I liked him. I thought he was a good organization man. He left not too long—could I see that timetable?

Storey: He was here '77 to '80.

Ruud: '77 to '80.

Storey: About three years.

Ruud: Yeah, what time in 1980?

Storey: I don't know exactly when he left.

Rodney (Rod) J. Vissia

Ruud: Well, I guess Rod [Rodney J.] Vissia[29] was chief engineer when I left.

Storey: In that case, could you quickly tell me about Rod Vissia? Unfortunately, I need to be out of here in ten minutes.

Ruud: Well, I'll very quickly tell you. Rod Vissia had been in planning in California, and

29. The Reclamation history program has done oral history with Rod Vissia.

he worked his way up through the organization, and between a combination of planning know-how, engineering know-how, and political activity, Mr. Vissia became chief engineer. I was not a great champion of his when he became chief engineer, because I had known him and had known of his work earlier on, but the more I met him and the more I became associated with him, I began to appreciate that Vissia was probably as good a manager as any of the engineers that we have had.

Engineers have a terrible problem. They manage by the numbers, and everything is supposed to be predictable and controllable. Many engineers have a very difficult time making the transition to become managers, because where they have to deal with people, and people don't always do exactly as they're told. Like you roll the ball down the hill, it's predictable. When you send a person out on a mission, it's not entirely predictable and controllable. So engineers have this problem, and it's very rare that you find an engineer who is also a very good manager.

". . . I always kept the management route very much foremost in my mind . . ."

My goal was to try to become a good manager as well as become a good engineer. I had a problem as to which field to start out in the beginning, and I opted for the technical route, but I always kept the management route very much foremost in my mind and constantly studying the people above me, their management styles, their leadership styles and all of this. I think that *all* of them were very good in their own way, but I must go back to suggest that Elwood Mead probably was the *epitome* of all these people that I had any knowledge of.

Storey: I think somebody said to me that Jansen was not very well received, though, because he was deemed an outsider.

". . . I thought that the commission and Mr. Jansen were very kind to the Bureau in their investigation [of Teton] . . ."

Ruud: Yeah, well, that's a problem that we have as an engineering organization. As I said, all the associations that all these people all had for twenty and thirty-year careers, Jansen had been with the state of California. I don't know. There's a dim thing in my memory that maybe he worked a little bit for the Bureau early on, but then he left to go to the state. But, no, I didn't find, and I didn't feel, in any sense, that Jansen was an outsider. A lot of people may have felt that, because he headed up the commission to investigate the failure of Teton Dam, and that's not always—well, let me rephrase this. Mr. Jansen's investigation of the Teton Dam failure was *not* a full-scale adversary proceeding where he was against the Bureau. As a matter of fact, I thought that the commission and Mr. Jansen were very kind to the Bureau in their investigation, and the fact that he came from the state to work here, as far as I was concerned, was no problem at all, because I had studied his actions and his work in that regard, and I didn't feel that Jansen was an outsider. I thought he was an extremely good man. The last I know of, he retired and he's moved to Spokane, but then somebody told me he'd left Spokane. I had a common

bond with him because Spokane was like my second hometown. My grandfather, a land examiner, lived in Spokane.

Working in Cairo at the Same Time as Rod Vissia

But I left here in 1980, in August, and that's when Mr. Vissia was chief engineer. Had some little contact with Mr. Vissia back East when he was working with the World Bank back East and in Cairo. I was in Cairo working for the World Bank on putting computers into the pumping irrigation system, and Mr. Vissia was working for the irrigation ministry in Cairo. So I got acquainted with him over there. Now he's since gone down and worked in Brazil, and he's probably back and settled somewhere by now. But he was a good man in the management area. He could get a lot of things done. That was one of his great fortes. He was a planner and, of course, all engineers are planners, but all planners aren't engineers. This is the problem. (laughter)

But it's been a great career. I loved it. I wouldn't ever have worked anywhere else.

Storey: Well, I really appreciate your coming in the third time, and would like to ask you again if you're willing for these tapes and the resulting transcripts to be used.

Ruud: Don't quote me. (laughter) Yes, of course!

Storey: Thank you very much.

END SIDE 1, TAPE 2. FEBRUARY 1, 1996.
END OF INTERVIEWS.

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APPENDIX A

Resume of Qualifications

FRED RUUD, P.E.

6440 Independence Way
Arvada, Colorado USA 80004
(303) 422-3359

Consulting Engineer

For

Hydroelectric Installations

SUMMARY OF QUALIFICATIONS

General

- More than 40 years of professional engineering and consulting experience
- Skilled in evaluation and review of hydroelectric power plants, pumping stations, and pumped storage projects.
- Established a distributed microcomputer-based Management Information System for operation and maintenance of pumping stations in Egypt.
- Consultant on many private and public sector projects in the United States and abroad. Extensive foreign travel on professional missions.
- Experience in reporting to top management.

Engineering

- Experience in a wide range of engineering analysis studies and field testing of large hydraulic turbines, pump-turbines, and pumps.
- Capability of "hands-on" vibration measurement and waterhammer testing.
- Expert in structural analysis of hydroelectric equipment.
- Major achievements in consulting on penstocks, hydraulic conduits, and pump discharge lines.

Pumped Storage Experience

Grand Coulee Pump-Generators PG 7 and 8

- Established peak efficiency at point where majority of water was delivered (i.e. minimum head) instead of average head.
- Changed pumping criteria to pump only near peak efficiency gate opening, since gate vibration precluded pumping at off-peak gate positions.
- Participated in startup tests PG-7 with mechanical instrumentation.

San Luis Pumping Generation Plant, California

- Participated in startup tests with mechanical instrumentation.
- Provided mechanical instrumentation for rapid reversal tests, full pumping to full generation in approximately 60 seconds.

O'Neil Pumping Generation Plant, California

- Evaluated excessive vibration of pumps due to inadequate support structure for bearings and shafts.

Mt. Elbert Pumped Storage, Colorado

- Provided review of Waterhammer Analysis required by changed performance characteristic following design and construction. Resulted in surge tank installation to prevent water column separation in discharge line.

Garden Bar Project - Sacramento, California

- Prepared general design layout for 210-mw plant, using rock-fill dam, hydraulic conduits, and surface-excavated powerhouse, resulting in major cost savings.

Management Information System Experience

Irrigation & Drainage Pumping Station
Rehabilitation I - MIS Component - The World Bank

- Provide guidance and direction to clearly define the tasks to be accomplished.
- Review and rewrite system specifications to convert from a centralized approach to a distributed processing system with a micro computer at each location.
- Establish procedures to provide the organization all pertinent data as required for management to maintain the organization, including goals, programs, personnel, production and equipment.
- Utilize the very latest technology available at contract time, and ensure continuing flexibility and provision for changes in system.
- Ensure that all systems are sold, designed and supported at the local level.
- Provide proper job training at each level of organization to clearly define problems and enable decisions on progress of system.
- Initiate innovative programs to gather data for data base.
- Establish a working pilot program within a reasonable time.
- Guide user through iterative design effort with regular check points to evaluate progress. Check that the latest systems and technology are in fact in use. Review with programmers new technology that may help or hinder effort. Confer with designers of the system and determine if proper design and direction is in progress. Work as a sounding board with designers of the system. Meet with user organization to assure that deadlines and targets can be met. Monitor progress of the system on behalf of the user. Meet with all parties to resolve conflicts. Determine if project is on schedule and review payments to be released to vendors.
- Require the final system to be built on a working model pilot program with input from all user departments.
- Provide extensive training on computers wherever located to encourage each user department to make intelligent recommendations and to utilize diverse and distributed user talents.
- Establish proper organization and procedures to protect and enable orderly change of programs.

PROFESSIONAL WORK EXPERIENCE

1984 Denver Water Board
Denver, Colorado

Foothills Pipeline Consultant
Studied waterhammer effects and energy dissipation requirements for major hydraulic conduit. Recommended installation of hydraulic turbine alternative at 4000 kW. This alternative was adopted and installed.

1948-1980 Bureau of Reclamation
Denver, Colorado

1974-1980 **Head, Technical Engineering Analysis Section**
Supervised a staff of up to 12 professional engineers, investigating structural problems and doing stress analyses, performing fluid transient and mechanical vibration studies. Served as a recognized authority on structural design, stress analysis, vibration problems, waterhammer and hydraulic studies, earthquake effects on mechanical equipment, and installation of hydroelectric peaking power. Member of hydroelectric inspection team in Bucharest, Romania, following the March 1977 earthquake.

1965-1974 **Research Engineer**

Performed startup, troubleshooting and vibration tests on large pumps, pump-turbines and turbines. These included the following projects: Grand Coulee, San Luis with California Department of Water Resources; O'Niell; Dos Amigos; Tracy; Trinity; Shasta; Spring Creek; Glen Canyon; Judge Francis Carr (Clear Creek); and Hoover Power and Pumping Plants.

Special assignments included transmission line conductor problems; transmission tower vibration failures; and evaluation of spacers and other hardware for multiple conductor transmission lines.

1952-1965 **Mechanical Engineer**

Performed stress analysis and mechanical vibration studies on hydraulic turbines, pumps, penstocks, pump discharge lines, and wye branches. Specialized in solving problems of hydraulic equipment failures. Checked turbine designs using a variety of structural engineering methods. Solved a major problem involving thermal stress failure of concrete dam construction blocks. Reviewed the mechanical and structural aspects of large motors and generators and other electrical equipment. Analyzed waterhammer on existing and proposed powerplant and pumping plant designs.

PROFESSIONAL CONSULTING EXPERIENCE

1989 — Central Arizona Water Conservation District
Phoenix, Arizona

Vibration Consulting
Solved a major vibration problem at Havasu Pumping Station, involving noise from the blades and vanes of six 60 mW pumps.

1989 — Stone and Webster
Boston, Massachusetts

Retained for Konaktepe Project in Turkey
Member of the International Board of Review for 400 mW project.

1981-1991 — World Bank (EMENA Division)
Washington, D.C.

Consultant on Pumping Stations
Reviewed and evaluated 90 irrigation and drainage stations for rehabilitation in the Arab Republic of Egypt. Determination of repairs, replacement, or new construction was required onsite for the stations and associated equipment. Prepared cost estimates. Member of Board of Consultants for Management Information System for over 1000 pumping stations in Egypt.

Prepared specifications following the World Bank format for a wide range of pumps, motors, vehicles, construction and communication equipment for the Dongli II irrigation project near Xian, in Shaanxi Province of China.

1982-1985 — Parsons, Brinkerhoff, Quade and Douglas
San Francisco, California

Member of Review Board
Member of FERC Board of Review for Camp Far West Hydroelectric Project. Prepared conceptual design layout and cost estimates for the 210 mW Garden Bar pumped storage project.

1983-1987 — Tudor Engineering Company
San Francisco, California

Hydro Project Consulting
Resolved penstock vibration problems, sychronous by-pass valve linkage design, and a variety of pump and turbine performance difficulties. Vibration studies of Rollins and Sly Creek powerplants led to runner replacement.

1948-
1952 **Mechanical Engineer**, Grand Coulee, Washington

Responsible for mechanical inspection of the 120-mW turbines, 50-mW pumps, structural steel, heating systems, radial gates, large penstocks, and piping. Participated in vibration testing of the Grand Coulee pump discharge lines, and in subsequent modifications to the pumps and lines.

OTHER WORK EXPERIENCE

1956-
1960 Department of Applied Mathematics
University of Colorado Extension
Denver, Colorado

Non-Resident Instructor
Taught applied mathematics, college algebra through calculus and differential equations.

PUBLICATIONS

1) "Stress Analysis of Hydraulic Turbine Stay Ring" (with John Parmakian), Trans. ASME, Journal of Engineering for Power, Vol. 86, Series A, No. 1, January 1964, PP 77-83.

2) Engineering Monograph No. 30, "Stress Analysis of Hydraulic Turbine Parts," Bureau of Reclamation, 1962.

3) "Instability of a Hydraulic Turbine with a Very Long Penstock," Trans. ASME, Journal of Engineering for Power, Vol 87, Series A, No. 3, July 1965, pp 290-294.

4) Engineering Monograph No. 32, "Stress Analysis of Wye Branches", Bureau of Reclamation, 1964.

5) "Hydraulic Turbine Setting Criteria," Trans. ASME Journal of Engineering for Power, Vol 87, Series A, No. 3, July 1965, pp 295-300.

6) "Prediction and Control of Cooling Stresses in Concrete Block," Proceedings of the American Concrete Institute, Vol. 62, 1965, pp 95-103.

7) "A Review of Penstock Branch Connections," Proceedings of the Power Speciality Conference, ASCE, Denver, Colorado, 1965.

8) "Self-Excited Vibration of a Hydraulic Turbine" (with Clair Crawford), Trans. ASME, Journal of Engineering of Power, Vol. 89, Series A, No. 4, October 1967, pp 573-576.

9) "Proposed Vibration Criteria for Transient Operation of Hydroelectric Units," The Second International JSME Symposium on Fluid Machinery and Fluidics, Tokyo, September 1972.

10) "Pump Storage Potential at Existing Hydroelectric Sites of the Bureau of Reclamation." National Engineering Foundation Symposium, Rindge, New Hampshire, 1974.

11) "Vibration of Deriaz Pumps at Dos Amigos Pumping Plant," Transactions of ASME, Journal of Fluids Engineering, Vol. 98, Series 1, No. 4, December 1976, pp 674-680.

12) "Pumped Storage and the Changing Role of Hydropower in the Bureau of Reclamation," Proceedings Second World Congress, International Water Resources Association, New Delhi, India, December 1975, Vol. 1, pp 73-77.

13) "Initial Operation of 600-mW Turbines at Grand Coulee Third Powerplant," 8th IAHR Symposium on Hydraulic Machinery, Leningrad, USSR, 1976.

14) "Vibration Criteria for Transient Operation of Hydroelectric Units," 10th IAHR Symposium on Hydraulic Machinery, Tokyo, 1980.

15) "Vibration of Penstocks in Hydroelectric Installations," Proceedings of the International Conference on Hydropower, ASCE, Denver, 1991, pp 2214-2223.

EDUCATIONAL BACKGROUND

University of Colorado
Denver Extension Center
Denver, Colorado
Master of Science Degree in Mechanical Engineering
1956

Washington State University
Pullman, Washington
Bachelor of Science Degree in Mechanical Engineering
1950

REGISTRATION

Registered Professional Engineer in Colorado
No. 2219
(1954 to present)

PROFESSIONAL MEMBERSHIPS

Member, American Society of Mechanical Engineers
Past Chairman, Colorado Section

International Electrotechnical Commission
(Working group on Hydraulic Turbine Vibration)

MILITARY BACKGROUND

United States Army
Battalion Communications Sergeant
Fort Benning, Georgia
Honorable Discharge 1946

PERSONAL DATA

Year of Birth: 1925
Married: 3 grown children

TRAVEL RESTRICTIONS

None. Willing to travel domestically and internationally
Maintains valid passport
Excellent health and physical condition

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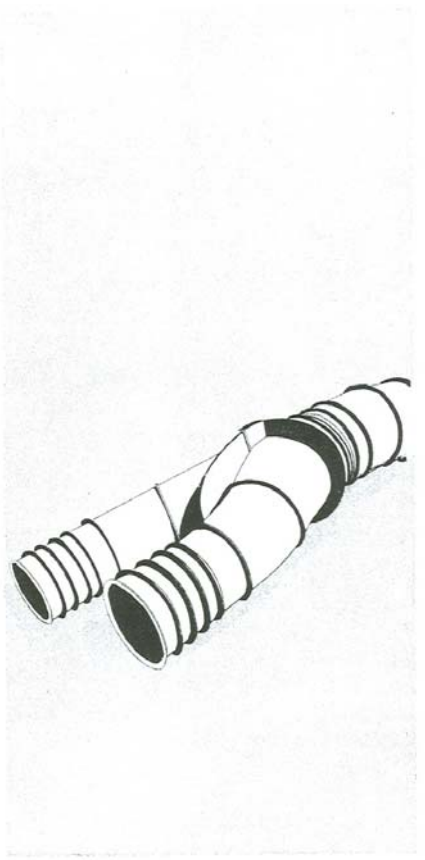
Appendix B: Miscellaneous Report Title Pages

A WATER RESOURCES TECHNICAL PUBLICATION

ENGINEERING MONOGRAPH No. 32



Stress Analysis of Wye Branches

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

HYDRAULIC TURBINE SETTING CRITERIA

by
Frederick O. Ruud

Bureau of Reclamation
United States Department of the Interior
Denver, Colorado

A paper to be presented at the annual meeting of the American Society of Mechanical Engineers, New York, New York, November 30–December 5, 1964.

ENGINEERING MONOGRAPHS No. 30

United States Department of the Interior
BUREAU OF RECLAMATION

STRESS ANALYSIS OF HYDRAULIC TURBINE PARTS

by F. O. Ruud

Denver, Colorado
July 1962 75 cents

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