ORAL HISTORY INTERVIEWS

Philip (Phil) H. Burgi

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STATUS OF INTERVIEWS:
OPEN FOR RESEARCH

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Interviews Conducted and Edited by:
Brit Allan Storey and Michael Jackson
Bureau of Reclamation

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Brief Chronology of Career

June 28, 1942–Born Franklin, Pennsylvania

1965–Graduated from the University of Akron with a degree in civil engineering

1965-1967–Peace Corps in Temuco, Chile

1968–Began M.S. degree in civil engineering at Colorado State University at Fort Collins.

1969–Received M.S. in civil engineering

1969–Began to work for Reclamation

1976–Departmental Manager Development Program

1979-1980–Took an assignment in Peru to work on an Inter-American Development Bank project to review proposed agrarian projects.

April 1, 1984–Selected as branch chief in the Hydraulics Branch with three sections under him.

1994–Research Division reorganized during the Commissioner Daniel Beard's term in office.

September 2000–Retired from Reclamation.

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Date: June 17, 1999 Signed: Philip H. Burgi
Philip H. Burgi

INTERVIEWER: Mike Jackson
Michael (Mike) Jackson

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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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For more information about Reclamation's history program see:
www.usbr.gov/history

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Oral History Interviews
Philip (Phil) H. Burgi

Storey: This is Brit Allan Story, senior historian of the Bureau of Reclamation, interviewing Phil Burgi of the Bureau of Reclamation's Denver laboratories, in Building 67 on the Denver Federal Center, on April the 28th, 1999, at about one o'clock in the afternoon. This is tape *one*.

Mr. Burgi, I'd like to ask you where you were born and raised and educated, and how you ended up at Reclamation.

Born in Franklin, Pennsylvania, in 1942

Burgi: I was born in Franklin, Pennsylvania, June 28, 1942, on a small farm, and lived there till I was about four years old. About that age, my sister, who was a year and a half older, had developed asthma fairly seriously, and so the family decided, after the doctor's recommendation, that we needed to move West; otherwise, we were going to lose her.

Moved to Ajo, Arizona, in 1946 for Sister's Health

So they made the brave decision in 1946 to sell the farm, had a huge auction, and pack up the few worldly belongings we had, bought a trailer, and, with his car, pulled us out to California, where his brother lived. On the way through Arizona, we stopped at a little town called Gila Bend, and asked if there was any work out in that area, and they suggested that there might be some openings in the copper mine in Ajo, Arizona.

Storey: Awful? A-W-F-U-L?

Burgi: Ajo, A-J-O.

Storey: (Laughter) Okay.

Burgi: "Garlic" in Spanish. (Laughter) So after going out over the holidays to visit my uncle in California, we returned, and my dad took us down to Ajo, and he checked in to see what he could do. He ended up being a driller operator in the open pit [copper][1] mine there in Ajo, Arizona.

Returned to Ohio in 1951 after Dad's Death in a Mining Accident

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 also 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.

So that was my introduction to the West. My sister did much better in the dry, warm climate of the West. In '51, he was hurt very seriously in a mining accident, died two days later, and that took another turn in my life.

Attended the University of Akron, Graduating in Civil Engineering in 1965

Without going into a lot of that history, we returned to Ohio, where my aunt lived, and I finished my grade school and high school education in Ohio, met my wife there, went to the University of Akron, and received a degree, bachelor of science, in civil engineering, in ~~1964–actually,~~ 1965~~, I guess it was~~.

Went into the Peace Corps for Serve in Chile for Two Years

At that time my wife and I were very interested in the Peace Corps, and so we went with the U.S. Government in the Peace Corps to Chile, South America, with the University Education Group.

Thought He Would Be Teaching in the University, but Ended up Working as a Civil Engineer in a Small Village, Temuco

I went down with the idea that I'd be teaching in the university, but they needed a civil engineer in a small village in southern Chile, a place called Temuco, T-E-M-U-C-O, and so we were moved down to that area.

Wife Worked in a Hospital as a Medical Technologist

My wife is a medical technologist. She worked in the hospital [in Temuco].

Three Days a Week Worked with Other Peace Corps Volunteers Working to Move the Village of Trovolhue out of an Area Prone to Flooding

I, three days a week, would go out to a little village called Trovolhue, T-R-O-V-O-L-H-U-E, where a community development Peace Corps couple wanted to move a small village from a flooded area to some higher land, and they needed a civil engineer to help them. So I was involved with that effort.

During Their Second Year in Chile He Taught Mathematics at the Catholic University of Chile in Temuco

Then my second year down there, taught mathematics, college mathematics, at the Catholic University of Chile in Temuco.

December of 1967 Completed Their Service in Chile and Moved to Fort Collins to Work Toward a Master's Degree in Civil Engineering

Upon finishing our service in–let's see, that would have been in December of '67, we went back to visit family in Ohio, and then in January I came out to Fort

Collins, where I started into a master's program in hydraulic engineering. Let's see. From January of '68 through June of '69, I was in Fort Collins.

Assigned to the Hydraulics Laboratory at Reclamation in June of 1969

Upon graduation with a master's at Colorado State, I came to work with the Bureau of Reclamation.

". . . went through about a six-month rotation period, through planning and concrete dams and a couple of other groups here in Denver, and then was permanently assigned to hydraulics lab in probably January of 1970. . . ."

I guess it was in June of 1969, had a rotation program at that time, and I was assigned to the hydraulics laboratory, which is the area that I really wanted to work in, and went through about a six-month rotation period, through planning and concrete dams and a couple of other groups here in Denver, and then was permanently assigned to hydraulics lab in probably January of 1970. Harold Martin was the branch chief at the time. I think within six months after I started, he retired. He had been branch chief for, probably, twenty-one years. Bill Wagner became the branch chief.

I don't know, did I answer your questions?

Storey: Yeah, that's fine. Tell me more about why you studied civil engineering. What got you interested in engineering?

How an Interest in Engineering Developed

Burgi: That's a good question. I suspect it was in the seventh or eighth grade, I took one of these tests that they would give in those days on what we like doing, with the idea of helping us determine what we'd like to do for a career. I don't remember the name of the test, Kepler Test or something like that.

I really liked engineering from the start. I remember reading books about railroads and the development of the railroads throughout the West and throughout the U.S., and thought that even at that early age I wanted to be an engineer. I liked outside work. I think I was probably led that direction maybe because of the days in Arizona when I just loved to be outside in the desert.

I think that civil engineering has always appealed to me because I liked working with structures, and I think the idea of public service was something that was always pretty deeply a part of my life. I wanted to do something I felt would help people.

"The water aspect of it probably came on . . . at University of Akron. We had a senior project, and the one I did was in the hydraulics part of the lab . . . a study on a culvert and how to pass water under a roadway. . . ."

The water aspect of it probably came on once I was in college at University of Akron.

We had a senior project, and the one I did was in the hydraulics part of the lab, just a small lab, and I did a study on a culvert and how to pass water under a roadway. So that sort of grabbed my interest, and I think after the Peace Corps I really felt like I needed more education. I felt like I'd been out of the culture for a couple of years.

". . . engineering has always been of interest to me. I enjoy how things work, and I enjoy the history of how civilization has developed over time, and realized that civil engineering is a big part of that. . . ."

The best man in my wedding had gone to Colorado State University in structural engineering and said that they have a really good water program there, and if I really wanted to do something in water, I ought to look at Fort Collins. So that's the reason I applied there. But engineering has always been of interest to me. I enjoy how things work, and I enjoy the history of how civilization has developed over time, and realized that civil engineering is a big part of that. Whether you're talking about water supply, or transportation systems, or buildings that people lived in, it seemed to me like civil engineering was a critical part of that.

Storey: And water had sort of captured your interest?

". . . water did capture my interest. You start looking at essentials in life, and water is one of those, in my mind. I think the Peace Corps helped me appreciate that some, too, in the fact that you realize in these small villages that water was really important. . . ."

Burgi: Yeah, water did capture my interest. You start looking at essentials in life, and water is one of those, in my mind. I think the Peace Corps helped me appreciate that some, too, in the fact that you realize in these small villages that water was really important. In fact, sometimes I think upon retirement that I'd like to go and do some things in the Latin culture where I have a language and the culture, and particularly as it relates to water and sanitation. Seems to me like that's a critical area on a much smaller scale than what we might build projects in Reclamation.

"Many villagers have to go miles to find good-quality water. Others live without good-quality water, and because of the diarrhea and the other issues dealing with children, many of them die at a very young age. So, yes, I think water's critical. . . ."

Many villagers have to go miles to find good-quality water. Others live without good-quality water, and because of the diarrhea and the other issues dealing with children, many of them die at a very young age. So, yes, I think water's critical.

Storey: How did you get interested in the Peace Corps?

At One Point Wanted to Serve as a Christian Missionary, but Found the Mission Boards Were Only Interested in Preachers

Burgi: I think it was sort of a service mentality again, probably comes out of my own upbringing in the church. I suspect when I was a junior, senior in high school, I had heard much about these missionaries that were killed in an attempt in Ecuador to get into some small villages, and at one time I wanted to be a missionary. I wanted to go overseas and work as a Christian missionary. But I also loved engineering. I called a couple of Mission Boards, and, of course, they weren't interested in anyone other than preachers, really. So as an engineer, I didn't quite fit the category.

With a Quaker Background, a Service Mentality, and Lack of Interest in the Vietnam Conflict, Turned Toward the Peace Corps

So those were the years when, in the sixties, of course, they were very turbulent. You have a President, [John F.] Kennedy, that had a vision, and certainly with the Peace Corps starting under Sargent Shriver and people like Maurie Albertson up at Colorado State, that I learned much later CSU was a real important player in the Peace Corps, I didn't know that before, when I was entering the Peace Corps, it seemed to me like that would be an area to be able to serve my country. I really wasn't interested in the Vietnam War. Part of that was my Quaker background, so that fits into that also. But the Peace Corps seemed to be a way to serve my country and yet do something that might help me appreciate and give back to life things that I'd been given. So it certainly wasn't for the money. (Laughter)

I'd just been married six months, and my wife had similar interests. We knew that this wasn't a lifetime occupation, but, hey, a couple of years of service in this way was a good way to start our own life. So it turned out to be a very good thing.

Storey: Now, down there, did you do any water work, work with water?

Burgi: Not really water. Even though I'd had an interest in my bachelor's program in water, I hadn't been to CSU or hadn't done any of the graduate work in water hydrology. Most of the engineering work we did was to move this village about four kilometers. They needed an access road, they needed a bridge. We're talking about sixty or eighty families that needed land laid out so they could tell where to put their houses. The land was donated, I think, by the Catholic Church, and USAID had promised that they would furnish corrugated metal roofs if these people would build their own houses. This was in a wooded area.

". . . basically we worked with the government officials to encourage the people to move from their old land, which flooded every winter, and which had no electricity, and promised them this *new* land with a new school, electricity, and much better living conditions . . ."

So basically we worked with the government officials to encourage the people to move from their old land, which flooded every winter, and which had no electricity, and promised them this *new* land with a new school, electricity, and much better living conditions because they would be four or five hundred feet up out of this valley. So we laid out lots and laid out a center plaza, laid out a lot for a school building and a city municipal building, worked with the local folks in grading a road, actually laying out how to get the road from down below up to the new property, worked on the design of the bridge.

Then we, one Saturday, got everybody together and did a little lottery on who was going to get what lots on the new site, so we had all the lots numbered and put little pieces of paper in a hat with numbers of the lots, and, of course, everybody wanted to be on the central plaza, and not everybody ended up there because not everybody is going to get the right draw.

So what happened was, I really teamed up with a community development couple that lived in this little community, and I'd go out three or four times, well, three or four days a week, and give the technical help that really gave the whole project credibility in the sense that he knew the language much better, although I had Spanish, and the fact that he had the credibility of the local leaders, he lived right with them, but he didn't have any engineering.

"He was really a liberal arts graduate from Berkeley that had been in jail a couple of times over the Vietnam War situation and was glad to get out of the U.S. at that moment. But they were a great couple to work with. . . ."

He was really a liberal arts graduate from Berkeley that had been in jail a couple of times over the Vietnam War situation and was glad to get out of the U.S. at that moment. But they were a great couple to work with.

So other than we did find a spring up a little higher on the countryside there a couple of kilometers away from the new village site, and, as I recall, when I left Chile, we had given them some rough sketches on how to get that water down, but it wasn't done.

Returned to Trovolhue in 1980 and Found the Relocated Village Doing Well

I returned to South America (Peru) in 1980, with the U.S. Government, and my wife and I went down to that village. This would have been sixteen years later. And met with some of the people. And what an amazing thing. The people had all moved up to the new site. There was a school, there was electricity. I think when I left Chile, when my Peace Corps time was up, there might have been five houses up on the new site, so it was started, but it was a long ways from being completed. That was really neat in '80 to go back [with my family] and visit with some of the people that we'd worked with, give sort of a closure to what turned out to be a very good project.

The government said that they couldn't go to the new lots unless they abandoned their old lots, because they didn't want people coming in behind them and taking over this really very poor area. Where the village was originally located was in a flood plain, and every winter when the rains would come, they were very close to the ocean and tides would come in. You could be out there in an outdoor toilet and you would see the waterline halfway up on the toilet where previously the water had gotten that high. Maybe thirty yards away there was an open well where they took the water for drinking water. So you knew that it was a contaminated water supply.

The new sites would be much better for the people.

So eventually, by 1980, they'd pretty well all moved up there to the new lots, so that was a very rewarding experience.

Storey: What about your teaching?

Taught Trigonometry and Advanced Algebra

Burgi: Teaching went well. The second year I taught– actually, down there it was trigonometry and advanced algebra was their first year in the college curriculum. I went into a university that was really a branch of the [Catholic] ~~Central~~ University in Santiago. Temuco is probably five or six hundred miles south of Santiago, and this branch university had just started. It maybe had been there two years and had a faculty of about fifteen professors. Maria Villa Nueva was the math director, and she was the only one teaching math. She needed help teaching some of the classes. This is a little bit of a nontraditional school in the sense that I'd say half of the students that I had of twenty, maybe half of them were regular college age like here in the States. The other half were older, maybe forty. Some were even fifty. It was maybe a little bit like a Metro [State College] situation when it first started, adult education. A lot of times my classes were in the evenings after these students had completed their work day.

The Political Situation in Chile

That was an interesting experience because, again, we went back in '80, we had a little party with all the students that were still in the area. The history of Chile is one where President Frei, Eduardo Frei was the first Frei that was president, it just happens his son is president of Chile now, and [the father] ~~he~~ was the president at the time. It was a democratic election and, in fact, Chile was very proud of their democracy.

It wasn't long after that, after we had left Chile, that [Salvador] Allende was elected president, and because of the Communist tendencies, a lot of problems were created. I don't know what all the U.S. involvement was, but eventually that government was overthrown, and [Augusto] Pinochet came into power, of course.

But what was interesting, we went back in 1980, Pinochet was still president, and there were probably two or three of the students that I had had in the late sixties that were no longer around, and none of their classmates knew what had happened to them. Some of the students had just disappeared. There was a lot of civil unrest in those years.

". . . the Peace Corps will always be one of the highlights in my life . . . we learned so much about ourselves being away from our families for two and a half years. . . . I had only been married six months, and we lived for two and a half years without a refrigerator and [in] a house without hot water and without our own bathroom. . . ."

But to just see how these students had gotten out of school, those that had stayed out of trouble, the government, they had their careers, they had families. Of course, some of them even had families when I was there. But, again, to see fifteen or sixteen years after we had served down there, some of the results, maybe the fruit of our work, was really very rewarding. I think other than raising kids ourselves and my career here in Reclamation, which has been a great joy, the Peace Corps will always be one of the highlights in my life because of the many friends that we made, and we learned so much about ourselves being away from our families for two and a half years. We didn't get to [come] ~~go~~ back [to the States] and visit during that whole period. I mean, here I had married this woman, I had only been married six months, and we lived for two and a half years without a refrigerator and [in] a house without hot water and without our own bathroom. We shared a bathroom with another family down the hall. No vehicle. So I often tell Kay that everything's been ["downhill"] ~~uphill~~ since then, because even moving into student housing at Colorado State was a big improvement over what she had been used to for two and a half years of our marriage, the first two and a half years.

Storey: Did she do something in the Peace Corps also?

"... the Peace Corps had a little problem trying to place both of us. . . ."

Burgi: Yep. She was a graduate of what at that time would have been Ashland College in Ohio. She comes out of a Brethren background. But her degree was in medical technology, so the Peace Corps had a little problem trying to place both of us. There wasn't really a medical school in Temuco, and although I was there to teach and to work on this village, their hospital did need help, so basically she worked at the hospital as a medical technologist for those two years in Temuco. I think she felt sometimes like she was window dressing. I'm not sure. I think that probably other than the fact of the many trips that we took and just the enjoyment of being in Chile, I don't think she would feel like she was doing the service work that I was fortunate enough to get to do. She enjoyed the people she worked in the hospital with, but the problems and difficulties of trying to place both of us in work that was very rewarding was a little difficult to try to accomplish.

Storey: How were housing arrangements handled?

While in the Peace Corps Were Paid Something like $90 a Month Each in a Bank Account in the U.S. and about $150 a Month for Living Expenses in Chile

Burgi: Basically we were given a little income. I think we were given ninety dollars in a bank account here in the U.S. the whole time we were there, every month, so that was, I don't know, 3,500 or so for our combined income when we got back. We used that to buy a car. That was used just to get us back into the country after the Peace Corps.

"... it was up to us to find our own housing. We enjoy traveling so much that we chose to live in a fairly economical housing situation . . . But then we traveled to

Argentina and Peru and Chile and Brazil, quite a bit of traveling within Chile. I think we were given like maybe three weeks a year to travel . . . [we'd] save up our money to do those types of activities. . . ."

When we were there, I think we probably were paid $150 a month or something, and it was up to us to find our own housing. We enjoy traveling so much that we chose to live in a fairly economical housing situation, actually lived in a three-room apartment that was a part of a house that a lady lived in, and we shared a bathroom with her.

But then we traveled to Argentina and Peru and Chile and Brazil, quite a bit of traveling within Chile. I think we were given like maybe three weeks a year to travel, so we fully took advantage of that. We'd buy airplane tickets and save up our money to do those types of activities.

Storey: Were there other Peace Corps members?

"Our team that went to Chile, we trained at UCLA for three months and then also a month in Puerto Rico. The team of forty of us, and we were spread all across Chile . . ."

Burgi: Oh, yeah. Our team that went to Chile, we trained at UCLA for three months and then also a month in Puerto Rico. The team of forty of us, and we were spread all across Chile, all the way from Antofagasta in the north to Puerto Montt in the south, in Temuco we were the only two from our group, but in the Temuco area there were maybe twenty other volunteers. They would have been involved in what was called community development, forestry, some agricultural projects.

"We were the only university education group in the country . . ."

We were the only university education group in the country, but basically most of them were either in Santiago, Concepción, some larger cities. We were the exception, and I think mainly because of my background in civil engineering and Kay's medical background, they could get us both into Temuco and this little village work.

Engineering Challenges in Surveying the New Town Site

I went down there [from Santiago] and laid it out, surveying equipment, early on before we actually moved down there, and they were real pleased with the work that I had done and my ability to work with Brian Loveman, who was the local community development person. We had to borrow surveying equipment. They were used to a 400-degree circle instead of a 360, and so everything I had learned in college, and also metric, so I had to learn quite a bit of things on how to operate within their system. I would turn a 90-degree angle and it wasn't a 90-degree angle. I needed to go 100 degrees to get the right angle. So there were a few things like that early on in the engineering that was a real challenge.

". . . it was a real challenge, but it was driven by the fact that the government

really wanted to move this village, and the church provided the land and USAID provided some help . . ."

We had to work a lot with the local officials, the land surveyors down there, actually using their equipment and borrowing equipment like Caterpillar tractors to do the roads and things. We didn't actually drive those; we'd get their people to come out. We would do all the advance surveying on how to put the grade in. So it was a real challenge, but it was driven by the fact that the government really wanted to move this village, and the church provided the land and USAID provided some help in the sense of these roofs, and that was enough incentive for these people to decide they could either tear down the lumber in their old houses or, in most cases, they would use new lumber and build a house, then were forced to tear down the old ones. So, yes, it was a real good experience.

". . . I often heard the comment, they were down there for a couple of years to try to find themselves. I think Kay and I knew who we were; that was not the issue in our case. We just wanted to do something of service. . . ."

A lot of the Peace Corps volunteers, again, in the late sixties, maybe even as today, people are trying to at that age figure out not only what is life all about, but I often heard the comment, they were down there for a couple of years to try to find themselves. I think Kay and I knew who we were; that was not the issue in our case. We just wanted to do something of service. As I said earlier, it turned out to be, I think, critical to a lot of the other decisions we made in our lives, and certainly gave us a real appreciation for our own country, the freedoms we have here, the material things that we have, but also gave us a great appreciation for the human spirit and the fact that wherever humans find themselves, they enjoy life and they enjoy their children and they may not have all the material things, but there's a lot of satisfaction. So [unclear] life itself, there were a lot of great experiences that we learned in those two and a half years.

Storey: How did you go about getting into CSU?

Applied to Colorado State University from Chile, Partially Because He Wanted to Expose His Wife to the West

Burgi: I applied from Chile. Of course, we had been in communication with many friends here in the U.S. I think I got it down to two places: New Mexico State in Las Cruces and Colorado State University, both land-grant schools, but I really wanted to expose Kay to the West. She'd not been out of Ohio before I took her to the Peace Corps. ((Laughter) And sort of my argument with her was, "Well, let's go out to school for a year and a half and give you a chance to see whether you like the West."

Was Interested in Water Projects and Working for Reclamation

I really was by then interested in water projects. I had written to people like Jim Carlson, who actually was in the hydraulics laboratory when I started in '69, and wrote about the possibility of work and the types of projects that he was working on in the lab. So I had that interest with the Bureau right from the beginning. This would have been from maybe as early as '62, I was interested in the Bureau of Reclamation.

". . . I think I got a little bit better of a scholarship offer from Colorado State. . . . I don't recall, but it was probably . . . 400 [a month], maybe, from the school, and rent was a couple of hundred dollars. . . ."

So I don't know, I think I got a little bit better of a scholarship offer from Colorado State. Probably in those days, I don't recall, but it was probably 250, 300 dollars a month for a research assistant. No, it must have been more than that. It must have been 1,000 dollars a month, because I think our rent at Aggie Village was 200 a month. I think we thought that our rent was half, so maybe I made 400, maybe, from the school, and rent was a couple of hundred dollars.

". . . they had a program there that I was able to get a scholarship with the Agricultural Research Service out at their foothills campus, and, of course, took the class work and then also worked on a thesis on the loss of water in a unlined canal . . "

But they had a program there that I was able to get a scholarship with the Agricultural Research Service out at their foothills campus, and, of course, took the class work and then also worked on a thesis on the loss of water in a unlined canal, so it dealt with water receding into the groundwater in an open canal. So that was my laboratory research up there.

". . . at Colorado State, I think the two things was the fact that it was in the West and this good friend of mine suggested that they had–I think in 1965 they had just built a new engineering research facility out at the foothills campus . . ."

But at Colorado State, I think the two things was the fact that it was in the West and this good friend of mine suggested that they had–I think in 1965 they had just built a new engineering research facility out at the foothills campus, and so this would have been only two years after that, that I had applied. They responded very favorably, so that's where we ended up.

Storey: Why did you limit it to those two land-grant schools when you were looking?

Burgi: I don't know. I think that probably I didn't have as much information as I would have had in the States. Wasn't an internet at that time [did not exist.]

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Attended the University of Akron for Five Years Because the Last Two Years Were Spent Working Half Time in a Co-op Program with the Ohio Highway Department

Burgi: I think maybe a third school that I was looking at was the University of Cincinnati. Of course, they're in Ohio. In fact, at the University of Akron, I actually went to school five years because it's a co-op program where the last two years you go to school about half your time, and the other half time you're working. I worked for the Ohio Highway Department, in fact, back there. I felt that Cincinnati was probably going to be pretty similar to that, and I wanted exposure in the West.

Applied to Reclamation, the Corps of Engineers in Vicksburg, and the Salt River Project

We had family that lived in California, but I really wasn't interested in California. Again, I knew that Bureau of Reclamation was in Denver, at least the technical part of the Bureau, so that may have had some impact there. I know before I graduated, of course, from Colorado State, I was applying, and I applied for the Bureau. In no time at all I went ahead and applied with the Bureau of Reclamation and also [U.S. Army] Corps of Engineers, Vicksburg Laboratory, and with Salt River Project, which was a pretty booming project at the time down in Phoenix.

Accepted an Offer by Reclamation Which Reclamation Subsequently Tried to Withdraw

When I applied to the Bureau, I don't know, they sent me, probably a month before I graduated, an acceptance that said to go ahead and take a physical, and started dealing with me on employment. So I turned down the Corps of Engineers job–I'm not sure I had responded to Salt River yet–when I got a second fax from the Bureau saying that they were sorry, but they couldn't hire me. They said that there had been some cuts in government expenditures or in their budget, and that they weren't going to be able to hire me. I remember firing a fax back, saying, "I turned down another job, I've taken this physical, and, by golly, you'd better hire me." ((Laughter) I don't think I worded it quite that strongly.

Went to Work in the Hydraulics Lab in 1969

So they did hire me in '69, and I think I was one of maybe two or three rotation engineers that year. Then a few years later, there was a RIF [reduction in force] that happened, and I thought for sure I was going to lose my job. So the Bureau experience over my career has been interesting, because there has been a lot of changes in Reclamation, but certainly my early start with the Bureau was pretty tenuous and whether I was really going to be a Reclamation employee or not. I finally succeeded in encouraging them to hire me.

Storey: How did you find out about Reclamation?

How He Became Interested in Reclamation at the University of Akron

Burgi: Well, again, it would have been back when I was in Akron. I must have been doing some water research on this other project on culverts. I suspect that's what it would have been.

Emory Lane and Jim Carlson

I hadn't really thought about that, but I think in my library research I ran across research articles by Emory Lane, who was, in fact, the old first chief of the Hydraulics Laboratory. That's L-A-N-E. And Jim Carlson, who was another old-timer in the lab.

As I looked at their studies and saw the type of lab work they were doing, I thought, "Man, this would really be interesting work to do. It would make a great career to work in a lab like this." So I think probably my college research at University of Akron, trying to find projects dealing with water and laboratories that were doing water projects, that's how I would have first come across the Bureau of Reclamation, and that would have been like in '63, maybe, six years before I finally came to the Bureau.

Storey: When you say you became interested in Reclamation, are you saying you became interested *only* in Reclamation or just one of the many interesting possibilities out there?

Burgi: I think when I went into the Peace Corps, I wasn't sure what I was going to do next. I knew I was going to go into engineering because I really liked civil engineering, I liked the coursework I took. The school I went to, University of Akron, was very strong in structural. Alan Richards, my major professor there–Richards was his name– he's quite a mentor, a great professor. So structures was probably the thing laid out there before all of us the most, but I still had this interest in water, I still had this interest in the West, mainly because of my years in Arizona. Those things seemed to fit together.

". . . probably the thing that drew me to the Bureau more than anything else was the laboratory. . . ."

When I was in the Peace Corps and starting to look at where I wanted to go to school again, again I wanted to pursue water, I wanted to be in the West, and I think when you think about water and the West, Bureau of Reclamation is one of the places you end up. The Salt River Project would have been another one. I think I knew by that time that I'd already been with the Federal Government for a couple of years. I think they had told us that–and I wasn't concerned about retirement in those days. I'm sure there's something about, "You know, we just want you to know before you leave the Peace Corps that if you go with the Federal Government, at some future time, these years that you put in count toward retirement, toward your service time." I don't think that was a big thing, but probably the thing that drew me to the Bureau more than anything else was the laboratory.

". . . I just *always* felt very fortunate that I could get into the hydraulics lab. . . ."

I knew about Hoover Dam and Grand Coulee and all those big projects, but in those days there was still a lot of construction going on in Reclamation. The hydraulics laboratory was key to that, and it was sort of where I could play out *my* interests in research and particularly as it relates to water. So it doesn't really surprise me when I think back upon it, that I would end up there eventually, as long as there was a job opening. That was always the interesting thing, is in Reclamation, as I found out in '69, there wasn't very many jobs available, and I just *always* felt very fortunate that I could get into the hydraulics lab.

There had been years when–I'm sure in my time with the labs, there have been years when we didn't hire anybody over a period of five or six years. And here I am coming out of a master's program, and if I'd have gone with Salt River or Vicksburg, I think the chance of getting back into Reclamation would have been pretty difficult. So I've always felt very fortunate, as I look back over my career, that I had this opportunity to be involved in a job that I've always loved, even though I get accused[, by my wife,] sometimes of coming to work and playing in my sandbox. I've always enjoyed the laboratory. I have felt that it's played a key role. I look back through some of the history of the lab, it's just amazing, the personalities that were involved in the hydraulics area and Reclamation projects over time. So I have felt very good about that time with Reclamation, this time with Reclamation.

Storey: Tell me about an M.A. in civil engineering. Do you go in specializing in one area or how does that work?

Burgi: It's an M.S., Master of Science. Yes, you go in–I don't remember. I think I took like maybe thirty class hours and then you take about twelve hours of credit that is on a research project, then you do a thesis, then you defend it in an oral defense.

The way it's set up is that to get in, first of all, of course, they have to accept you, and then almost always at the master's level there's some kind of a stipend that helps you be able to stay in school. So I think at CSU when I had this, as I said, probably a 400, 450 dollar stipend monthly, then they waived tuition, and half of my time was to be spent on my research project for Agriculture Research Service in this case, because ARS is the one that funded me. At that time up there, USGS also had quite a bit of monies at the university.

So most of the graduate students that were working on a research project, they were sort of directed in their research by what monies were available, if there was, in this case, ARS money available for studying unlined canals. At that time my professor was Dave [David A.] Woolhiser. He said, "There's a couple of projects here that ARS is interested in. Would any of these be of interest to you?" Of course, if you answer yes, then you're funded. So that wasn't a real hard decision for me to make, so I actually–*while* I was taking my coursework, I was also working on laying out my planned research in the laboratory and probably started–in fact, I did start working with a fellow by the name of Dave Seburn, who was working on another research project. I was sort of his helper, getting used to where equipment was in the lab.

Over the course of about six months, I got to the place where my own project was ready to start, so I started laying it out. Probably the last six months of my time at CSU, I was basically out in the laboratory working. It was in those days that Kay called and said, "You need to get home. I need to go to the hospital. We're going to have a baby." (Laughter) She came back from the Peace Corps about six months pregnant, so our daughter, who now is a civil engineer with Black & Veach, was born at Poudre Valley Hospital when I was a graduate student.

Kay would say that six months into the Peace Corps in Chile, she wanted to come home. I don't remember this that well, but she said I counseled her that we were going to stay one year, because if we decided to go home, we had to pay our own way home, which would have been a lot of money. I had said, "We're going to stay one year, and if at the end of one year we don't think it's going to work, then we'll go back." By the end of the year, she was okay. But she would say that she probably would have stopped taking–she was taking the pill, because we weren't allowed to have children while we were in the Peace Corps, and she's told me since then she thought a lot about the possibility of getting pregnant, because they would send you home if you did. So she just ran about as close as she could. When we knew we were going to be leaving, she went off the pill and when we came home, she was six months along with our first child.

"Fort Collins was a good place. . . . Aggie Village was the little married student housing, which was a very special place for us. We actually had hot water and we had a washer and dryer right across the street from us. We had our own bathroom, and we had nice furniture and we had a TV. These are things that we hadn't seen for two and a half years in Chile . . ."

Fort Collins was a good place. At that time it was probably 30-, 35,000 people. Aggie Village was the ~~little~~ married student housing, which was a very special place for us. We actually had hot water and we had a washer and dryer right across the street from us. We had our own bathroom, and we had nice furniture and we had a TV. These are things that we hadn't seen for two and a half years in Chile, so we were very happy campers.

Liked Fort Collins as a Place to Live

I really enjoyed getting back into school after being away from studies for a couple of years, and the culture up there was very supportive of us in the sense of our–well, we just felt comfortable. I think if I could have found a job in Fort Collins, I would have loved to have just stayed in Fort Collins, but you sort of go where the work is.

That was the other surprise that Kay found when she still talks to her family, which she's one of seven children, almost all of them live within a couple of hundred miles of home in Ohio. She would still say that she wasn't smart enough to realize that if I went to school in the West, that we'd probably end up there, because that's where the job offers would be. (Laughter) So that's the way it worked. We've raised two kids out here now. Our son came along a couple of years later after I'd started here, so they're both Colorado natives. This is our home.

Storey: Tell me about your research project. How does one figure out about water loss in unlined canals? What kinds of things do you have to do in order to be able to do that?

Planning an Experiment to Measure Water Loss in Unlined Canals

Burgi: Well, yes, that's what's interesting in research or in laboratory work, is you really do have to try to, in some kind of a scale, come up with a model or design, or model design, that will allow you to recreate conditions that occur out in the real world. So they had a big box out there built out of concrete block that's about four feet high and I'd say it's probably thirty feet wide and 130 feet long, and it had dual walls on the side. The inside wall on both sides was porous, and this three-foot-high flume, I would call it, or a box, you'd fill with sand. Then between these outside walls, they were really water wells and you could bring the water level up or down in there, and therefore actually affect the groundwater level in the sand.

So I actually had an instrument that would create 130-foot-long little canal in the sand, and we made a little trapezoidal skiff that we would pull through there to get that shape. Then I would start some of the tests, you'd come up with a whole series of tests, some of them you have no groundwater and you're running the water through the canal and you see how much water loss you get.

Storey: In other words, you measure it when it goes in and when it comes out?

Burgi: Yep, you measure it when it goes in, when it comes out. I don't recall everything I did on that study, it's been a long time ago, but I think we actually measured the–well, we certainly would have been measuring the water depth or water height in the wells on either end of the box.

Then we put what we called piezometers in the soil, and these little piezometers tell you what the water pressure is in the soil. So the further away you would get from the canal, the more that pressure dropped. So the whole purpose of the research was to look at what happened over time with water leaving the canal, given different depths of water in the groundwater, and then also just studying the erosion that would occur. The shape would change over time. As I recall, I went in there with what we call a point gauge. You go in and actually look at what the surface of the canal, it may have started as a trapezoid very nicely formed, but over time it would change in shape, it would go deeper or maybe part of the banks would slough away.

You would relate that then to the other parameters, how much water was in the canal, what your groundwater level was, and, of course, you just do a *large* number of tests because your parameters, for instance, might be what discharge do you have in the canal, what's the slope on the side of your canal, what depth of water do you have in the canal, where's your groundwater, is it below the [canal] invert~~ed canal~~ or is it up into the area above the [canal] invert~~ed canal~~.

"In research, you don't want to change very many of those parameters at once, so you don't know what's happening . . ."

In research, you don't want to change very many of those parameters at once, so you don't know what's happening, so you typically set up a research plan that maybe you would run with a certain groundwater height and change your discharges in the canal, keep the slope the same, and then you might go back and keep everything else the same, but change your side slope angles and run those tests.

"So you gather a tremendous amount of data and, of course, the next step is to analyze that data and try to make sense out of it. Typically what you're trying to do is find some theory that can explain what you're observing, and that's how you end up with equations and guidelines in research. . . ."

So you gather a tremendous amount of data and, of course, the next step is to analyze that data and try to make sense out of it. Typically what you're trying to do is find some theory that can explain what you're observing, and that's how you end up with equations and guidelines in research. Typically what you'll do is most of that type of research might be called empirical research, where you're actually–the empirical aspect of it is, you're just gathering this raw data and when you gather enough of it, often you can form equations that make sense out of that data. You use the data to verify equations.

". . . of course, you're also doing literature research. You're trying to find out who else has done any work in that area. . . ."

Then, of course, you're also doing literature research. You're trying to find out who else has done any work in that area. Again, I went back to Jim Carlson and Lane's work. So I always found that interesting. In fact, I've got a copy of the dissertation over there in my office. I'm sure that I have referenced Lane and Carlson's work. Again, this would have been maybe six years after I had looked at this back at Akron. Again, it sort of led me toward–gee, Bureau of Reclamation lab, is it still down there? I remember calling once and talking with them. I think I actually went down and visited the Denver office here before I even applied, actually to physically see what it was like. I didn't even know what it looked like.

So anyway, but the research is coming up with a problem, [coming up with a solution theory,] coming up with a design of a plan of progress: what are you going to do, first of all, that represents what a field situation would be; what the real-life situation would be; what instrumentation are you going to use; what kind of data are you going to collect. A lot of this you would start out your research by doing a literature search. You would certainly find out all the information out ahead of time, because that helps you build on other people's experience.

Then you go from there and go into a study program, present your theory as to why you think what you're observing is happening physically, and then come up with your conclusions, and try to convince your major professor that you did something worthwhile that allows you to graduate.

Storey: Why did ARS want you to do this?

Agricultural Research Service Funded His Scholarship Because of His research Project on Water Loss in Unlined Canals

Burgi: I don't know all the details of that, Brit. ARS, of course, is Agricultural Research Service, and they have quite a bit of research monies that they get from the Department of Agriculture. My knowledge of them now, of course, is a lot more than it was then, but probably on an annual basis they set up sort of a research review and decide, okay, if we have this much research money, what are some of the hot topics that we need to be looking at? Where is it that we need more information?

Some of those they do in their own laboratories. For instance, at Stillwater, Oklahoma, they have a research laboratory.

Storey: That would be OSU [Oklahoma State University]?

Burgi: No, it is, in fact, an ARS laboratory that's separate from OSU I'm sure OSU has some students working over there, but it's a separate lab. But then they would also have people in some of the universities. For instance, David Woolhiser was an ARS employee, so there could be some at OSU that way, too, now that I think about it.

And I'm sure that David had a certain amount of monies that he could allocate to some of these research projects. Then, of course, what they were trying to do is match a graduate student that has an interest in some of this to the projects that they're trying to get accomplished. I'm sure they're working with something where they say, "We know this graduate student's going to be around for a year and a half. Can we size this project to a point where we can accomplish something and this would make a good thesis for a graduate student?"

So I think at that time ARS does a lot of work with–Reclamation does a lot of work bringing the water to the major canal systems, but ARS tends to be more in the field. They're concerned, of course, not only about crop production, but also about the little canals, the feeder canals right in the fields.

Storey: The laterals and things.

Burgi: The laterals and things. So that's why, as compared to my research wasn't on energy dissipation or stilling basins or spillways, which, of course, is a lot of what I did when I came with Reclamation. Historically, they've done a lot of the work–Reclamation has done a lot of the work within their own laboratory. They do work some with universities, but ARS and USGS have a lot more research money available, and so they, along with the National Science Foundation, provide a lot more to universities.

Storey: Did you run into any research issues that came up while you were doing this?

Burgi: You mean in addition to the research I was working on?

Storey: Unanticipated issues, maybe is the way I would put it.

Burgi: Oh, I'm sure I did. I'm sure that my plan of action didn't completely go the way I had planned it. I think that certainly some of the research issues you run into in a real-life project like that is that, for instance, my piezometers were plugging up much quicker than I'd expected. I don't remember all the details, but I was probably using some kind of a metal mesh on them, and stainless steel would have been better. There's things that you learn as you go through the process and you say, "Boy, if I had thought this through a little bit more, I probably would have used different materials here."

I think on any research you sort of say, "Okay, this is the big picture and this is what I want to accomplish," and sometimes in a hurry to get things done, we don't fully appreciate some of the other problems associated with that research. A lot of times it's in the gathering of the data or in the fact that we have many more [variables] ~~parameters~~ than what we expected, and we often have to put limits on our study and say–for instance, I didn't study different slopes along the canal. I studied the side slopes, but certainly it would have been interesting to have looked at, say, a tenth-of-a-percent slope versus a half-a-percent slope along the canal [length].

". . . in those days when you're gathering all this data by hand . . . it took an awfully long time. Now with some of the computers and the data acquisition systems we have, we can gather data much faster. . . ."

You soon find that, at least in those days when you're gathering all this data by hand, that it took an awfully long time. Now with some of the computers and the data acquisition systems we have, we can gather data much faster.

". . . most of the research issues that came up . . . dealt with the methods and the instruments and the ancillary equipment of trying to make sure I was gathering good data. . . ."

But I'd say those were probably the–most of the research issues that came up, in addition to the major project I was working on, dealt with the methods and the instruments and the ancillary equipment of trying to make sure I was gathering good data.

I think the other thing that happened when I was there, too, is that Neil Gregg and others, Verne Schneider with USGS, several of them were working on other projects that sort of piqued my interest, too, anywhere from water measurement to sediment problems.

"One of the neat things about working in a laboratory like Colorado State is that . . . it's always interesting to see a little broader scope. . . ."

One of the neat things about working in a laboratory like Colorado State is that not only are you working on your project, but there's other activities going on, and it's always interesting to see a little broader scope. You can use this laboratory for a number of different things. Just the quality of the people that were working in the lab, both the students as well as the professors, it was just a great environment.

"I think I probably had some thoughts in my mind of, gee, I'd like to just stay in this type of university environment compared to going out and working for a government agency. . . ."

I think I probably had some thoughts in my mind of, gee, I'd like to just stay in this type of university environment compared to going out and working for a government agency.

At that time, though, I think, as it is now, you really need the doctorate degree, and I really wasn't interested in staying in school that much longer. I wanted to get out and actually get to work.

Storey: While you were there at that lab, did you ever hear any stories about Reclamation testing that had been done there?

Reclamation Worked with Colorado State University as Early as 1930

Burgi: That's a little foggy history. I don't know. I may have either read about that since or I may have read about it in the early sixties when I was still in Ohio, or I may have heard about it when I was there. I became aware over time that as early as 1930, in fact, next year it will be seventy years that the Bureau of Reclamation will have had a hydraulics laboratory, and that as early as 1930, we, the Bureau of Reclamation, had decided to work with the Colorado Agricultural Experiment Station, I think it was called in those days, to do laboratory studies on Hoover Dam.

Max Parshall probably started the laboratory in the early 1900s, maybe as early as 1910-, 1912, something like that, but in 1930 people like Emory Lane, from the Bureau of Reclamation, and [Jake] Warnock would have been one of the fellows, Jim Ball, worked with Whit [Whitney] Borland was another one, worked up at Colorado State University. My understanding was that they were actually Reclamation employees working in the laboratory at Colorado State, and had some kind of apparently an agreement, because I think it was even referred to as Reclamation's laboratory, even though it was CSU's laboratory, or at that time the Colorado A&M hydraulic laboratory. But, yeah, as early as 1930, there would have been a really interesting history there between Colorado State and the Bureau of Reclamation.

The Bureau also–at that time they were looking at a drop shaft for the spillway at Hoover Dam in 1930. They were doing those studies at Colorado State and came up with this idea of using a overflow side channel spillway. The bathtubs that I refer to now is what we have at Hoover.

Studies on the Uncompahgre Project at Montrose, Colorado, for Hoover Dam

They were studied at Colorado State. I think in the period between 1930 and 1936, there was some work at–I take that back. Probably around 1935, Montrose [Colorado] at the Bureau of Reclamation had a project already up there, [using] the old Gunnison [tunnel.]

Storey: The Uncompahgre Project.

Burgi: The Uncompahgre. There was a channel up there that they were actually able to, in the summer for several years, use as an outdoor laboratory. Guys like Whit Borland and–I think Jake [Jacob E.] Warnock was up there, but certainly Bradley would have been, did studies on Hoover Dam, on the Imperial Dam that's down on the Colorado River on the border of Mexico, and I think there were a couple of others early on, maybe even Grand Coulee.

". . . around 1934, the Bureau started a laboratory in the basement of the old Customs House, downtown . . ."

Then sometime–in fact, I wrote this down here–sometime around 1934, the Bureau started a laboratory in the basement of the old Customs House, downtown [Denver]–

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BEGIN SIDE 1, TAPE 2. APRIL 28, 1999.

". . . we were working on Grand Coulee Dam, and there was, I know, a 1-to-60-scale model of Grand Coulee Dam up *at* Grand Coulee. . . . the early laboratory was located in Fort Collins, there was some up at Montrose, there was some up at Grand Coulee, and then, of course, in the Customs House. . . ."

Burgi: They had a small laboratory in the New Customs House, when the New Customs House was built in downtown Denver. At that time we were working on Grand Coulee Dam, and there was, I know, a 1-to-60-scale model of Grand Coulee Dam up *at* Grand Coulee. So it's sort of interesting, the early laboratory was located in Fort Collins, there was some up at Montrose, there was some up at Grand Coulee, and then, of course, in the Customs House.

The Laboratory Moved to the Denver Federal Center after World War II

Then after the war, there was this effort to *move* the hydraulics laboratory. I'm not quite sure when the concrete and materials laboratory started, but in 1946 there was this Denver Ordnance Plant out here on the west side of Denver that was used during World War II for armament [ammunition manufacture]. I don't know all the details of that, but somehow several of the Federal agencies located out at this Denver Ordnance Plant–I think they started using the name Denver Federal Center, and at that time I think Building 56 was actually called B-1, something like that. It was like a big warehouse where they were fabricating armament.

Modifying Building 56 to Serve as the Hydraulics Laboratory

We have old pictures over in the lab that show that they came in with these steam cranes and actually dug the channels and laid out all the piping for the laboratory that's still there. Then from '46 on, I think basically everything was brought into the hydraulics lab here.

There Were Plans for an Outdoor Hydraulics Laboratory Test Facility, Including Desilting Basins Because of Sediment Issues at Imperial Dam

I was looking through some old files here this last week, and at one time here where Building 67 is located and off to the west toward the Sheraton, there was actually some fairly good plans on an outdoor hydraulics laboratory test facility, desilting basins. Again, the sediment issues at Imperial Dam were still a big issue then. They were looking at obviously a hydraulics laboratory that not only was centered in Building 56, but that might have outdoor facilities here at the Federal Center. For whatever reason, that was never built.

So, yeah, there's quite a history of a joint effort between Colorado State and the Bureau of Reclamation in those early days. The Bureau's early staff is interesting, too, in their hydraulics area. They had several people come in from Cornell [University]. Warnock, who was head of the labs when it first moved out here in 1946, of the hydraulics lab, really wanted to see people with–a lot of them might have had master's degrees or higher, had really gathered together a strong group of hydrolicians to do the work.

". . . this was great work for folks in hydraulics. You're working on these projects like Hoover Dam and Grand Coulee. . . . these type of projects were never built before. So there was a lot of advancements in . . . the hydraulics area . . ."

Of course, this was great work for folks in hydraulics. You're working on these projects like Hoover Dam and Grand Coulee. I mean, these type of projects were never built before. So there was a lot of advancements in not only the concrete mix and foundations and trial-load methods and some of the other areas, but in the hydraulics area that would have been issues of large gates and valves, larger than had ever been built before.

Some of the work on needle valves and, more recently, jet flow gates, the hydraulics laboratory developed those. All the work on energy dissipation, cavitation, that's in the literature, it's greatly expanded by Reclamation's involvement. Corps of Engineers did some of that as well, but certainly the Bureau was a highlight of a lot of the work.

Engineering Monograph 25 and Al Peterka

Then as time went along, certainly water measurement and more recently as we've gotten into some of the environmental issues, fisheries issues, the types of things we're doing now, monographs like *Engineering Monograph 25*,[2] which is a world-class monograph on energy dissipation that deals with stilling basins and outlet works, various types of dissipation structures, really resulted from a guy by the name of Al Peterka, who was one of the section heads in the group, had a lot to do with

2. *Engineering Monograph 25: Hydraulic Design of Stilling Basins and Bucket Energy Dissipators* (Denver: U.S. Department of the Interior, Bureau of Reclamation) first appeared in 1958 without an author attribution. Subsequent editions in 1963, 1978, and 1984 show the author as A. [Alvin] J. Peterka.

some of the early studies in the labs.

I think Lane and some of those folks actually taught up at Colorado State, too. I don't know quite what the connection there was with some of the folks in the lab.

Storey: How long did it take you to get your thesis done?

Burgi: Well, I was there for a year and a half on the whole graduate program. I suspect that I probably did the laboratory studies for three months. Of course, getting it written up and ready for final publication in order to graduate, there's some pressure there, I remember. I suspect that, all told, from the time that I started working on it till I finished, it was probably six months. It was a fairly clean project. It wasn't the size it might be on a doctorate candidate level, but certainly I ran into problems real quickly on not having a box that was that big. To start moving sand around or doing anything in it, it took a lot of time, more time than I originally planned. But I think probably from the time I actually started the testing until I completed the report was six months.

Storey: Do you remember how you went out looking for work with Reclamation, with the Corps?

Looking for a Job

Burgi: Well, I think probably if I started in January of '68, I suspect by January of '69 I was getting pretty serious about looking for work. As I recall, I'm sure I did just send out some letters, "Dear Sir" type letters. I found the names and addresses for the laboratories at Vicksburg and Bureau of Reclamation, and I suspect those are the only two laboratories that I wrote to.

"With either Vicksburg or Reclamation, *my* desire was to go to a laboratory. . . ."

I realized that at the Salt River Project they really didn't have a hydraulics laboratory. If I'd gone to work for them, it probably would have been in hydraulics design type of things. I knew they were doing a lot of work both on the Salt and the Verde Rivers, and so I just expected if I'd gone to Salt River, it would be either canals or dams or outlet-type work, but it would have been more on the design or maintenance side than it would have been on the research side. With either Vicksburg or Reclamation, *my* desire was to go to a laboratory.

When I first came to work for the Bureau, I rotated through the design section and concrete dams. Jim Legas–let's see. [Al] Coplin. There's several people up there that I really enjoyed working for, and they really wanted me to come to work in their group, and yet I felt a loyalty to Harold Martin, who had hired me, and I still had this desire to work in the lab. I'm not sure how long I'd stay with Salt River Project if I really had that strong a desire to do the laboratory work, and there just, frankly, isn't that many government laboratories, hydraulics laboratories available at the universities. You have them at Utah State and University of Iowa and Colorado State, and I think there's a small one out at Berkeley, but Federal hydraulic labs, I think there's just the two big ones. TVA has one, too, in Norris, Tennessee.

Storey: Did you apply to that one?

Burgi: I don't think so. Again, it was probably an issue, too, of where I wanted to live. I really didn't want to live in the South, for no other reason than I like the sunshine and I like the outdoors of the West. So I'm sure I was prejudiced toward the Bureau's offer. That's probably my reason that I was so disappointed when I got the faxing of, "Yes, we know you started down this road, but we've had some cuts in our budget and we're not going to be able to hire you." I remember being pretty devastated that day, that this can't be happening. (Laughter) I guess that's why I got a little courageous and went back and said–I think Gould, G-O-U-L-D, was the head of the Human Resources or Personnel, as they called it in those days, group, and I may have even come down and talked with him or interviewed with them again.

But in any case, as far as where I applied, I think it was limited to those three, and I don't remember–I think I probably heard back from the Corps, as I said before, and when I heard from the Bureau it was sort of like, "Okay, that's the one I want. I'm not going to go any further on this thing."

Storey: Do you remember how you got the initial offer?

Burgi: Yes. It was a telegram that came, saying, "We reviewed your application and we think we have a position." It talked about the rotation program and the [unclear] of rotation engineers, but that you'd be assigned to a home base and rotate through, then we can't guarantee that you'll be back at that place, but indicated that typically you end up back where you started.

Yeah, so it was–in fact, I think in a notebook somewhere at home I still have a copy of that, but it was a telegram. Then we went through this for about another month after the second time they informed me that they were sorry they couldn't, and I said I'd given up on some other offers. I was trying to put a little bit of a guilt trip on them. In fact, there's some truth to that. I had put out fifty bucks or something for a physical that they had required, and really sort of felt that, you know, they were obligated to offer me a job. And they finally did come back and say, "We think we can."

I think at that time it was about a page or two fax that talked about they would help with some of the moving expenses and probably detailed a little bit more what my initial salary would be and what were some of the conditions of employment type thing. That was sort of a comforting fax that went into some of the details of what employment was going to be like with Reclamation.

Storey: So you came down and they put you in the hydraulics lab.

"Because I had a master's degree, they said, 'Well, we really can't afford to put you on a year rotation.' . . . So I ended up with just–I think it was a six- or seven-month rotation . . ."

Burgi: Yes. Starting in the hydraulics lab. Because I had a master's degree, they said, "Well, we really can't afford to put you on a year rotation." Typically you'd go out to a regional office for two or three months and work on a construction site. So I ended up with just–I think it was a six- or seven-month rotation that included a couple of months in planning, a couple of months in the concrete dams group, and the rest of the time in the hydraulics lab.

Storey: What did they put you to work doing in the hydraulics lab?

"The first model that I remember working on was Pa Mong . . . It's on the Mekong River in Cambodia. . . ."

Burgi: The first model that I remember working on was Pa Mong, P-A-M-O-N-G, still a project that's around. It's on the Mekong River in ~~Vietnam.~~ [Cambodia.] At that time they were looking at some kind of a South Asian program where I guess Reclamation might have been involved in a feasibility study for. It was a little sectional model of a bucket spillway, actually a ogee spillway with a bucket energy dissipater on it, similar to Grand Coulee.

"I remember conducting those studies . . . with . . . Glenn Beichley. . . . within days after I started on that, though, Glenn had another study going in the laboratory, and he forgot to close one of the valves that isolated his model, and when I turned mine on, I blew his up. . . ."

I remember conducting those studies out in the lab in a little sectional model with a guy by the name of Glenn Beichley. I think within days after I started on that, though, Glenn had another study going in the laboratory, and he forgot to close one of the valves that isolated his model, and when I turned mine on, I blew his up. So that sort of went down in history as–I remember going out there, it was just a little conduit that was soldered together, a one-by-one square with a flat gate on it.

"I went out there when I realized what happened, went over and looked at it, and the whole end of the model was just flared out . . . I didn't feel too bad about it, because he didn't close his isolation valve . . ."

I went out there when I realized what happened, went over and looked at it, and the whole end of the model was just flared out, all four ends of it just like it had blown apart. I didn't feel too bad about it, because he didn't close his isolation valve, and he never got on my case too much about it, but it was one of a number of hilarious things that happened in the lab over there, over time.

Glenn had this habit of calling his stock market guy during the day, and every once in a while–he was getting to be older and he'd get real sleepy in the afternoon and he'd sit back in his chair, and I remember being in the office and you'd hear this bang every once in a while. He'd actually fallen asleep in his chair and fell out of the chair. It was just the way things were done in his office in those days.

Then Worked on Jackson Lake Dam

But, yeah, Pa Mong Dam was one of the first ones, and then Jackson Lake Dam. There were a few others I worked on in those early days.

“. . . then finally in about . . . ‘72 or ‘73 . . . Danny King, who was then . . . my section head . . . Said, ‘I’m going to give you a model study on Crystal Dam,’ so that was my first model that I was in charge of, and I’d probably been there three or four or five years by then. . . .”

In all those cases I was working under another engineer, and then finally in about, oh it was probably ‘72 or ‘73, my recollection isn’t that good, I remember Danny King, who was then the branch chief, said–Danny was my section head at that time. Wagner. Bill Wagner was still the branch chief. Said, “I’m going to give you a model study on Crystal Dam,” so that was my first model that I was in charge of, and I’d probably been there three or four or five years by then.

“It was an arch dam with a ski-jump spillway on it. It was just a fabulous model. . . .”

It was an arch dam with a ski-jump spillway on it. It was just a fabulous model. It’s just sort of neat to go out to Crystal Dam and see it there now.

“. . . we actually did two studies. . . . for Crystal . . . in the design groups over here, there was still quite a bit of competition between whether an embankment dam or a concrete dam was going to be built at any given site. . . . after we did the embankment study in the lab, they came back and said, ‘We’re going to look at a thin arch concrete structure for Crystal, because it has much less of an environmental impact . . .’”

This was a time when we actually did two studies. Mike Colgate did a study on an embankment, it would have been a morning glory spillway on an embankment dam for Crystal, and in the design groups over here, there was still quite a bit of competition between whether an embankment dam or a concrete dam was going to be built at any given site. It ended up, after we did the embankment study in the lab, they came back and said, “We’re going to look at a thin arch concrete structure for Crystal, because it has much less of an environmental impact in the area down there.”

So that’s what they ended up actually building. It was just, again, neat to be involved in affecting design on Crystal, both outlet works and the spillway. Some of the unique features of that waterway design came out of our lab and came out of my work on it, which I’ve always felt good about.

Storey: Tell me why you would model something like Crystal Dam. I mean, you design it on the boards, right? And you apply the trial load method to make sure that it’s safe. So why do you have to model it?

"The main reason you do the hydraulics models is that although we have pretty good theory on where the water's going to go when it comes in off that spillway, there's a lot they did not know at Crystal . . ."

Burgi: The main reason you do the hydraulics models is that although we have pretty good theory on where the water's going to go when it comes in off that spillway, there's a lot they did not know at Crystal about the wave action. If you know that area of the powerhouse, it's a very tight canyon. The powerhouse is almost underneath the spillway. There was a lot of concerns about how that flow going into the plunge pool was going to dissipate energy-wise across the full range of the discharges from just a meager flow going over it to the design flow.

Reclamation Was Concerned That it Didn't Know How the Spillway Would Perform

So one of the main reasons that Crystal was studied was, we really didn't know how that spillway was going to perform. It's a very tight canyon. In fact, the spillway is very close to the right abutment, so close to it, in fact, that as the water approaches it, it's sort of–if I can use the word freely, the water's sort of bouncing or deflecting off of the right topography upstream of the spillway, so you're getting these funny-looking waves approaching the spillway from the upstream side.

Spillway Relocated Due to the Model Studies

I remember when we studied this in the laboratory, we really don't want those conditions, so we moved the spillway a little further away from the right abutment, I think five feet or ten feet, and about all we could do, given the design of the thin arch. Then we also suggested they go in–and I think they actually did this, they removed some of the topography on the right abutment upstream of the spillway, sort of benched it below the spillway crest so that as the flow approached the spillway, it would have a much better approach flow condition than what it did originally.

So I think they've actually excavated part of the right abutment upstream of the dam, but below the water level, so that as the flow approaches, it has a much better angle. So we did some fine-tuning there and then also down in the basin itself, where the road was located for the powerhouse, the size of the wave action.

You're talking about a project, I don't know how many hundreds of millions of dollars it cost, but I suspect in those days a laboratory study was 50- or 60,000 dollars, and the fact that you can test in the model some of these problems that may occur and resolve them before you actually build the thing, is certainly a lot more economical than going out and building it and then saying, "Oh, I guess we need to go up there and remove some concrete," or "move the spillway."

Modeling Can Also Assist in Development of the Design Operating Criteria for a Dam

So you verify the design in the model. The other good thing that you can do, though, is you can really do a lot of operational things. You can put the design flood through there and see what it's going to do so that if that ever happened in your designer's operating criteria, you can actually see what those waves are going to look like, and you can write things in there to help the operators at that time know how this is going to perform.

So it's not only verifying the design and make sure it works, but, in my mind, there's a lot of other things in the operational side. For instance, a lot of our models have spillway gates. I could see where somebody might decide if there's three gates, let's just open one and leave the other two closed. Well, you can set up some really severe hydraulic conditions in the basin where you bring materials into the basin. If you're not knowledgeable of that and you've never seen that in a model, an operator might not know that. But when designers put together design operating criteria, they have those types of information in there. Part of that's based on the model studies. We know that if you operate this facility in a certain manner, you're going to have damage here. So don't operate it that way or this is the type of thing that can happen.

"We also looked at the flip bucket to see what angle of exit there would put the water in the right place down in the pool. . . ."

We also looked at the flip bucket to see what angle of exit there would put the water in the right place down in the pool. So, as I said, even though you have some of the theoretical equations that what I say would help you in the Far Field design, you get into the Near Field, we get close to the structure, we still find even today that the physical models are needed, because we don't have the Navier-Stokes equations completely defined so that we can go into a computer model and solve those issues.

Some Considerations in Building Models

For instance, in a reservoir, we might know what the approach conditions are temperature-wise and flow up to, say, a selective withdrawal structure, but we can't yet write the equations that will take the water through that structure and tell us what the head loss is going to be, like at the Shasta temperature control device. The way we define those is in a hydraulics model that allows us to actually measure them. There are scaling laws that tell us that if we stay within certain Reynolds numbers–for instance, you don't want to build a model at a 1-to-150 scale if your Reynolds numbers are so slow that everything is laminar in flow. You want it turbulent. So you choose your model scale. Optimally we would use–well, most of our models, we don't go below 1-to-60, and sometimes we're as high as 1-to-12 on some of our gates, trying to make sure that the–we call it the Froude Law, F-R-O-U-D-E Law, is adhered to.

If we can adhere to those laws, that and the Reynolds number, we can measure a velocity in a model and know that the velocity in the prototype is the model scale to the one-half, and the discharge is to the five-halves. The pressure is the linear scale. So there are the scaling laws that as long as you have good judgment in your design of a model, allows you to say with confidence that this is the velocity you're going to have on the Glen Canyon spillway, and we know exactly what it's going to be from the model that we've done.

"A lot of this modeling started in Germany. A lot of the early hydralicians came out of Germany and France and some of the early U.S. folks actually went to Germany, a place called Karlsruhe, to study. . . ."

These are laws that have been around probably for–I'm not sure when Froude lived, but I suspect we're up close to 150 years. A lot of this modeling started in Germany. A lot of the early hydralicians came out of Germany and France and some of the early U.S. folks actually went to Germany, a place [called] Karlsruhe, to study.

". . . I like to say that usually the cost of the model can more than be offset by savings just in the amount of concrete. Often we can come into efficiencies in our design . . ."

So there are some–I like to say that usually the cost of the model can more than be offset by savings just in the amount of concrete. Often we can come into efficiencies in our design, maybe the pier can be a little smaller, one thing or another, we can save $60,000 on a Crystal study quite easily on some of the design of it, and that doesn't even include the problems that we've solved before we ever built it, or the operational knowledge that we gain from using the model.

"We do some numerical modeling, but the physical models serve us in a number of ways . . ."

I've always been a proponent. We do some numerical modeling, but the physical models serve us in a number of ways, not only in improving our designs, but more recently, for instance, we did a study on a boat ramp down here on the Platte River a few years ago, on Union Avenue, and we were able to bring in all the local political groups that were involved in those decisions, anywhere from the county to the state, to the Federal, to some of the boating interests, the kayakers. They were actually able to observe this model operate. We sort of became, in the lab over there, a focus point where these people could gather and have discussions on how do we resolve this issue or another issue. So the physical models have also served the purpose of, I think, providing a forum for public discussion on designs.

Storey: I'm glad you addressed the issue of how you can take these little things four feet high and get them to model the larger situations. I'm wondering if any of these modeling laws were developed at Reclamation that you're aware of, or if they're older than that.

"Most of the modeling laws are older than Reclamation. I think where Reclamation has had input is in the size of the projects that we've modeled. . . ."

Burgi: Most of the modeling laws are older than Reclamation. I think where Reclamation has had input is in the size of the projects that we've modeled. Hoover Dam, for instance, the tunnel spillways on Hoover Dam were phenomenal in their size, in the energy, issues like the high-velocity flow over concrete surfaces. There's issues like that that were never really looked at, say, for instance, in some of the earlier studies in France and Germany.

So I would say that where the Bureau has really had impact in the total knowledge of hydraulics has been in the size of some of the facilities that we have designed and built and, in fact, tested before we ever designed them. There's a great history there that has really been synthesized into manuals like *Design of Small Dams* and this *Engineering Monograph 25* that I spoke of, that now are used worldwide, because we're not building those projects, but a lot of nations are. Of course, that science continues to grow, but in that gap of the size of some of the structures.

". . . the other area where the labs have really had major input is certainly in the large gates and valves . . . the design of some of those, and then also more recently some of the cavitation work on high-velocity flow. . . ."

I think the other area where the labs have really had major input is certainly in the large gates and valves that I referred to earlier, the design of some of those, and then also more recently some of the cavitation work on high-velocity flow. We're talking about here now even working in the sixties and seventies and maybe early eighties. We built those tunnel spillways and for years thought that they were fine, because in the science that we had in the forties, we really didn't understand cavitation, for instance.

Damage to Yellowtail Dam Spillway Studied in the Hydraulic Laboratory

In the late 1950s, early 1960s, [Yellowtail,] ~~Flaming Gorge,~~ we released quite a bit of flow from [Yellowtail] ~~Flaming Gorge~~ through the spillways, and we had this tremendous damage in the tunnel spillway, down in the [tunnel] elbow area. Our lab really got serious at looking at what was happening there, and we understood there was a thing called cavitation, but I don't think we appreciated how destructive it could be in our concrete tunnels.

So some of the development work with what we refer to as air slots in spillways started early on with Reclamation. I think even back at Hoover, at the time of Hoover, there was this recognition that if we introduced air into the flow, we wouldn't prevent the cavitation from occurring, but we could prevent the damage, because the air, even as low as eight percent in the water, serves as a cushion and takes some of the energy out of the shock waves.

Storey: So-called "soft water"?

Reclamation Put in the First Air Slot in the Spillway at Yellowtail Dam

Burgi: Yes, you might call it soft water. The first air slot that we put in was at [Yellowtail Dam.] ~~Flaming Gorge.~~ This would have been, I think, in the late sixties. I remember when I first came with Reclamation in the hydraulics lab, I think in the seventies, early seventies, we had a problem, so maybe we didn't put an air slot until mid-seventies. In any case, we recognized that [we had a problem with tunnel spillways exposed to high velocity flows.]

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BEGIN SIDE 2, TAPE 2. APRIL 28, 1999.

Storey: . . . Glen Canyon.

Reclamation Has about Five Big Structures with Tunnel Spillways

Burgi: Yes, and several other of our tunnel spillways. We have them at about five big structures that we were going to have problems there if we didn't address them.

Spillway Problems at Glen Canyon Dam in 1983

In fact, at Glen Canyon in 1983, we had a large inflow to the reservoir in June and were caught with a full reservoir, and when we started releasing through the spillways, on the left spillway after about three days, we had a hole that was ten feet deep in the concrete. I remember going down into that tunnel on a cart, and they closed the [spilling gates]–we were about six inches from the top of the gates, and they closed the gates, and we went down in to look at it.

"I remember coming back up and saying to the folks that were there from Salt Lake that, 'We can't use these spillways.' They almost laughed and said, 'Look at where the water is on the gates. What else are we going to do?'. . ."

I remember coming back up and saying to the folks that were there from Salt Lake that, "We can't use these spillways." They almost laughed and said, "Look at where the water is on the gates. What else are we going to do?"

". . . we had a serious problem, and that's when we came in and we actually added plywood flashboards on top of the gates that were four feet high and then eventually we went to eight-foot high metal flashboards. . . ."

We realized that we had a serious problem, and that's when we came in and we actually added plywood flashboards on top of the gates that were four feet high and then eventually we went to eight-foot high metal flashboards. But we had a serious issue in that even though a few years *earlier* we had started working on designs to fix the tunnel spillways at Glen Canyon, we had not done that. So we were caught in a very serious situation.

Over the next three months, I probably flew on small airplanes to Glen Canyon eight or nine times. Tom Gamble was the ~~sort of~~ project manager at the time, and he called and said, "Gee, we're hearing all these noises." Basically what we had to do [was to open the spillway gates] ~~is turn the spillway back on,~~ on the left side, and run it at about 30,000 cubic feet a second. Over time, they were down in the tunnel at the powerhouse and other places in the galleries, and you could hear the~~–you knew~~ cavitation damage that was occurring.

All we could do is–Hank [Henry T.] Falvey was working in our laboratory, and he was really the expect on cavitation, but at that time I was the one that was traveling down to Glen Canyon and we'd meet and talk about what do we do next. All we could do is just keep operating it. We finally, I think, got up to levels as high as 45-, 50- cubic feet a second through the left spillway, and was causing enough damage that we were a little concerned about where the damage was going.

Storey: You said 45-, 50- cubic feet? You mean–

Burgi: forty-five thousand, fifty thousand cubic feet a second. Thank you. We would meet.

"We were hoping . . . the damage . . . was staying on-line and not diverting to the right or left. . . ."

We were hoping–we knew the damage was occurring in the tunnel, because we'd seen–in the elbow of the tunnel, and we were hoping it was staying on-line and not diverting to the right or left. If it diverted to the right, of course, if it started going to the right, it could eventually come out through the canyon wall. Then we would lose the whole reservoir over time if that were to happen. Or if it started going upstream and went through the tunnel plug, we could lose the whole reservoir.

"So we were quite concerned. After some time we saw what we thought coming out of the downstream end certainly pieces of concrete and to some degree red material that made us think that we'd better start using the right spillway. We knew when we started using the right spillway, that we would also damage *that* spillway . . ."

So we were quite concerned. After some time we saw what we thought coming out of the downstream end certainly pieces of concrete and to some degree red material that made us think that we'd better start using the right spillway. We knew when we started using the right spillway, that we would also damage *that* spillway just because they were designed exactly the same.

"Anyway, we nursed our way through, releasing as little water as we could through the spillways, and releasing all we could through the powerhouse and through the outlet works. Got into early August and that was the first time since June 6th that we could actually close the spillway gates and go down into the tunnel and see what damage had occurred. Of course, when we first went in, we hadn't pumped it out yet, but there was rebar hanging off the ceiling like spaghetti in that area, and both sides of the tunnel were eroded into the sandstone. . . ."

Anyway, we nursed our way through, releasing as little water as we could through the spillways, and releasing all we could through the powerhouse and through the outlet works. Got into early August and that was the first time since June 6th that we could actually [close the spillway gates and] go down into the tunnel and see what damage had occurred. Of course, when we first went in, we hadn't pumped it out yet, but there was rebar hanging off the ceiling like spaghetti in that area, and both sides of the tunnel were [eroded] ~~gone~~ into the sandstone. We assumed that we had a fairly deep hole. As it turned out, when we pumped it out and actually did a damage assessment, I think the hole on the left side was 40 or 50 feet deep and maybe [50] ~~100~~ feet [wide, and] ~~long,~~ 150 feet long.

"Fortunately, it had stayed on-line and it had continued downstream of the plug so that we really had not endangered the reservoir storage at all. But then the problem was, well, how do we fix this thing . . . We'd already heard indications that '84 was going to be another high runoff year . . ."

Fortunately, it had stayed on-line and it had continued downstream of the plug so that we really had not endangered the reservoir storage at all. But then the problem was, well, how do we fix this thing from August? We'd already heard indications that '84 was going to be another high runoff year, and we can put concrete back in the hole, but we really have not touched what's causing it. How do we solve that issue?

". . . we knew from the studies at Flaming Gorge . . . that an air slot would be needed in both tunnels. . . ."

So we knew from the studies at Flaming Gorge that we had done, that an air slot would be needed in both tunnels.

". . . the damage wasn't quite as serious on the right side, but it . . . was a similar damage, but it hadn't had the exposure that the left side had. . . ."

By the way, the damage wasn't quite as serious on the right side, but it was still 150 feet long and maybe 30 feet deep, so it was a similar damage, but it hadn't had the exposure that the left side had.

". . . we went into the laboratory and actually built a scale model of the Glen Canyon spillway, and designed a air slot and made several modifications to that in the laboratory. . . . put out a spec on it . . . and repaired the spillways, put in the air slots, and had it back up and running by, I would say, late May of '84. And actually, the '84 runoff was higher than the '83 runoff. . . ."

So anyway, we went into the laboratory and actually built a scale model of the Glen Canyon spillway, and designed a air slot and made several modifications to that in the laboratory. The designers went ahead then and put out a spec on it, and we went into a fast mode where we went in and repaired the spillways, put in the air slots, and had it back up and running by, I would say, late May of '84. And actually, the '84 runoff was higher than the '83 runoff. We left the eight-foot flashboards on the spillway gates. Actually, we had to beef up those gates because they were already holding back sixty feet of water, and we were putting another eight feet on them.

Then what we wanted to do, of course, we of the research mentality, we told the regional office we thought we ought to run some tests on those [aerators,] ~~things,~~ and their reaction was, "We really don't want to run tests on those, not during our watch. What if it fails again?" And we said, "We have enough confidence in the design that we think it'll work."

". . . in May [1984] we actually ran some tests up to 90,000 cubic feet a second through the spillways. We ramped it up and we'd go in and check for damage each time, to make sure we weren't doing something that was really going to mess up the spillways again. . . . and actually we ran it at higher discharges for longer periods than what it had been exposed to in '83 . . ."

So in May we actually ran some tests up to 90,000 cubic feet a second through the spillways. We ramped it up and we'd go in and check for damage each time, to make sure we weren't doing something that was really going to mess up the spillways again. But we had pretty much confidence that it would work, and actually we ran it at higher discharges for longer periods than what it had been exposed to in '83, and really had the confidence that these could be operated.

". . . during '84 we did have to operate them again, and again we went in after those runs, and there was no damage in the tunnels. . . ."

So during '84 we did have to operate them again, and again we went in after those runs, and there was no damage in the tunnels. So it's quite a success story both in the–Jack Tyler, who really was the project manager down there on the construction, did an excellent job with a number of Navajo working on it, a pretty big crew.

". . . that was probably one of the high points in my career because it was a very critical problem, and although we had a pretty good idea of where we were going to go for the solution, we still had to bring it in and model it. . . ."

Guy Atkinson, the company that actually did the contract work, we in the labs, the operators out at Salt Lake, it was quite a–that was probably one of the high points in my career because it was a very critical problem, and although we had a pretty good idea of where we were going to go for the solution, we still had to bring it in and model it.

". . . shortly after that, because at Hoover Dam we also had problems that year, we went in and went through *all* of our tunnel spillways and put in air slots. . . ."

Actually, shortly after that, because at Hoover Dam we also had problems that year, we went in and went through *all* of our tunnel spillways and put in air slots. So now we have two at Glen Canyon and the two at Hoover, the one at Blue

Mesa, of course Flaming Gorge, and Yellowtail.

"Actually, it was Yellowtail Dam that at the start of the story is where we first put in the air slot, not Flaming Gorge. So those are the five main dams that have them now. . . ."

Actually, it was Yellowtail Dam that at the start of the story is where we first put in the air slot, not Flaming Gorge. So those are the five main dams that have them now.

But again, it was a case where the hydraulic modeling allowed us to come up with a design that would work, and this type of modeling was different than things that had been done earlier. As I mentioned earlier, with the early German work in the 1800s, they weren't looking at structures that large.

Air Demand Around Large Gates Becomes an Issue If the Guard Gates Are Used in Emergency Situations to Stop Flow

The other thing is just the whole air demand issue around large gates, the air venting in gates. There have been problems in the past where we typically have a control gate at the downstream end of an outlet works and way up in the pipe, maybe under the middle of the dam or even higher, we have what we call a guard gate, which we close, and we can dewater the pipe to inspect it and also inspect the control gate.

The Bureau has more recently gone into a procedure that if something happened with the downstream gate, we would actually use the guard gate in an emergency closure. Most of our older structures did not have air vent capacity to safely use those guard gates in a control gate mode of operation, so we've done quite a bit of work in the labs over the last fifteen years, with air demand and sizing air vents on outlet works, to make sure that even when we test them for safety-of-dams inspection, there were times when we probably tested some of the old ones when we were probably outside of the range of safe when we did it.

"You can create some low pressures in those tunnels that could actually cause the whole pipe to collapse. So in some cases we put in bigger air vents . . ."

You can create some low pressures in those tunnels that could actually cause the whole pipe to collapse. So in some cases we put in bigger air vents, in other cases we've actually put in more, heavier gussets or rings around the outlet works, pipe, to prevent it from collapsing during emergency closure.

So those are some of the things ~~maybe~~ that have come along in more recent times.

Storey: I don't quite understand what we're talking about here with getting air in with these guard gates and so on. Can you explain it to me so maybe I understand it?

Burgi: Yes. Well, I can try. It's difficult without pictures. Just take, for instance, if you had a five-foot-diameter pipe going through a dam, and this was an outlet pipe, and it might be a couple of hundred feet long, as I say, an embankment dam. You would have at the very end of that pipe a control gate or valve that you would open and close to let the water out of the reservoir.

Further up in there you've got another valve that's called the guard gate, and usually it was not meant to operate in a control mode. In other words, normally in a guard gate you would close your downstream gate and your water pressure would go all the way up the pipe, but then you would close your guard gate with no head differential across. The pressure would be the same on both sides.

Storey: There wouldn't be water flowing.

Burgi: There wouldn't be water flowing through it. Right. What happens in emergency closure is, for whatever reason, your downstream gate is not functioning, so now you have to close your guard gate with water moving by it. Those gates are not designed to do that, and in most cases the venting downstream of it aren't.

In other words, if you have 100 feet of pipe downstream of this guard gate and you start closing it, you may close it fast enough that the water flowing down through the pipe is still moving at a very high velocity, and there is no more water coming, so when this water column starts going down through the tunnel, it's creating a vacuum behind it, it's pulling a vacuum. The only way that can be relieved is if you have a vent in the pipe.

Most of our vents on those guard gates were not designed to work in that manner, and so what happens is, you can try to pull so much air through there that you go into a supersonic flow condition, which can break people's eardrums if they're anywhere near there, but also you've choked it to the point where you can't get enough air. Meanwhile, the water's still moving down the pipe and it will basically just be like an aluminum pop can and collapse if you were to pull a vacuum.

So what we're trying to do, what we have done is gone in and studied those, and in some cases we put in larger vents, where you can put more volume of air through the vent to take care of the problem. In other cases, we've actually had to go in and strengthen the pipe and, as I said, just actually put more ribs around the outside of the pipes so that if you had to operate in that condition, you could keep it from collapsing.

Those are some of the complexities that we get into in this day and age that maybe we didn't have to deal with when we were first building some of these projects, but certainly as some of the projects get older, we're more and more looking at what would happen if this scenario happened. When these were first built, we didn't worry too much about those gates.

Storey: Well, that's very interesting, and I suppose it may surprise you to know that two hours have gone by.

Burgi: We have moved right through.

Storey: I'd like to ask you now whether you're willing for the information on these tapes and the resulting transcripts to be used by researchers.

Burgi: Yes, I have no problem with that.

Storey: Good. Thank you very much.

END SIDE 2, TAPE 2. APRIL 28, 1999.
BEGIN SIDE 1, TAPE 1. MAY 5, 1999.

Jackson: My name is Mike Jackson and I am interviewing Phil Burgi. It's just past 8 o'clock a.m. Today is May 5, 1999. This is our second scheduled interview. this is tape one. We are sitting in the conference room on the fourteenth floor of Building 67 in the Bureau of Reclamation Building.

Adjusting to Life in the United States after Spending Time in the Peace Corps

Phil, picking up from where we left off, I have a couple of questions I wanted to visit about. I find it interesting to listen to how you went from the Peace Corps to your graduate degree at Colorado State, and then [to] the Bureau of Reclamation. It seems your daily routine would have changed substantially. I was just wondering if you could give an idea what a typical day was like at the Bureau of Reclamation when you started back in 1969.

Burgi: Yes, 1969 That's a good observation. In fact, one of my fears at leaving the Peace Corps was that I wasn't sure how well I could get back into society here in the U.S., which was running at a very fast clip. So the university experience sort of became a transition year and a half to get back, and actually maybe just to start into the workforce.

Started with Reclamation in 1969

So I did start with the Bureau of Reclamation in June of 1969, and I was on a six-month rotation because at that time if you came in with a master's, I think I came in as a [GS-7] ~~GS-9~~ and I wasn't allowed the full year. They felt that I should be getting about my duties in the laboratory as soon as possible. So it was a shorter detail.

Typically in those days a rotation engineer would start and spend like three months in what they called home base, which was where you expected to be at the end of a rotation. They couldn't assure you that you would be in that job. But the idea was that you would start there, get some experience with the people and the type of work you'd be doing long term, and then visit several other offices just to get an idea of what they do, and then return and start in a full-time position.

Branch Secretary Would Come by Each Day to Determine What You Were Planning to Charge to and Whether You Had "Daily Notes" to Dictate

So the rotation assignment I did start in the hydraulics lab, I mean, after you go through the original or initial half a day with personnel and getting a little idea of when coffee breaks are and when you're expected to be at work, and what type of projects are being worked on, some of that orientation, a typical day[, at least in the hydraulics lab] would be–and this used to bother me, is that you had a branch secretary, she'd come by everybody's desk in the morning and ask us what we expected to charge to that day, job-number-wise, and if we had any, what she referred to as, daily notes. We took information records back in those days of any things that happened, maybe we'd talked with somebody in the field, and we took a little notation of that for our records. She was really into stenography, and all we did was dictate notes to her, and she'd sit there and take them down in shorthand and then type them up.

I found both of those questions very intimidating. First of all, most of those days I didn't know exactly what I was going to be working on, so it was a little difficult at the beginning of the day to say, "I'm going to charge four hours to this," or six hours to this. And then the other one was, I just had this expectation every day that I was supposed to be having something important happening that I could report to her in some kind of a stenographic note. I could give her job numbers. Eventually I'd just go ask people I was working for what to charge to. But it took me a while to get comfortable. In fact, I remember just writing out longhand my thoughts as compared to observing these other older engineers that could sit back in their chairs and just sort of talk about things in a dictation format that I found a little different.

". . . very early in the laboratory experience, you get introduced to the pumps, how to turn them on and off, and had several experiences where I didn't do it quite right and had air in the lines, and the controls on the system are a little difficult . . ."

But very early in the laboratory experience, you get introduced to the pumps, how to turn them on and off, and had several experiences where I didn't do it quite right and had air in the lines, and the controls on the system are a little difficult when you first start using them. Again, a little intimidating. So you work through some of that and typically you come in in the morning and maybe sort of get your day in order at your desk, and then end up going out into the lab, usually working *with* one of the engineers. At that time I was just a helper, helping to get the flow set up in a model. Usually had a lot of questions why we were doing this or that, and usually the people I worked with could more than easily answer those questions.

"Then I was often given a clipboard and a stopwatch and a pencil, and went about my day taking data . . . looking at the pump readout to see what discharge was coming into the model. . . . not only analyzing data and doing the math, but to get used to observing what's happening in front of you, making notations about how

did this look different than the test we ran yesterday. . . "

Then I was often given a clipboard and a stopwatch and a pencil, and went about my day taking data, either measuring pressures on manometers or putting a point gauge in the water to get the depth of water, or go looking at the pump readout to see what discharge was coming into the model. Was encouraged to make observations. I think of working in the laboratory is not only analyzing data and doing the math, but to get used to observing what's happening in front of you, making notations about how did this look different than the test we ran yesterday.

"At that time we had a laboratory photographer. . . So part of the job was to determine what flow rates we wanted pictures taken at. Invariably Bill would ask me, after I told him, 'I want this picture and that one,' 'Well, don't you want this one also?'. . ."

So we had to coordinate with a photographer. At that time we had a laboratory photographer, Bill Batts, who would come out and take pictures. So part of the job was to determine what flow rates we wanted pictures taken at. Invariably Bill would ask me, after I told him, "I want this picture and that one," "Well, don't you want this one also?" Sure enough, I did, I just didn't know it. It was a case where he had been around so long that he knew better than the engineers what angles of photographs and what types of photographs were needed.

". . . there was a learning curve there of learning to not be intimidated by the pumps and setting the discharges, bleeding all your lines so that you'd get good manometer readings, a lot dealing with laboratory technique. . . . that we needed to verify what we . . . thought we saw . . . so that what you're reporting is, in fact, good information–that you have repeatability. . . ."

Yeah, I don't know how much detail you want, but basically there was a learning curve there of learning to not be intimidated by the pumps and setting the discharges, bleeding all your lines so that you'd get good manometer readings, a lot dealing with laboratory technique. We were taught a lot about the fact that we needed to verify what we actually thought we saw, and often we would take, sort of like carpenters talk about you measure twice and cut once, you sort of take your time and make sure that you understand what you're doing so that what you're reporting is, in fact, good information–that you have repeatability.

Often we would set up a test and say, "Let's see if we can get that to happen again." If we couldn't, maybe our discharge wasn't right the first time or whatever. So the test procedures was one new thing for me in learning to methodically and systematically go about conducting laboratory tests.

". . . you had these super engineers that had been around forever, that were like walking encyclopedias, and then you had a lot of folks at the medium level that just led the various projects out in the laboratory. There were a few of us that were younger engineers that did what maybe today we would call technician work. . . ."

We did have a few technicians that helped us in the laboratory, but I think, at least back in those days, you had these super engineers that had been around forever, that were like walking encyclopedias, and then you had a lot of folks at the medium level that just led the various projects out in the laboratory. There were a few of us that were younger engineers that did what maybe today we would call technician work. That was part of the way you started. You earned your stripes, as I said, I think, last time. The first model study I did was Crystal Dam, the spillway study for that, and outlet works, and I'm not quite sure, I would say that was probably four or five years after I'd been in the hydraulics laboratory.

"Everybody came to work at the same time back in those days. You were expected to be there at 7:30 and work till 4:00. I think just about the time I started in '69, the government changed policies, and you could actually save sick leave. . . ."

Everybody came to work at the same time back in those days. You were expected to be there at 7:30 and work till 4:00. I think just about the time I started in '69, the government changed policies, and you could actually save sick leave. But I think the first year I was there, I just found the habits of Federal employees interesting. Not only did everybody sort of leave right at the same time, but I don't think you could save the sick leave, so people tended to use it more. Then when those policies changed, people recognized that, hey, saving your sick leave was maybe a good insurance policy if you had a bad back or some other problem where you were going to be off for a long term.

"There was peer pressure to do things the way everyone else did, anywhere like from coming in at the same time to taking coffee break at the same time. . . ."

There was peer pressure to do things the way everyone else did, anywhere like from coming in at the same time to taking coffee break at the same time. I remember when we got our first little numerical calculator, I don't remember what they were called in those days. It was an HP-31 or 43 or something like that. I mean, one guy, one of the super engineers in the group, had the privilege of having one of those, and it was 350 bucks. The rest of us might get to use it once in a while, but it was a very special piece of equipment. Of course, over time you realized that everybody could get those eventually, and now with the computers we have at our desk, it shows how technology has become a huge part of what we do.

"In the laboratory, over the years equipment changed a lot. . . . now almost all of our data is taken with acoustic velocity meters, and we can produce large amounts of data. So the data management itself becomes a critical part of trying to get the work done . . ."

In the laboratory, over the years equipment changed a lot. Where we used to take data with a lot of manometer boards, and clipboards, stopwatches, now almost all of our data is taken with acoustic velocity meters, and we can produce [large] ~~humongous~~ amounts of data. So the data management itself becomes a critical part of trying to get the work done compared to the notebooks of hard notes that we used to have and that we would work through. Didn't mean that there wasn't some instrumentation, but it was at a totally different level than what we see today.

". . . it was a fairly formatted-type day. You had lunch at a certain time, you did this at a certain time, and then you went home at a certain time. Of course . . . I remember staying *late* in the lab, too . . . It wasn't like you have today, where you can come in early or go home late, have the flex schedule that we have, which really helps some . . ."

So I'm not sure if I'm answering your typical day, but back when I started, anyway, it was a [very] ~~fairly~~ formatted-type day. You had lunch at a certain time, you did this at a certain time, and then you went home at a certain time. Of course, if you had a laboratory test underway, I remember staying *late* in the lab, too, when we had some test that didn't fit into an eight-hour day. You worked those extra hours. It wasn't like you have today, where you can come in early or go home late, have the flex schedule that we have, which really helps some of the younger families.

Jackson: Was there a certain core or group of individuals that you interacted with regularly?

Working with Others in the Branch and Section

Burgi: Yes. The way the laboratory was set up, you had the lab area itself, which is maybe 27,000 square feet or so, out in Building 56. The office area was back in one of the wings. In those days we had what we called sections. There was a branch level. We had the division, the branch, and then the sections. I think probably there were three sections in those days, and there may have been eight of us in each of the sections. For instance, I don't recall the name, but I was probably hydraulic structures is the section I started in. So we had a section head that sort of supervised all of us, and then in my case, when I first started, I worked a lot with a fellow by the name of Glenn Beichley, who was one of the lead engineers, and so certainly I had daily contact with a section head and Glenn.

But what was always true in the lab was, there were people like Mike Colgate and Bob Dexter and Hank Falvey, who were sort of the people you'd go to if you had some technical questions that maybe Glenn or Tom couldn't answer. It was always sort of like a big family.

Mike Colgate

For instance, if you weren't able to get the Venturi meters bled properly at the ends of the laboratory when you were trying to take discharge measurements, you'd just go in and grab Mike Colgate and say, "Hey, I'm having a problem here. Can you come out and help me?" And, of course, he sort of acted like God in some ways. He'd come out and show you how to do it.

I remember one day particularly where I had done just what he had told me to, because he had all these instructions written down, and it didn't work. So I went in and said, "You know, the manometer isn't bleeding right." And he sort of came out with this disgusted look on his face, like, "You young engineers, you don't know what you're doing. It's a very nice system, and if you talk to it right and follow the instructions, of course it works." Well, he went through the same procedure that I did, and after about ten minutes he's out there scratching his head. He finally just threw the instructions on the floor and walked back into the office, and I was left on my own to solve that problem.

But there was this being very proud of your work. Mike was one of those. He was out there in probably the mid-forties when we first built the lab, probably behind a team of horses with what the called a comealong that you actually used to dig out some of the dirt when you put the channel in. I think he started out as one of the carpenters or sheetmetal workers in the old lab shop up at Fort Collins, and he helped build the laboratory. Then, of course, he moved up to an engineering position and had the ability to–in fact, he may have gone back to school after the war. Some of those guys actually finished their studies after the war.

". . . they had this tremendous amount of ownership in the laboratory and in what we did, and a pride in what we did . . ."

But in any case, they had this tremendous amount of ownership in the laboratory and in what we did, and a pride in what we did, that really passed on to some of the younger ones in the sense that you come with a certain authority and say, "Yes, we can do this. In fact, we can do about anything if we bring our engineering judgment and experience and education to bear on the problem." It was that same attitude, I think, that made the difference in the early years of Reclamation when you're building structures like Hoover Dam and Grand Coulee and Shasta, really extending the envelope of understanding. Where the laboratory's help was, they had this attitude of "Hey, let's find out what kind of concrete we can make," or how fast a velocity we can put on to concrete and make it stick together. As far as our waterways, building valves that had much higher pressures than what had been used before.

"So I always sensed that there was this attitude that, yeah, you know, maybe this is difficult and complex, but if we put our community of minds together on this . . . 'We can do it, it just may take us a little longer.'. . ."

So I always sensed that there was this attitude that, yeah, you know, maybe this is difficult and complex, but if we put our community of minds together on this and, of course, we worked a lot with the designers and with outside consultants, even, solving some of those things, that there was this sort of attitude of "We can do it, it just may take us a little longer."

". . . there was a lot of passing from one generation to another of skills, and some people were comfortable with that, others weren't. . . ."

So, yeah, there was a lot of passing from one generation to another of skills, and some people were comfortable with that, others weren't.

". . . some rotation engineers came through the lab and maybe something broke on a model or they never could figure out the pumps right, and a week later we found out that they had decided to go and work in another group . . . I don't think the laboratory is for everybody. . . . certain personalities and certain approaches to how you do work, you'll get different people. . . ."

So some rotation engineers came through the lab and maybe something broke on a model or they never could figure out the pumps right, and a week later we found out that they had decided to go and work in another group in Reclamation, which was fine. I don't think the laboratory is for everybody. Just like design or planning or some of the other functions in Reclamation, certain personalities and certain approaches to how you do work, you'll get different people.

The Laboratory Often Was Asked about Issues That Developed in the Field

But in the laboratory, a lot of it needed to be hands on and the ability to take what you've observed and, through judgment and mathematics and the knowledge that you have in engineering, bring that to bear on a design or on a project or solution of some issue that had come up. They say, "Have you observed this in the laboratory? We seem to have this problem on the vortex out at the dam," or somewhere. Often those questions would come into the laboratory, because we were the ones that were trying to observe these physical phenomena in models that were occurring out on the big projects. So it became often a question of, "Gee, have you ever seen anything like this?" or, "What do you think would happen if this happened?"

Jackson: You mentioned that there was a strong sense of pride and confidence among the established people at the Bureau. As a newcomer did you feel extra pressure to prove your mettle or was there a trial period, so to speak?

Gaining Experience and Confidence in the Laboratory

Burgi: I think that's a good point. I'm trying to think back. I know when I went through the rotation program, I went to concrete dams, they try to get you in groups that you might be working with in the future in your assignment in the labs, and so I went over to the planning group for a while and then to concrete dams. I know particularly in concrete dams I *really* liked the people over there, and I liked the work, because you were looking at these huge structures that you were building. They sort of wanted me to come over there. I really felt some loyalty to the people I had worked with those first three months in the labs. I really felt very fortunate that I could even come to work for Reclamation in those days. The labs were still where I really did enjoy model testing and observing hydraulic performance in real time, as compared to running through equations or the theory.

But I had those questions in my mind of, gee, could I ever be a Mike Colgate or a Hank Falvey or a Tom Rhone. I remember looking at their daily notes that were taken by the secretary and just being intrigued by their responses. They would say, "Somebody came in from the Hoover office yesterday and had this issue with the needle values on the canyon walls," or whatever the issue would have been. They presented the problem and then Tom would go through in his notes, how he methodically helped them through that problem, and say, "There's no problem with this," or, "Yeah, maybe we ought to do a model study." I remember thinking, will I ever have the judgment that I could actually listen to somebody's problem and say, "This isn't really a problem," or, "Yes, this is a real serious problem. This is how we solve it theoretically, or with a model or just analyzing it."

So I had those questions, and, frankly, I think a lot of those were resolved when I got to the point where I think it was Bill Wagner, was the branch chief at the time, said to me, "Hey, I'd like you to take the lead on this Crystal model study that's coming in," and it was sort of like a confidence builder that he would come to me and say, "Amongst all the other folks around here, we think you're at a place now where you could take lead on this." So it's one of these things where you can often question "Could I really do that job?" But until you actually were assigned the job, you may not know what your capabilities are.

Laboratory Staff Helped One Another Succeed

I took it on as a challenge and I think sort of an attitude of "Well, this is going to be it. This is a watershed here. You can either prove that you can do a model study or you can't on your own." The nice thing in the lab was that you never had this attitude "Well, let's all ~~the rest of us~~ get up in the stadium and watch this performance out on the field and see if he can do it." It was more like if you had a question or if you needed help, you knew those guys would be there to answer your questions. They wanted you to be successful at what you did. So I never felt like it was "Okay, I'm out on my own here, trying to prove this thing."

Told Danny King He'd like to Have His Job One Day

I know I had those issues early on in my career with Reclamation. Could I really cut it? Could I ever get to the place where I could be a leader in this group? I mean, I've been leader of the group now for fourteen years, but I remember a time when I went in to the branch chief, Danny King–this would have been in the early seventies. He said, "What would you like to be later on in your career?" I said, "Well, I'd like to have your job." I wasn't being critical of what he was doing or asking him to leave, but it was sort of like, I wouldn't mind having this as a goal of some day being in charge of this hydraulics laboratory.

So I think that most of us set goals and we look at other people and we say, "I'd like to be able to do what he does some day." And at the same time questioning inside was, "Gee, if I ever had that opportunity, could I do anything with it? Would I ever make an influence on Hydraulics Branch of the Bureau of Reclamation, where I might be remembered as, 'Oh, gee, we did those things when Phil was around'?" I just think that's part of maturing in a career, but it helps to be in a group of people that want you to be successful. It doesn't mean we always agreed on things. Certainly you have differences in how you approach a problem.

There were times when a branch chief would come down to me and berate something that I wrote and say, "This report just isn't good enough to go out yet." I'm thinking, "Ah, shoot. Maybe I can't do it." But it's one of those things that I think if we really call each other to accountability and we're asked to prove our mettle, so to speak, I think in the long run we're better people for that. Somebody just soothing us through our career and never asking those serious questions, "What do you mean by this one? It looks like you're telling me that water flows uphill in this report." And you sort of take that personally because you wrote it. "Oh, gee, maybe I haven't quite stated this correctly."

". . . I felt that there was a good group of folks to work with, that called you to accountability, that you could get about any answer you wanted in hydraulics, in the group . . ."

So I felt that there was a good group of folks to work with, that called you to accountability, that you could get about any answer you wanted in hydraulics, in the group, but they certainly wouldn't let you come out with some conclusion or make some statement that was incorrect, because then that becomes part of the foundation of the hydraulics report that somebody could go to later and base some decision on that was completely wrong.

"There was a lot of peer review . . . that if this was going to go in our listing of hydraulic reports, it better be of a certain quality or it's not going to go in. . . ."

There was a lot of peer review, even though we didn't call it that in those days, that if this was going to go in our listing of hydraulic reports, it better be of a certain quality or it's not going to go in. So there's none of this stuff of, "Well, I wrote it, so nobody else is going to review it or make any changes." Almost all the old hydraulic reports were–they might even have on the title block that it was written, submitted, approved before it became what we called HYD reports, the hydraulic laboratory reports.

There Are Hundreds of Laboratory Reports, and They Are Often Consulted for Reference and Current Issues

Now there's a [library] ~~grouping~~ in our laboratories. We would have hundreds of those laboratory reports. You could look up things like Lahontan Dam or Gibson Dam or Coulee or Hoover, Shasta. All of those have, in one form or another, one and sometimes several laboratory reports that talks about the performance of the [structures–the] waterways[,] ~~of~~ gates[,] and values in those projects. That alone is quite an excellent documentation, and we still go back to those. There will be an issue on one of our older structures and you can bring out the report and somebody might say, what would happen if we ran another 10 percent through this outlet works. More than likely in these reports you'll find something written about the overage. In other words, we would test up to 100 percent, but often go beyond that and see what the performance was. So those become still very viable documents today to help us when we're looking in the field and saying what would happen if you did this.

The question often comes back to us "Do you guys still have those reports that we can look at?" And we do. We do have an excellent set of records of all those things.

Jackson: Were there some individuals that you might describe as having been mentors or that commanded respect as role models?

Tom Rhone

Burgi: Yes. There were probably–well, yeah. From a perspective of just the technical confidence, and maybe more than confidence, a better word is the competence of hydraulic laboratory work would be Tom Rhone. Tom was my first section head, and he was a–

END SIDE 1, TAPE 1. MAY 5, 1999.
BEGIN SIDE 2, TAPE 1. MAY 5, 1999.

"I don't know of a better person to have trained under in planning a model study. What we're talking about there is how do you determine model scale, how do you build a model, what questions do you really want to answer in this model study. . . . ability to determine when you've taken enough data. . . ."

Burgi: Tom Rhone was a very special person in my own career development, but certainly in Reclamation's laboratory also. He was another one that started right after the war. There were several people that really influenced me. Tom Rhone was, as I mentioned before, in the competence area of laboratory techniques. I don't know of a better person to have trained under in planning a model study. What we're talking about [here] ~~there~~ is how do you determine model scale, how do you build a model, what questions do you really want to answer in this model study. Some of the rules of thumb of, okay, if you're going to put an outlet works on this model and also look at the spillway, can you do it all in one model study or do you, in fact, have to build two models in order to get the scaling of the outlet works, the small valves right? [He had an] ~~An~~ excellent ability to determine when you've taken enough data. There are so many things that I learned from him by working under him over the years in the general sense of laboratory technique and model scale.

"I think the other great thing that Tom Rhone had was great writing skill and ability to succinctly state his observations. An excellent editor. . . ."

I think the other great thing that Tom Rhone had was great writing skill and ability to succinctly state his observations. An excellent editor. Of all the many reports that I've written, his review of those always amazed me, in that he would check into the detail. You might say something in the text and you'd go look at the figure, and if the figure didn't have those numbers that you were using in the text clearly stated or shown, he would say, "You need to make this clear," or, "The reader isn't going to have the advantage that you had of watching this model. You have to be able to explain this in a way that they understand it."

So you can go to a class and learn how to do technical writing, but you could sit under Tom Rhone and learn how to do it, too. The things that you learn from that type of on-the-job training are just incredibly good and long lasting. So I still have people today that I review reports that they sort of throw on my desk and say, "Can you look at this thing for fifteen minutes and then get it back to me?" I may take longer than that, but the point is, almost in all cases I will find little things that–just last week somebody said, "If you look in this photograph on the left, you can see on the left side downstream of the bridge that this river is eroding away at the bank." Well, it actually was on the right side. Tom had taught us so well that in the review process and in the writing process that you have to have continuity, because the power of what you write is in the ability of somebody to read that and make sense, that there's credibility in it, if you go to look at a picture after its been talked about in the text, and you can see clearly what's being explained in the text. So those are great skills that anybody that trained under Tom Rhone picked those up.

Hank Falvey and Mike Colgate

Other people like Hank Falvey, F-A-L-V-E-Y, and Mike Colgate were very good at teaching us and making observations. I remember standing out on a Crystal Dam model, for instance, and I'd be taking my data. Mike Colgate would come out there and he would stand quietly for fifteen minutes just looking at the water coming out over the spillway, and it just used to really get me, because I'm trying to get my study done, he's not saying anything to me, and I'm trying to figure out what is going through this guy's mind and why is he standing here on my model. Almost invariably he would finally say, "Phil, have you observed that rope coming over the spillway?" I'd say, "The what?" "Well, that rope, that vortex coming off of that right topography up in the reservoir just before you get to the spillway." Well, yeah, I hadn't seen that; I was too busy taking data and measuring water depths and all the other things you do on a model study.

"What Mike would teach me, and Hank Falvey would also, was the concept of sort of stepping back and looking at the big picture, and actually looking at the water. . . ."

What Mike would teach me, and Hank Falvey would also, was the concept of sort of stepping back and looking at the big picture, and actually looking at the water. Looking at the water, not just seeing the water, but seeing what flow does, what are some of the physics of what's going on in the water, being able to look below the surface and see turbulence and to see air uptake in the water.

"There are people that can . . . look at a model study and not see much of anything. There are others that have trained eyes and good judgment in what they're observing, whether it's in the field or in the laboratory, and they see

things that most people don't see. . . ."

There are people that can go over and look at a model study and not see much of anything. There are others that have trained eyes and good judgment in what they're observing, whether it's in the field or in the laboratory, and they see things that most people don't see. Those are the types of things I learned from Mike and Hank. It's sort of a inquisitiveness that wouldn't let go, an investigative nature about them that would turn over every rock to try to figure out why the water was doing this or that.

Danny King

Then the fourth one that really influenced me was Danny King, who was the branch chief just before me.

"His influence on me was more in the area of management skills and scheduling and learning not to spend too much time on things. . . ."

His influence on me was more in the area of management skills and scheduling and learning not to spend too much time on things. Again, there are skills that you pick up from people if you observe and can take them in and make them work for you. I'm a mixture of a number of different people, of really taking things that they did and bringing into my life and saying, "Hey, these are important to me."

Danny was not a procrastinator. If you came into his office and said, "I've got this issue on some problem," he'd just as soon as anything just get on the phone in that moment and call somebody and say, "We've got something here that we need to talk about," and we'd get it resolved. He had an ability in his performance reviews and in his accountability at that time I was a section head under him, when I learned a lot from him, in saying, "You said here six months ago you'd have this done. Are you through?" And if you weren't, you'd better have a pretty good reason why not. Did this slip in priority or did you just forget to do it or what's going on?

So a lot of my management style is a product of training under Danny King. It doesn't mean that everything he did I do. As I said before, I think what I did both with Tom Rhone and with Mike and Hank and with Danny was to take those parts of the way they did business that worked for me, that I could take on and say, "This is part of what I want Phil to be," and make them work for me.

Importance of Finishing Reports

So within our hydraulics group, those four and many others, but those four in particular, really influenced my management style, the importance I place on detail in report-writing, and why don't we make this the best report possible, and just the whole concept. Because we used to have a lot of people in the labs that felt the work was done when they finished the study. They talked to the designers and said, "This is where we need to put this spillway," or one thing or another. Danny was another, and so was Tom Rhone, that felt until you documented it with a report, you really hadn't completed the job.

So we have today–I'm sure Tom and Danny picked that up from the Emory Lanes and the Harold Martins and the others before them, but the reason we have a library of reports now that stand on their own is that that was started very early in the hydraulics, I'm sure back in the thirties and forties, and it's still true today.

". . . it's something you always have to work at, because it's against human nature to stop and do all the documenting that you need to. But until you document in reports, you're not going to be able to pass that on to the future. . . ."

But it's something you always have to work at, because it's against human nature to stop and do all the documenting that you need to. But until you document in reports, you're not going to be able to pass that on to the future.

The Importance of Writing Articles for Peer Reviewed Journals

In particular, there's always been a lot of pressure on us to write journal articles in the American Society of Civil Engineers or in other peer review-type journals. That's been a larger uphill battle because although it deals with professionalism, a lot of people feel that once you get that laboratory report written, then that's really all you need to do. The down side on that is that until you get it into some kind of a peer review publication, then there are many people that don't see that around the world. Most people don't have access to our [laboratory] ~~library~~ reports, but they do to an ASCE journal article.

Engineering Monographs

So if I can go on a little bit further in that realm, the other thing that the laboratories has done over the years is to put out engineering monographs. Usually what that would entail would be sort of a research-type document that would take the results of a number of different studies. Let's say we study several different spillway designs for ogee crest spillways–that's O-G-E-E. We might have somebody like a Tom Rhone, when he was not a section head yet, he would take the results of these many different studies and bring them together into a engineering monograph which really developed design criteria that the designers of the Bureau of Reclamation then would put into something like a *Design of Small Dams*. So an engineering monograph, for instance, on energy dissipators, *Engineering Monograph 25*,[3] had people like Al Peterka– I think it's P-E-T-E-R-K-A.

Burgi: He's a great guy, an important one in the hydraulics of the Bureau of Reclamation. He and Tom Rhone were authors of *Engineering Monograph 25*. Those monographs now stand on their own. You can travel throughout the world and you'll see people that have copies of those. I think we're up now to *Engineering Monograph 42*. Those were not all hydraulic monographs, but I suspect a good

3. See footnote on page 22.

third of them come out of the hydraulics group and/or the rest would have come out of one or the other laboratories.

But those documents are ~~sort of~~ benchmark documents that people use now in the consulting community of the United States, and across the world as well as by many other government agencies. If you want to know how to build a stilling basin downstream of a spillway, most likely you'll see references to *Engineering Monograph 25* and/or *Design of Small Dams*, which is a huge book that's been put out by Reclamation, basically led by planners, designers, and other engineers that describes how you build a small dam, anywhere from spillways to outlet works to foundations to the structural aspects of that.

"My point is that when you finish these laboratory studies, until you get that documented into something that can be brought into another document, like an engineering monograph or a book like *Design of Small Dams*, you've really not completed the job, because it's that *grouping* of all this *data* that you have and results that allows us today to understand how we build dams and what works and what doesn't work, and what are some of the criteria that you use. . . ."

My point is that when you finish these laboratory studies, until you get that documented into something that can be brought into another document, like an engineering monograph or a book like *Design of Small Dams*, you've really not completed the job, because it's that *grouping* of all this *data* that you have and results that allows us today to understand how we build dams and what works and what doesn't work, and what are some of the criteria that you use. Granted, we're not into the dam-building process anywhere near what we were in the sixties. I'm just always amazed at the number of internet inquiries we get now, but, before, phone calls and faxes–in fact, I had one just yesterday–saying, "Does the Bureau of Reclamation have any design data on how high a velocity you can place on a spillway chute?" Well, yes, we do have documentation on that.

". . . people that have been around a while know that you come to the Bureau of Reclamation, or the [U.S. Army] Corps of Engineers, or possibly Tennessee Valley Authority, because they're the ones that designed and built and now have stuck around long enough to see the performance of these structures, which is really the critical aspect. . . ."

But what's interesting is not the question, but the fact that people that have been around a while know that you come to the Bureau of Reclamation, or the [U.S. Army] Corps of Engineers, or possibly Tennessee Valley Authority, because they're the ones that [tested,] designed[,] and built and now have stuck around long enough to see the performance of these structures, which is really the critical aspect. It's one thing to say, well yeah, if you designed it this way, this is what would happen, but Reclamation, to their benefit, has got a tremendous amount of infrastructure out there that are, in essence, monuments to these old designers and early people in Reclamation, like a Hoover Dam, that has proven itself, that the design criteria and some of the early testing that went on works. So, maybe a long answer to your question.

Jackson: You may have just answered this, but with regard to the Army Corps of Engineers and the TVA, you talked about the publishing and disseminating of research. Did they also conduct their own research? If so, did the Bureau collaborate with them?

To Avoid Duplication of Effort, in about 1954 the Congress Required Reclamation, the Corps of Engineers, and TVA to Meet Every Two Years to Exchange Information on Their Laboratory Research Programs

Burgi: There's quite a history there. You could go back even further to the Ohio Valley. There was a Miami River Conservancy District or something in Ohio, where people like maybe Rex Elder, a few others in hydraulics came out of. They eventually, when the Tennessee Valley Authority was set up, those folks went down and helped the Tennessee Valley Authority. Some of the folks with TVA eventually came to the Bureau of Reclamation.

I say all that to say that there is a community of what might be called hydralicians, people that have looked at hydraulic performance in waterways that include people like Hunter Rouse, R-O-U-S-E, a professor at the University of Iowa for years, and then folks in Tennessee Valley Authority, Corps of Engineers, Bureau of Reclamation, that all sort of knew each other, they would attend these hydraulic conferences, they're all into this power development of the United States, hydropower and water projects.

In about 1954, the U.S. Congress–all these bills came up to Congress for funding for the Corps and the Bureau and TVA, and some congressman asked the question, "Do you guys ever get together and talk about making sure you're not duplicating your efforts? Corps of Engineers guys, you have your hydraulics laboratory down in Vicksburg, the Bureau has theirs out in Denver. How are we assured, that when we're funding these various laboratories, that you guys aren't duplicating effort? Are you really communicating with one another?"

So they actually, as a result of that, required the Bureau, Tennessee Valley Authority, Corps of Engineers to get together every two years and hold a conference of their hydraulic types, the people that did the concrete mix, the electric power people, and some of their environmental types. The idea was to come together and talk about what research activities and research in the broadest sense, what kind of studies you were doing, to make sure that the TVA, the Corps, and the Bureau knew what their various people were doing. Some of this was going on anyway in some areas. As I mentioned, I think particularly in the hydraulics area, I know that that was going on.

". . . later on Bonneville Power Administration came into that group also. . . ."

This was an effort, and then later on Bonneville Power Administration came into that group also.

But the idea was that we would get together every couple of years and actually, in summary form, talk about laboratory techniques that were developed in the Bureau of Reclamation lab or in the Corps of Engineers or in Tennessee Valley. Say, for instance, one of us came up with a new idea on treating concrete to allow the surface so it wouldn't cavitate. That would be presented at the conference, and then there could be a lot of discussion on "Is this something we could also do in our lab? Is there any way we can cooperate? Is this something that has been tested enough that we could bring into our design criterion in the Bureau of Reclamation?"

There Has Been Talk of Consolidating the Various Laboratories

So, yeah, there were plans, I think, in the [Richard M.] Nixon administration to bring all the natural resources departments together, whether it was in the Department of Agriculture or Department of Interior or Department of Defense. There's been talk of consolidating laboratories. It's never been done. I don't know all the political reasons why not.

". . .even though we're not consolidated, there is a lot of cross-pollination that goes on. . . ."

But even though we're not consolidated, there is a lot of cross-pollination that goes on. I know the people in the hydraulics laboratory in Vicksburg, as well as in some of the universities, and I know our materials people also know that. They know their counterparts in these other agencies. So there is a lot of give and take, sort of a sharing of information.

Corps of Engineers, of course, does a lot of work with navigation, and we get questions coming into the Bureau and invariably we'll refer them to Corps of Engineers. Corps of Engineers, of course, designed Folsom Dam, where we had the recent problem, but the Bureau of Reclamation is the one that's been responsible for maintaining and operating it. There's been a lot of cooperation in recent years on radial gates because of the one that failed out there at Folsom,[4] and how do we do a better job of beefing up those gates or finding out where else there may be some gates that have a design that needs to be improved. But that was a Corps of Engineers design, not a Bureau design.

Jackson: On radial gates you mean?

"What's really helped is that over the years the Bureau of Reclamation, as well as–maybe even better than–the Corps, has supported professional conferences, like American Society of Civil Engineers, American Concrete Institute, all of these various groups where our professionals participate by giving papers and serving on technical committees. I think it's really served Reclamation well . . ."

Burgi: Yes. But in any case, there's been a whole–I guess I'd refer to it as a community of people. What's really helped is that over the years the Bureau of Reclamation, as well as–maybe even better than the Corps, has supported professional conferences,

4. This gate failure occurred July 17, 1995. Tom Aiken, Reclamation's area manager at the time discussed the gate failure in his oral history interviews with the Reclamation history program.

like American Society of Civil Engineers, American Concrete Institute, all of these various groups where our professionals participate by giving papers and serving on technical committees. I think it's really served Reclamation well, because it keeps us from being in our own little world, doing *our* things and not being aware of what the bigger world, in the civil engineering or mechanical engineering or electrical engineering profession are doing. So you've got guys like Jim Pierce, who has been president of ACI[5] and now, I think, is president of ASTM.[6]

Is Involved in the American Society of Civil Engineers (ASCE) and the International Association of Hydraulic Research (IAHR)

My involvement with both American Society of Civil Engineers and the International Association for Hydraulic Research, those *groups* put you into a national and international community of people that are dealing with water resources problems, and it keeps us from being blindsided by saying, "Ten years ago somebody developed this and you guys don't even know about it." So it really keeps us much more aware of what's going on, actually, in the global community of engineering.

Jackson: You mentioned that there was sort of a gradual progression from gathering data by way of clipboards and stopwatches toward more computerized devices. You also mentioned that some of the people you respected as role models were very intuitive–they could observe a situation and assess a lot of information from it. As our culture has moved more and more into computers, I'm just curious to hear your thoughts about that methodology?

Why Intuitive Methods Need to Be Honed

Burgi: Excellent question, because, yeah, the intuitive methods that were used twenty-, thirty years ago, in my mind, required us to make observations that I'm not sure we do as well today.

A good example would be about ten years ago a young engineer came in to me and he said–I questioned him. I said, "On this right bank downstream in the stilling basin, you're saying the velocities are 25 feet a second."

I questioned that, and he said, "Well, that's what the data shows."

I said, "But physically there's not enough head in the reservoir to give you 25 feet a second. You can't physically have 25 feet a second."

And he just gave me this blank stare. He said, "Yeah, but the data that I got off the computer says that that's what it is."

"Well, you need to go out and redo it. It's wrong, and it's wrong because

5. American Concrete Institute.
6. American Society for Testing and Materials.

it's physically impossible." It's that type of thing that I think we have to be guardians of in laboratories today, because there is a tendency, when you see a computer printout or something coming off some kind of a piece of equipment that puts it out in nice tight form, in columns, that makes it look like it's truth, and that's a lot different than writing down with a pencil on a clipboard something that you've measured off a manometer. It doesn't mean we didn't make mistakes back in the earlier days. But there is a tendency, with all the rules of thumb and fancy equipment, to assume certain things happening that aren't really happening. And I think that's the importance these days of making sure we have good peer review and that we have people that have been around for a while and can say, "This doesn't make sense. Have you gotten away from taking the data to the point where you step back and you say, 'Can this physically happen?'"

Those are the obvious ones that are a little easier to catch, but you have to ask the question, or the question's begged, then, well, are there other areas in our data analysis, in our laboratory investigations, where we're making assumptions because we really don't understand the physical characteristics of what's going on in the model.

". . . we need a good group of graybeards, mid-level, and young folks. Young folks keep us honest by asking the questions that we ought to be able to answer. The graybeards keep us from making the mistakes that we've learned in the past . . . The folks in the middle area are probably the ones that are most productive in the group, because . . . they have the experience, and yet they have maybe more active lives and can do some of the things that the older folks can't. . . ."

I've always had this philosophy in our group that we need a good group of graybeards, mid-level, and young folks. Young folks keep us honest by asking the questions that we ought to be able to answer. The graybeards keep us from making the mistakes that we've learned in the past because we can go back and say, "We did a study on that in Shasta back forty years ago, and if you go look at HYD-310, you can see what we've done and then move forward from there." The folks in the middle area are probably the ones that are most productive in the group, because they're in that middle group and they have the experience, and yet they have maybe more active lives and can do some of the things that the older folks can't.

". . . it used to be that a major part of our budget on model study was gathering data, now probably a major part of our model study cost is *building* the model, and the time we take to run the tests are often a very short period of time, because we can gather the data so quickly. . . ."

But my point is is that I think anytime we move to automation–I mean, it used to be that a major part of our budget on model study was gathering data, now probably a major part of our model study cost is *building* the model, and the time we take to run the tests are often a very short period of time, because we can gather the data so quickly. So it's imperative that we look at the data closely and that we take time to go out and just observe what's happening on the model, to the point of saying, "Do these velocities, do the pressures, do the other things that we're gathering really make sense?"

You can take this over into the whole engineering curriculum, where a number of colleges now have dropped certain courses because they need more time to teach computer skills, so we don't have things like surveying as a civil engineering requirement anymore. Every civil engineer used to have to get out there and set up a tripod and learn how to level with it and take a transit and do a closure. What those skills taught you was the importance of closure and double-checking and making sure that what you think you have seen or observed is really what's there.

"The problem with the computer is that, yes, you can work a lot faster, but you're a level or two removed so that it's pretty easy to separate the physical world from the computer printout . . ."

The problem with the computer is that, yes, you can work a lot faster, but you're a level or two removed so that it's pretty easy to separate the physical world from the computer printout, and if you're not careful, if you've not developed the intuitive skills or the judgment to look at computer data or the new equipment, some of the results you get off of it, and say, "Does this physically work? Does it make sense?" then you have a problem.

One of the things that the laboratory has always been good at is–

END SIDE 2, TAPE 1. MAY 5, 1999.
BEGIN SIDE 1, TAPE 2. MAY 5, 1999.

Jackson: We're on tape two. My name is Mike Jackson and I am here with Phil Burgi. Today is Wednesday, May 5th, [1999]. Phil you were discussing one of the things the lab has been good at.

". . . we have always had the practice of saying, 'What theory applies here, and how do these observations fit into the theory?' If we can't answer that question, then we have a problem in laboratory investigations.' . . ."

Burgi: Okay. What I was saying was that one of the important things in the laboratory over the years is the fact that in almost all of our laboratory reports, we talk about the data that we gathered and the observations that we made, but we have always had the practice of saying, "What theory applies here, and how do these observations fit into the theory?" If we can't answer that question, then we have a problem in laboratory investigations. In other words, you call this gathering of data empirical, but it has to compare with the theory.

When you study in a master's program at a university, most of the civil engineers, anyway, will probably have some kind of a project. Say in the hydraulics laboratory at Colorado State University, the easiest example for me because that's the program I went through, is that you were given something where you were out in the laboratory taking all this data, invariably the professor would say, "Okay, what theory allows you to describe what you're observing?"

Let me give you an example. You might take water flowing over a spillway. It has a free trajectory into a plunge pool. It goes down deep into the plunge pool, dissipates, and then goes on down the river. In the model, you can put piezometers on the bottom of the plunge pool, and you can actually measure the impact pressure of the jet hitting it. There's also theory that allows you to describe this jet as it enters the water in the plunge pool, there are equations that tell you how quickly that energy dissipates and how broadly it dissipates once it hits the water, and what the pressure would be at the boundary, say, one diameter, two diameters, ten diameters away from the jet as it entered the pool.

So you gather all this data and then typically you plot it up on some engineering graph, and then you try to write an equation that describes what's happening across the range of test results that you have. Granted, it's not all going to fall into line, but there needs to be some continuity between the data that you've taken and the theory that you present.

What that allows you to do is, when you gather enough of this empirical data, it allows you to do what I talked about before, when you come up with general design criteria. Pretty soon you gather a tremendous amount of data that's been verified, and you can come up with a whole series of curves or data that says if you have this condition occurring, or you have this design of a plunge pool, and you want to know do you need to line the bottom of this plunge pool with concrete or is the plunge pool deep enough, given the head that you've got coming over the spillway that you don't need to line it. Most of that now, when you look at *Design of Small Dams* or *Engineering Monograph 25*, that work's been done in the past. You don't really need to build a model to re-verify that.

". . . what's important is that there is a way to verify. A couple of things in laboratory work is, one, you ought to be able to have repeatability. . . . You also ought to be able to come up with some theory that explains what you've observed and the measurements that you've taken. . . ."

So a lot of the things that we developed over time has allowed us to get to the point where we've developed these general design criteria that allow us to have engineering principles that eventually end up even in textbooks that are then taught to other students coming down the conveyor belt of time. But what's important is that there is a way to verify.

A couple of things in laboratory work is, one, you ought to be able to have repeatability. You ought to be able to go in, and if you did a test on one day and you set up the same conditions, there ought to be some repeatability there. If not, then something's wrong in your data analysis. You also ought to be able to come up with some theory that explains what you've observed and the measurements that you've taken. If you can't do that, then I think you need to question what's the purpose of the laboratory experimentation.

Consulting with Other Laboratories

So sometimes we're called in. A study will be done by another laboratory or maybe we've been involved overseas working in the Philippines and in Ecuador and a few other countries where we've actually gone down and helped them in setting up a laboratory, or maybe they're doing a model study down there and they've asked us to come in as outside consultants. Those are some of the basic questions you have to ask, is how credible is the data that you're taking? How do you verify your instrumentation? When is the last time you actually did a verification test on your Venturi meters or your measurement devices to make sure that they're calibrated and that they're working properly? Then the other questions deal with repeatability and ability to theoretically explain what it is you've observed in the laboratory.

Jackson: I'm kind of coming at this from a different direction. To what extent–or if you could describe for me to what degree your involvement with the Bureau of Reclamation is dealing with standardized principles and guidelines and applying them versus standard practices. For instance, when you started at the Bureau were you driven by standardized procedures and protocol or were things ruled by custom?

". . . lower-graded engineers in the research disciplines would be classified at a certain grade level because of the guidelines that they're using are already available. In other words, they're going out and running tests, and they can go to a textbook or they can go to a monograph and use those guidelines. . . ."

Burgi: Yeah. Again, a good question. The reason I'm pausing a little bit is I'm trying to figure out where does this fit into personnel classification of different types of people in the laboratory. For instance, under the research-grade evaluation–and I'm taking this in a little different direction, but that's fine, we'll work it through–some of the lower-graded engineers in the research disciplines would be classified at a certain grade level because of the guidelines that they're using are already available. In other words, they're going out and running tests, and they can go to a textbook or they can go to a monograph and use those guidelines.

"*. . . higher*-level engineers . . . have more competence in what they can do because of their education or experience . . . We may have some basic guidelines and principles on how we gather data, how we verify, but the equations aren't even written yet. So . . . we're actually developing guidelines that aren't there yet. . . ."

The research that we give to the *higher*-level engineers, which usually means, obviously, they have more experience and they have more competence in what they can do because of their education or experience, some of the cavitation work that we've developed in the last years has required people to do work in the laboratory when there's not many guidelines. We may have some basic guidelines and principles on how we gather data, how we verify, but the equations aren't even written yet. So then you're getting into an area where you, in fact–and I think that's getting to what you're asking, Mike–is we're actually developing guidelines that aren't there yet.

Laboratory Is Working on Providing Fish Passage to Slow Swimming Endangered Fish

A modern example would be the studies we're doing right now on fish passage. Over the years there's been a lot of work done with salmon in the Northwest. If you go around the dam, you'll see these fish ladders that allow the fish to go up around the structure. More recently in the laboratory, in fact, in the last two years, we're looking at what we call sucker species, or slow swimmers, that could never get their bodies out of the water. They can't swim fast enough to do that. So we're looking on the Yellowstone River and in the Colorado Basin, some of the endangered species. How do these fish get around a dam? You wouldn't put in a fish ladder like the salmon have, because fish couldn't jump from one pool into the next.

So we're doing research over there right now with sloping flumes and rock weirs that in the bottom, along the lower flow passage, there's a continuous water column that the fish can swim up and so they're not jumping from pool to pool, they're actually swimming up a serpentine-type ramp that has resting places. They can sort of, what we would call in a hydraulic area, eddy out and rest, and then they can get back in and swim some more.

"One of the other things that I see today more than we've ever had in the past is cross-discipline activity. . . ."

This is brand-new stuff. One of the other things that I see today more than we've ever had in the past is cross-discipline activity. We're only able to do this because our civil engineers are working with our fishery biologists. We understand the engineering skills that are needed in the principles, but we don't understand fish behavior. The fishery biologists understand fishery behavior, but they don't understand how to engineer something. And so by working together, we're developing– and this is brand-new stuff that is coming out.

". . . Fish and Wildlife [Service] and NMFS, National Marine Fishery Service, are using this early data that we're producing to help design what we call fish passage around low structures. . . ."

And, in fact, Fish and Wildlife [Service] and NMFS, National Marine Fishery Service, are using this early data that we're producing to help design what we call fish passage around low structures. We have hundreds of these small dams in the Western U.S.

So to get maybe to what your first question was, is that, yes, when I first started with Reclamation, the types of assignments I had were sort of mundane studies where I pretty well knew what the guidelines were and went out and did the test, gathered the data, wrote the report.

There were *others*, even in those days, working on things such as cavitation and gate slots. Mike Colgate was doing some of that work that was brand-new stuff, and he was, in fact, developing guidelines.

"So here in the same laboratory you had some work going on that's sort of just mundane–you know, you just do the study and you can get the results and know what the answers are. . . . There's other work going on where you're actually developing new guidelines, new criteria . . ."

So here in the same laboratory you had some work going on that's sort of just mundane–you know, you just do the study and you can get the results and know what the answers are.

Changing Public Values Affect What Is Worked on in the Laboratory

". . . we're still out here on the fringe, trying to understand these things. And this changes over time as public values change. . . . Now the public values are much more . . . [that] we need to more efficiently use the water . . ."

There's other work going on where you're actually developing new guidelines, new criteria, and I suspect that has always been the case and always will be, that there's a broader base of knowledge than what we've ever had before because of the things that we've developed over the years, but we're still out here on the fringe, trying to understand these things. And this changes over time as public values change. Public values in the fifties and sixties dealt with water development–well, way back in the thirties, developed the water in the West. Now the public values are much more in the area of we're not necessarily developing new water supplies, so we need to more efficiently use the water, so water conservation is becoming a much more important thing.

The environmental impacts of some of the structures we've built, whether sediment, whether it's fishery issues, are becoming the big issues. So now if we're to respond to those public values as a public agency, obviously our research and our development needs to fall into these new areas, so where in the past we were known and we did good work in cavitation and development of waterways, now we're moving out into some of these other areas of water conservation, which deals with things like canal automation, and better water measurement techniques and environmental issues that deal anywhere from wetlands, how do we keep a certain water level in a wetland, to fishery issues, to we want to bring a certain temperature of water out of Shasta Reservoir.

Temperature Control Device at Shasta Dam

Well, how do we design a inlet structure for the powerplant that allows us to bring the water out of the reservoir at just the exact temperature we want? And therefore we develop something called a temperature control device, the T-C-D, for Shasta–an eighty-million-dollar project that was built here a few years ago. Our laboratory was involved in coming up with where you would need to place this structure on the upstream face of the dam to access the water at the right temperature in the reservoir at any season of the year. So it's a very complex structure that has gates, that can be opened to get you the right temperature, but what's important is you have a certain head loss going through that structure now, so you lose some of the power. How much power do you use and how physically does this model work, or how do you operate this facility most efficiently so it will not be destroyed in a couple of years but in fact will last for a long period of time?

Thoughts on the Need for and Stages of Research

So I hope I'm getting to some of that question of, yes, some of the work we do, we go in and we just do a study using the guidelines that are already developed. There's other areas where, yes, we may have to develop a few guidelines, and then there's a third area which I really call the research part, and that's where we're developing new guidelines. We're on the frontier in areas that we've never been in before. To me, research is a critical part of our laboratories and has been over the years, and it's an ongoing argument. Do we still do research? How much money do we spend on research? On a quantum leap, or on a scale, you could say research is the initial development of new concepts. Then you take it into a demonstration phase and then you finally take it into an application phase.

When you're in the research phase, you almost need to be funded by general funds that allow you to–because no project wants to pay for that, so you need some general funds that will allow you to do that basic research. When you start moving into demonstration, then you go out to a Shasta or to a project and you say, "Hey, we'll put fifty percent of our money into this from a research pocket," but we need to get some of your project money to actually go out and try this in the project, then we move into application, where we're almost fully funded by a project, and what we might do is for several years after this thing is built, go out and do some field test, say, "Hey, is this thing really performing the way we saw it back in the research phase?" So we may need some research money to do that.

". . . research is an important part of laboratory investigations, and we are not a university and we don't do basic research, but we do applied research because that's what allows us to get in the area of developing new guidelines. To me, that's what the laboratories is all about . . ."

I may be getting off your questions a little bit there, but research is an important part of laboratory investigations, and we are not a university and we don't do basic research, but we do applied research because that's what allows us to get in the area of developing new guidelines. To me, that's what the laboratories is all about and always has been, and that is, you don't need laboratories just to do production work; what you need laboratories for is to build a Hoover Dam. What kind of concrete do we need to build a Hoover Dam?

So you're developing things that were never developed before. What kind of spillways do you need to drop water five hundred feet from a reservoir down to the river down below? What kind of energy dissipaters do you need? Questions we ask today are, what kind of fish passage do we need to get around these small diversions? How do we do a better job of measuring water?

"So as these questions come up, which really are the result of the problems that our society is dealing with today, that keeps us viable. . . ."

So as these questions come up, which really are the result of the problems that our society is dealing with today, that keeps us viable.

"My sense as a group manager has always been, I need to be looking out on the horizon five years from now, and so do our researchers, saying, what are the questions? What are the big issues that we're going to be facing as an agency that somebody's going to be coming to us four or five years from now for answers, and we'd better, by golly, have been doing some work on that so that we can come to the table when those questions are asked . . ."

My sense as a group manager has always been, I need to be looking out on the horizon five years from now, and so do our researchers, saying, what are the questions? What are the big issues that we're going to be facing as an agency that somebody's going to be coming to us four or five years from now for answers, and we'd better, by golly, have been doing some work on that so that we can come to the table when those questions are asked and say, "A few years ago, we were thinking this might come up. We don't have the answer yet, but we've got some ideas on how we might proceed."

So I'm a firm believer in research, and, again, not talking so much about basic research as the fact that we always need to be looking for what are the big issues that our projects and area office folks are dealing with that they may not even see as a big, significant problem across Reclamation, but we may be getting that kind of input from several different projects, and we ought to be doing something with it. That's what makes, hopefully, some of our new research projects. This is what we're working on. That's why fish passage is important now, and twenty years ago cavitation was important.

Jackson: I am a lay person not familiar with the technical side. I am very curious to hear how a model is created. Could you walk me through how a model is created–from the idea to the evaluation of the need to the design to the research, demonstration, application and any other issues around that?

Modifications Are Proposed to More Efficiently Operate Folsom Dam During Flood Events and the Laboratory Had Been Modeling Alternatives

Burgi: Yes. Let me try to do that. I ought to be able to do that. I'm trying to think of a good recent example. Folsom Dam might be a good one. Folsom Dam has been around for a while out in California, but more recently–again this may deal with some of the public value issues–but there is pretty serious flooding around Sacramento many times, not uncommonly every few years.

Folsom Dam spillways and outlets are such that you really can't pass much of the flood until you get up to the spillway elevation, so there's a plan now to change the Folsom Dam so that you might put some bigger outlets deep in the concrete dam that would allow us to pass large amounts of water even as the flood is coming into the reservoir, but well before it gets to the spillway crest.

What this does is it allows us to pass this water on down to Sacramento, through the Sacramento River down through Sacramento, to the point where we don't have to wait and open the spillway gates so large and pass a *huge* amount of water. We can start earlier and get the water, the volume, through the structure [earlier].

Considerations in Building Model(s) for the Folsom Dam Project

So the designers come to us and say, "We want to put bigger outlets on the auxiliary spillway at Folsom Dam," which means they're going to put tunnels right through the dam and out onto the face of the spillway, to be able to pass more water. It's going to be big conduits, bigger than what's in the old part of the dam. How is this going to affect the stilling basin below the dam and the river? What problems will we have with cavitation? Cavitation is a very technical term, but it really means this development of small bubbles in the water under low-pressure conditions that produce damaging effects [when they implode against] ~~on the~~ concrete [surfaces].

You can design your waterways so that you do not have damage from those. Do we have enough data in our past, that I just got done talking about? We can just design this based on design criteria we already have? And the answer to that is, yes, we can do parts of that with designs, but because the Folsom spillway stilling basin is such a unique site-specific, the chances are that we're going to need to have a hydraulic model to look at what happens under various operating conditions if you operate these new outlets and you're not operating the spillway on the main part of the dam. Or if you want to operate them together, what's going to happen? So, yes, we think a model study is important and that some of the things we can learn from that model study, we can better design the structure and also we can tell you better how to operate it once it's built.

So the next question is, what kind of a model do we build? That's when we have to ask the question, "Well, what are we going to study?" Okay. We want to put more flow through the dam, so we need to look at these new outlets. We need to build the new spillway, which is a change on what's called the auxiliary spillway. We need to build the old service spillway. We need to build the old outlet works. We need to build the stilling basin and enough of the upstream reservoir so that we have the approach conditions all set up.

In our laboratory we can put about twenty cubic feet a second through a model. Knowing the discharge at Folsom, we could probably build that at a 1-to-36 scale. So we're going to build a model that every foot on the model will be thirty-six feet on the prototype. So if we want to build conduits in this little model now that, let's say, are twelve feet high, we will build those four inches high on the model. If we do all this and then we measure our velocities, we know what scale that will be, so that the model, whatever we observe on the model will be an exact representation of what we have that will occur on the future dam, that scale of 1-to-36 is a scale where we can measure the velocities, we can look at the stilling basin, we can build it in the laboratory.

By the way, that will probably cost you, off the back of my envelope here, I would say 200,000 dollars to build it, to study it, and to write a report. That's pretty small monies compared to what it's going to cost you to build this [structure] ~~thing out~~ in the field, and we believe that the savings and the fine details on that model will more than be offset by savings in construction, maybe just savings in concrete alone, by going in and fine-tuning this on a physical model.

However, now, when we start talking about the cavitation or the damage at the gates, these outlet gates that are going to be deep inside these conduits, I don't think a 1-to-36 scale is going to work, because now we're talking about little [conduits] ~~things~~ four inches high and maybe two or three inches wide. So we would recommend that you also build a second model that wouldn't look at all six of the gates, but would be a model that would just look at one of those, with an approach conduit and an exit conduit and a gate. Our suggestion is that you would build that at, say, a scale of 1-to-6. So now what did I say? If we had a four-foot-high structure in the real prototype and we went to 1-to-6, we would be looking at maybe a two-foot– no, it wouldn't be that big. It would probably be about an [eight] ~~eighteen~~-inch conduit.

So we would have a conduit and a gate large enough that the physical [measurements] ~~data~~ that we would gather on that model could be scaled up to a prototype, and we would know that we were in the right range. I say that without going into a lot of detail. As I mentioned before, there are scaling laws that, for instance, if you're wanting to look at cavitation damage and pressure data, you need to make sure the model is at a scale that you're into what's called a Reynolds number range that allows you to measure these pressures, and if we're doing it on a 1-to-16 model, did I say?

Jackson: One to six.

Burgi: One to six. If you're doing it on a 1-to-6, then every foot of pressure that you're reading on the side wall of this conduit, you multiply times six to find what the pressure is actually going to be out in the field. If you're measuring a velocity, you take that velocity and you take the [square root of the] scale of 1-to-6, ~~and you take the square root of that,~~ because that's the model laws that we use, and you multiply that times the velocity you measured in the model, times the square root of six, and that will give you the velocity out in the field.

You can do the same thing with the discharge. You take that model scale of 1-to-6 and ~~you lift it to the five-halves power, so two and a half power of six, using those laws, you~~ [take the model discharge and multiply by 6 raised to the 2.5 power to arrive at the field discharge.] ~~can come up with the exact discharge you're going to be able to get through that conduit.~~ You can put pressure piezometers in the model and find out where you have really low pressures. Then you would go into that model, and what you would do is take all this information we've had in the past sixty years and you'd come up with the best design you could based just on the theory.

And that's where you'd start in the model. Then you would test that in a model and confirm that, hey, this isn't too bad.

Chances are there's going to be some things that are going to be different on Folsom. Maybe it's the length of the upstream conduit, maybe it's the approach velocity is different than anything we've ever looked at before. So it's very likely that we would go into that gate frame area and maybe have to put an offset in order to introduce air around the jet coming through the gate to make sure that we don't have cavitation damage.

So this is where I would call the fine-tuning of the model. So more than likely, and this is a possibility that this is going to come up, that we will be looking at Folsom and will do what I would call a large-scale model of one conduit and the gate, because there are questions there that need to be answered, and then we would do a smaller-scale but a larger model, probably the size of a house, almost, a small house, in the laboratory of the actual spillway, stilling basin, and reservoir, of what we would call a three-dimensional model of the whole facility.

". . . what we are looking for are problems that could develop that for whatever reason in the design aren't showing up, but it's certainly much, much easier to find those problems and to solve them in the model and, therefore, as a result of the model study change the design and correct that before you go out and build it . . . We have developed so much confidence over the years, if we set the scale right on the models, that we can solve these problems that could possibly develop before we ever build it. . . ."

Again, what we are looking for are problems that could develop that for whatever reason in the design aren't showing up, but it's certainly much, much easier to find those problems and to solve them in the model and, therefore, as a result of the model study change the design and correct that before you go out and build it and somebody calls in from the field and says, "Hey, we just opened those new outlets and there's this horrific noise going on in there. We've turned it off and we've gone in there and we see that we ran it for two hours and we already have six inches of concrete missing on the walls." The cost of repair of those big structures is tremendous. So the purpose of the models are to look at those in a laboratory situation. We have [developed] so much confidence over the years, if we set the scale right on the models, that we can solve these problems that could possibly develop before we ever build it.

Designers Are Often Actively Observing Tests and Working with the Laboratory

So, anyway, after we'd developed the scales, and we ran the test, we would present this information to our design group in this building. Often, by the way, they would be over many times during the study to observe what's going on. They're the ones that actually direct it. We tell them, "These are the observations we have and these are the areas where we think we have problems. There are several things, alternatives we could do to solve this problem. From a design perspective, what works best for you? What saves you the most concrete or looks to you, if the contractor had to get in and build this, would be easiest to build it?" They would give us their concept of what works. We would put that into the model and then rerun it and verify that it works. Then eventually we would get to a final report.

Craftsmen in the Laboratory Shop Have to Build Very Precise Models

What I didn't talk about is the fact that we also have a laboratory shop over there that we've always had. It's ranged from anywhere from thirty craftsmen. I think today we're probably at one of our lowest levels. We only have eight, and they're made up of carpenters and machinists and craftsmen that can work with plastic and weld, and work with urethane.

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BEGIN SIDE 2, TAPE 2. MAY 5, 1999.

Burgi: So the laboratory shops are an important part of what we do, and we have, for instance, well I mentioned, we have these various craftsmen. What we would do is, let's say, on the Folsom, continue on that theme, if that model comes in, we would be looking at the design drawings that the designers have, and usually we would call those like concept or feasibility drawings. This is what they hope to build. That's when we would decide what scale that we would actually use, and then what our engineers have to do is to take those drawings and actually reduce them down to what a 1-to-36 model would be, let's say, on the big models.

What we would do is, the engineers would conceptually lay [out] those [drawings,] ~~out~~ and then we would more than likely give them to one of our technicians. Given where we are today, we would do that on AUTOCAD. The technicians would actually draw those plans up and we would give them to the carpenters, and they would build a box.

"The reason why we have the shop on staff instead of contracting is that they best understand us and what we need. . . . But once we start getting into the details of the waterways . . . we need real accuracy in those areas. We're talking down to maybe a thousandth of a foot or so . . ."

The reason why we have the shop on staff instead of contracting is that they best understand us and what we need. For instance, we build a big box that we actually build the dam inside of, but the box doesn't have to be real accurate. But once we start getting into the details of the waterways–and I refer to waterways as anything from the spillways to the conduits that the outlet works are made up of– we need real accuracy in those areas. We're talking down to maybe a thousandth of a foot or so, where the spillway crest, when you're doing a model of 1-to-36, if that crest isn't right on and we have a trajectory where the jet goes out, or however we're designing that, that has to be right on, because when we have our piezometers located down in the outlet works because we think we know where the jet's going to impact, if we're off just a mil on the measurements on that crest surface, the jet's going to be going to a different place than what it's planned to go to.

"… talking about machinists or carpenters, particularly those two crafts need to be very good at what they do. . . ."

So I say all that to say that these craftsmen are, in fact, craftsmen, and whether we're talking about machinists or carpenters, particularly those two crafts need to be very good at what they do.

Engineers Work with the Shop Staff to Develop the Models

In any case, what we do is, we don't make drawings as if this was going to an outside shop, but they *are* good enough drawings that we can give to our shop people, and they take and work off of those, they order the materials, and then we go into the process of, depending on the size of the model, anywhere from a couple of weeks to six weeks actually building a model, and our engineers really turn into contract specialists, so to speak, in the sense that they're working daily with the shop people on answering questions and they may be out to make an observation because they may be out there taking measurements.

"… it's a team effort, where daily we don't supervise the shops. They have a shop foreman, but our engineers work very closely with the craftsmen in making sure that what is actually built is what we expect to be built. So the shops are a very important part of the work . . ."

But it's a team effort, where daily we don't supervise the shops. They have a shop foreman, but our engineers work very closely with the craftsmen in making sure that what is actually built is what we expect to be built. So the shops are a very important part of the work, and often what we'll do is immediately after they have the basic model built, we'll actually put water in the model and go through some verification tests and really collaborate that what we have built is what we wanted.

"Then we go into a phase where, we call it, 'mods as needed,' 'modification as needed,' but the engineer will go out and make some initial test, and the designers will come over and look at it. Very often, early on we make some very quick changes because of issues that we see before we even start gathering much data. . . ."

Then we go into a phase where, we call it, "mods as needed," "modification as needed," but the engineer will go out and make some initial test, and the designers will come over and look at it. Very often, early on we make some very quick changes because of issues that we see before we even start gathering much data. So the shops are an integral part of this [process] on almost a daily basis, doing a model test where we come in, we have to move some concrete around or we make a change on a chute coming off of a spillway or something about the gate isn't quite right, and we need to make changes.

"So it's an ongoing process of working with the laboratory shops, working with the designers, and bringing the model study to fruition. . . ."

So it's an ongoing process of working with the laboratory shops, working with the designers, and bringing the model study to fruition.

Jackson: How often the process is just a straightforward and linear progression with no exceptions and how often it's a matter of trial and error and continuous revisiting of earlier thoughts and reconstructing?

Burgi: Again, it's a good question. For instance, we're doing a study right now for an outside public utility, and that one's pretty straightforward. It's going to go along pretty linear, an area where we know pretty much what the next step's going to be and we just do it.

"There's other studies, and most of these are Reclamation studies, where we get into a *lot* of issues. The most recent one is the Animas-La Plata Project near Durango. We've had a model in the laboratory for . . . like three or four years, of the Animas River and the pumping plant. The big issue there is that technically we can do about what we need to do and we've proved that in the model, but it's a humongous political issue. The size of the project keeps changing because of the political issues between some of the environmental interests, some of the whitewater rafters, some of the Native American interests, the Fish and Wildlife Service. There's a number of political players on that particular project, all of which want to influence really ultimately the size of the project. . . . So that's a good case where we have looked at numerous different alternatives for a pumping plant on the Animas River in Durango, not because technically we need to do it, but because there are some public values, political interests, that are driving the need to do these various studies. . . ."

There's other studies, and most of these are Reclamation studies, where we get into a *lot* of issues. The most recent one is the Animas-La Plata Project near Durango. We've had a model in the laboratory for two years now, actually probably more like three or four years, of the Animas River and the pumping plant. The big issue there is that technically we can do about what we need to do and we've proved that in the model, but it's a [big] ~~humongous~~ political issue. The size of the project keeps changing because of the political issues between some of the environmental interests, some of the whitewater rafters, some of the Native American interests, the Fish and Wildlife Service. There's a number of political players on that particular project, all of which want to influence really ultimately the size of the project. How much water are we going to take out of the Animas River?

So that's a good case where we have looked at numerous different alternatives for a pumping plant on the Animas River in Durango, not because technically we need to do it, but because there are some public values, political interests, that are driving the need to do these various studies. So we get to a place and we say, "Okay, this is what we want." Designers may come over and say, "Well, we just got a call from Durango and now it looks like that won't work, and we need to look at a different approach."

I think this is a lot more of an issue in the nineties than it was in the fifties and the sixties, when you had a person like Floyd Dominy, who was the commissioner and who had a lot of friends in Congress. Not that there weren't political questions then, but basically we came to a design pretty quickly, we looked at it, said technically, "This is feasible and it's competent design. Let's go with it."

". . . Animas-La Plata Project is a good example of one that has really gotten sort of out of the technical realm and into the politics. What we need to do is just wait until all that dust settles and then come up with whatever the political decision is. . . ."

Today, Animas-La Plata Project is a good example of one that has really gotten sort of out of the technical realm and into the politics. What we need to do is just wait until all that dust settles and then come up with whatever the political decision is. So that's a case where we've had a lot of iterations.

Issues in Designing the Temperature Control Device for Shasta Dam

Then another example is one, I think the Shasta [temperature control] curtain. Actually, we started with the curtain and went to a fixed feature on the upstream face of the dam, which we call the temperature control device. Originally, though, it was going to be a curtain and it was going to [cost] ~~be~~ fourteen million, not eighty million dollars. But there were some technological problems with the curtain, stretching our ability to know how this 400 foot deep curtain would actually [perform] ~~function~~ for [the] long term, and so that's when we went in and the designers said, "We need to also look at something that would be a permanent fixture similar to what we put on the upstream face of Flaming Gorge Dam."

So we went through many iterations on the temperature control device for Shasta. In those cases, often we had to go back to the designers and say, "Well, this is what we said we could do it for cost-wise. We're making these changes, so we're going to need another 20,000 dollars to make these changes on the model, and run the test." Normally that's not a problem. The designers know that. OK, if they make changes in what they want then there's going to be more involved in doing those laboratory studies.

". . . some of them are pretty straightforward, but often, particularly if we're into this sort of frontier land of new investigations, it may take us much longer to come up with a solution. . . ."

So, yes, to answer your question, some of them are pretty straightforward, but often, particularly if we're into this sort of frontier land of new [innovations,] ~~investigations,~~ it may take us much longer to come up with a solution. In fact, sometimes we've used some of the research monies to help come alongside project monies, and we've justified that by saying, some of the data we're gathering off this physical model for, say, Shasta Dam, is also going to go into a compendium of general information that we will use in some design criteria in the future that we're willing to pay for out of research funds in order to gather this extra data. The project may say, "We don't need all this data." We're saying, "Hey, we want to gather it because it has general-purpose interest to us that helps us in the design criteria in the future." So sometimes we've used some research monies to help in that.

Jackson: You touched upon how political issues come into play with the application of data that's already been gathered. Do you run into pressures today where politicians or whomever feel like there's a perception that the physical models as less efficient when computers are available?

Computer Modeling Versus Physical Modeling

Burgi: Yes, those issues come up, and they probably wouldn't be from politicians as much as our own people in the Bureau of Reclamation or in other agencies that may say one of two things. One of the often comments is, "We don't have time. We're going with the design. Can't you come up with just an analysis or a numerical model that would solve this problem?"

"Other times it's the issue of, we don't have money. Particularly as we're dealing more and more with smaller projects, the model studies are not cheap, and we could almost use up all the money to design a project just in building a physical model. . . ."

Other times it's the issue of, we don't have money. Particularly as we're dealing more and more with smaller projects, the model studies are not cheap, and we could almost use up all the [project design] money ~~to design a project~~ just in building a physical model. So that is a reality that we have to deal with. The answer to the question is, is that we are doing a lot more with numerical models than we ever have in the past.

Some Things We Know and Others We Don't, and the Things We Don't Know Require Physical Modeling or Other Data to Be Able to Answer the Questions

It gets back to this equation stuff. Let me see if I can explain it in a way that might make sense. Let's take Shasta as an example. We want to release a certain temperature of water out of the reservoir for the downstream fishery, so we're trying to design a device to put on the upstream face of the dam that would allow us to draw out water at the right temperature. We can do a numerical model of the whole reservoir. We have excellent reservoir models that will tell us if water's coming in from certain flows coming into the reservoirs, certain rivers and creeks, and we're releasing so much water. We have models that can tell us what the temperature stratification is going to be in the reservoir, throughout the reservoir.

Determining Head Loss at Shasta Due to Installation of the Temperature Control Device

What we don't have models for is when somebody asks us, "Well, now how much head loss are we going to get if we open a gate down below, down deep in the structure, and we've got to run it through the structure now and up to the penstock and then down through the powerhouse? How much more head loss is that going to give us than what we had before we put this structure there and the outlet for the penstock or inlet for the penstock was right on the face of the dam without all this metal structure out in front of it?"

The Far Field Model and near Field Model

We do not have numerical equations that can explain all the head loss coefficients in those structures yet. Every year we're getting better at that. We're developing models that have some of those equations in them, but we call that–the Far Field Model would be the numerical model that looks at the whole reservoir. The Near Field is the physical model allows us to look at actual physically measuring head losses, water pressure drop through a structure on its way down to a penstock.

". . . when you talk about bringing water in through a metal structure placed on the face of the dam, and it has a lot of beams and internal structures in there, there's no way that you can take a computer program . . . So in those areas the physical model is our only answer. . . ."

If we have a straight conduit going in, a pipe, there are mathematical equations that can do that, but when you talk about bringing water in through a metal structure placed on the face of the dam, and it has a lot of beams and internal structures in there, there's no way that you can take a computer program–I mean you could probably develop one, but it may take you several years to come up with those equations. So in those areas the physical model is our only answer.

"Crystal . . . I mentioned to you before that Mike Colgate would come out and say, 'Did you look at how that right canyon wall is affecting the spillway flow?' . . . Well, again there's no way you could write a numerical equation for that little outcrop of rock in the reservoir on Crystal that would have allowed you to describe what he called rope going over the spillway. . . ."

I could go back and talk about Crystal just briefly. On the intake, I think I mentioned to you before that Mike Colgate would come out and say, "Did you look at how that right canyon wall is affecting the spillway flow?" We actually had to move the spillway in the model to make it work better. Well, again there's no way you could write a numerical equation for that little outcrop of rock in the reservoir on Crystal that would have allowed you to describe what he called rope going over the spillway. I can talk more about this in the future.

". . . as good as numerical equations are, as helpful as they have been, there are still numerous situations that are singularity points that there is no equations for or that we don't have the equations written into the programs . . ."

The point is that as good as numerical equations are, as helpful as they have been, there are still numerous situations that are singularity points that there is no equations for or that we don't have the equations written into the programs to do it. This can deal with fish passage, it can deal with cavitation, it can deal with basically any water flow close to a structure, where you have a gate or an intake structure or a diversion or a spillway chute, most of those things we still do not have the capability to put it into a numerical or computer program.

". . . what we don't have are those unique situations . . . About the only way you're going to be able to observe and take data on those is to physically try to represent it in a model, and that's when you've got to get into some pretty good scales. . . ."

Computer programs work well in reservoirs, say, a pipe system for the city of Denver, where everything is in pipe flow and you're trying to figure what the losses are. Equations we have down very well for those, but what we don't have are those unique situations where you may have open channel flow, and then it goes to closed conduit flow, or we have a unique structure where you have a canyon wall interfering on a spillway. About the only way you're going to be able to observe and take data on those is to physically try to represent it in a model, and that's when you've got to get into some pretty good scales.

In the Laboratory's Work, Roughly 70 Percent Are Physical Studies, 10 Percent Are Paper Studies, 10 Percent Are Numerical Studies, and 10 Percent Are Field Studies

So I would say, like in our laboratory right now, about ten percent of our studies are numerical studies, and maybe another seventy percent are actual physical studies out in the laboratory. We probably have another ten percent that we do out in the field, where we're actually taking field data and analysis, and then another amount that's just paper studies, where we sit down and we run through some equations, and we can answer some of these questions.

Hybrid Modeling Is Using a Numerical Model to Determine the How You Might Build the Physical Model

In the field of hydraulic laboratories these days, there's a lot of what's called hybrid modeling, and we call it hybrid modeling because what it is, it's taking a numerical model and using that to get the idea of how you would build a physical model to study the details that you want to study. In other words, you do all that you can in numerical model, then you use that as the entrance conditions for the physical model, so that you can build the physical model smaller sometimes and use the numerical model to get the entrance conditions to the model. I can talk a little bit more about that when we talk about Crystal model study.

Jackson: Looking at my watch here, we've got a time constraint at 10:00. We're going to do some more interviews. I just was wondering are there any issues today that you'd like to go back and elaborate on when we start again next time, or are there any issues that popped into your mind that you especially would like to make sure that we address?

Burgi: I think certainly going back and maybe looking at the Crystal model study would be one thing we could do. I'm sure there are other issues. I'm trying to think right now, as we're talking, what they might be, but certainly there are some gates and valves that I'd like to talk about sometime, the development of the needle value, and then more recently the jet flow gate replacement, because of some deaths that we had in 1984, where some of the needle values actually exploded. We were involved in some of the investigations on those.

Jackson: Okay, well with that I'm going to go ahead and turn off the recorder now.

END SIDE 2, TAPE 2. MAY 5, 1999.
BEGIN SIDE 1, TAPE 1. MAY 12, 1999.

Jackson: Today is Wednesday, May the 12th[, 1999]. It's about ten minutes past eight in the morning. My name is Mike Jackson. I am sitting here on the fourteenth floor of the conference room in the Bureau of Reclamation building, Building 67. This is the first tape today of the interview with Phil Burgi.

Phil, picking up with one of the topics that we touched upon before, I just wanted to try to go into more depth today regarding Crystal Dam and have you just tell me the whole start-to-finish, the genesis of it, how it came from an idea to a finished product.

Burgi: Okay. Let me just give you a little more history there as to where I fit into it. I think by the time I finished my six-month rotation as a coop student, it was probably–must have been around January of 1970. I think as I mentioned on one of the earlier tapes, of course, I was a junior engineer and was always assigned with a senior engineer on a project. Many times I'd be the one collecting the data and doing some of the analysis, maybe even some of the report-writing, but there was always another engineer in the laboratory that was in charge of it.

"Bill Wagner . . . asked if I'd like to do a Crystal Dam model study. . . . I was very excited about the opportunity to be in charge of my own model study. . . . Probably a year before that, there had been another model study on Crystal Dam that was a tunnel spillway study for a earth embankment dam at Crystal Dam site. . . ."

I don't know, sometime in '72, maybe, a couple of years after I'd been there, Bill Wagner, who was the branch chief at that time, had asked if I'd like to do a Crystal Dam model study. What was sort of interesting was–well, first of all, I was very excited about the opportunity to be in charge of my own model study. I took that as a very heavy responsibility, because I really did appreciate and realize that the work that we were doing was important work.

Probably a year before that, there had been another model study on Crystal Dam that was a tunnel spillway study for a earth embankment dam at Crystal Dam site. I remember this was early in my career, and I thought, boy, this is something, that we're actually doing two model studies and two different designs.

"There Was an Original Design for an Embankment Dam, and Then for Whatever

Reason, I Don't Know the Internal Politics in Reclamation, but it Was Decided to Go with a . . . Concrete Arch . . ."

There was an original design for an embankment dam, and then for whatever reason, I don't know the internal politics in Reclamation, but it was decided to go with a concrete dam, actually a concrete arch, a beautiful structure, in a narrow canyon. In many ways it made a lot of sense, because it was in a narrow canyon downstream of Morrow Point Dam.

Crystal, Blue Mesa, and Morrow Point Dams on the Gunnison River

Actually, Crystal was to be a reregulating reservoir, with Blue Mesa, the upstream reservoir, as sort of a storage reservoir. Then the water coming into Morrow Point, where the power was produced, and then Crystal Dam was there to ~~sort of~~ capture the water after it had gone through Morrow Point, and release water at a fairly constant discharge down the Gunnison [River].

". . . the purpose of the model study was to look at . . . details of the spillway. . . . the plunge pool . . . action of that plunging jet . . . on the powerhouse and the parking lot in this very narrow canyon . . . the outlet works . . ."

So Crystal was not anywhere near as big a dam as Morrow Point in the sense of its size or the powerplant, but there was a small powerplant designed for Crystal. Crystal was to have a beautiful sort of an overflow ski-jump-type spillway on the right side of this concrete arch, going down into a very narrow canyon downstream. So the purpose of the model study was to look at two or three items. One was the details of the spillway. It was located very close to the right abutment. There was to be this ski jump that would come down, I'd say maybe a third of the height of the dam, with a bucket, and the jet was to come out off of that bucket and land down in the plunge pool. So the spillway needed to be studied, the plunge pool, obviously, the action of that plunging jet might have on the powerhouse and the parking lot in this very narrow canyon on the downstream side.

And then the other big item was the outlet works for passing water when you weren't running it over the spillway or through the powerhouse. There was some concerns on the vertical tower on the upstream face of the dam, and turning the water 90 degrees through the outlet works, and then how that was going to be released in a submerged condition into the downstream pool.

So this looked to me like an exciting project, and I was eager to get going on it. Basically, in a project like this, the designers from here in Building 67 [developed the design.] ~~would come up.~~ Actually, we did a lot of discussing right at the very beginning on, "Hey, this is our concept of what the spillway ought to look like," and we went through some calculations on where that jet for the spillout ought to discharge.

"After . . . verifying that this was our best guess at a design, I was given the job of choosing the scale for the model. . . ."

Modeling and Scaling Laws and Other Issues Applicable to the Laboratory

After ~~sort of~~ verifying that this was our best guess at a design, I was given the job of choosing the scale for the model. As I said earlier, we used Froude Law criterion–F-R-O-U-D-E, name of a gentleman in Germany that in the 1800s developed the concept of scaling for hydraulic model studies. What that means is if you chose a 1-to-36 scale, that every inch on a prototype represented 36 inches, or three feet linearly on the prototype. Once you know what that linear scale was, then these scale laws broke down into velocity, what you would do is you would take the square root of 36, and so whatever your [velocity] measurement was on the model, you'd multiply that times the square root of 36 to find out what the velocity measurement was on the prototype.

The discharge measurements, in other words, if you had a certain discharge, let's say ten cubic feet a second in the model, you would take that scale of 1-to-36 and raise it to the five-halves power, and multiple that times your ten cubic feet a second, and that would tell you what it was out on the prototype. Pressures were, if you measured a certain amount of pressure in feet of water, you'd just multiply that times 36, and that's what it would be in the prototype.

So the scaling laws are very accurate once you choose a scale that, as I mentioned before, follows the Froude and Reynolds number criteria, which you can study that in your textbook. But basically what it does is, you're trying to get to a place in your modeling where the surface tension effects and other scale effects are not a large factor. And then, in fact, when you measure a certain hydraulic phenomenon, whether it's pressure, velocity, or discharge, you can replicate that by scaling it up to the full size, and if you measure a certain pressure on a wall in the model, you can be assured that that's what the pressure is going to be on the prototype.

". . . the major difficulty you have in construction of a model, then, is to make sure that the profile of the spillway is exactly what the profile is going to be on the prototype. . . . every little fraction of an inch becomes very important on the model. So you need to have craftsmen available that can make these scale models the way they're designed to be. . . ."

So the major difficulty you have in construction of a model, then, is to make sure that the profile of the spillway is exactly what the profile is going to be on the prototype. Some of the measurements that you take when you scale those down by 36, every little fraction of an inch becomes very important on the model. So you need to have craftsmen available that can make these scale models the way they're designed to be.

"Crystal was one of the first models we used urethane for the spillway crest, and it's something like styrofoam, only it's denser. We actually, down in the shops, used a mill machine to get the surface profile of the spillway . . ."

Crystal was one of the first models we used urethane for the spillway crest, and it's something like styrofoam, only it's denser. We actually, down in the shops, used a mill machine to get the surface profile of the spillway, because not only did it have a curvature in the direction of flow going down across this ski jump, but since this was a thin arch concrete dam, the spillway itself, looking down on it in plan, had a curve to it. So the spillway is converging as you go downstream and through the ski jump.

So in any case, we came up with a 1-to-36 scale on this three-dimensional model, and basically the model would have been on the order of maybe 80 feet long and, let's say, 25 feet wide. It would have a head box that would allow us to represent the reservoir right upstream of the dam, and then, of course, the dam would be constructed, at least that part of it that would have the spillway crest.

Then we built what we called a tailbox, which was the receiving area when the water would come through the spillway or through the outlet works. The tailbox would be the box that would receive that water. In the tailbox, normally what you would build would be all the topography for the downstream canyon walls and, in this case, the powerhouse and the roadway going up to the powerhouse.

Again, you would get drawings from the designers, and these would be topographic maps, and you would scale those down to the 1-to-36, and then the carpenters actually would go in and build this topography in the model, so that when you were through, all the major surfaces of the upstream reservoir, the dam itself, and then the downstream canyon and river were replicated in the model. What we would do then was, they would also come up with what we called a design discharge.

~~Can we stop the tape for a minute? [Tape recorder turned off.]~~

~~Jackson: Okay. We're resuming.~~

Burgi: Okay. What I was saying was that early on in the study, of course, the hydrologist would have said what the maximum discharge would be coming down that river, and it would be based on the upstream watershed and other dams on the river upstream, all the effects that would allow the engineers to come up with what could be the possibly maximum amount of water coming down that river upstream of the dam.

That then is run through some equations that allow us to determine how much of that would be stored, how long the flood period would last, and eventually you come up with what we would call the design discharge for the spillway. In other words, that would be the maximum discharge that that spillway would ever be expected to pass. I think the number for Crystal was 45,000 cubic feet a second.

So, typically in a model study, we would want to make sure that our scale that we chose, in this case 1-to-36, would allow us to come up with a discharge with our pumps in the model, or in the laboratory, to get this 45,000 cubic feet a second.

And so all those things we would work through ahead of time, and that would be part of the rationale in choosing the scale.

In other words, the scale of the model would depend on, first of all, getting into a range that makes sense for modeling; 1-to-36 is a good number. Secondly, can, in fact, given our laboratory space, we put a 1-to-36-scale model of Crystal in between the columns and where we have space. We would also be looking at the discharge and make sure we could get that amount of water to the model.

Once we had all that decided, then we would go in and start actually designing the model based on the prototype drawings. Those would be made up of drawings of the topography itself, which would just be off of survey maps. Then, of course, the designers would imprint on those where the abutments of the dam would be, where the powerplant was going to be located, and all that would be brought into the model.

Once we knew what those maximum discharge numbers were, another question we would often ask is, well, what would be some of the lower discharges. For instance, on an annual basis, what might be the most common discharge that the spillway could expect? Often we're also concerned about at real low flows going over the spillway, when this jet is paper-thin, what's it going to look like when the wind blows on it? We have this bucket at the bottom of the ski chute, so what do we do about it when water's just standing in it? Do we put drains in it? A lot of these minor questions we can also look at in the model.

As I mentioned, I think, last time we talked, one of the problems at Crystal was on the right side upstream. Some of the topography in this very steep canyon actually came out and protruded in line with where the spillway was to be located. This protrusion actually became a problem for us in that it affected the flow over the spillway.

As Michael and I talk, I'm just going to show him a picture out of a model study report.

Jackson: You want to go ahead and reference the page number and citation?

Burgi: Sure. This is out of what's called "Hydraulic Model Studies of Crystal Dam Spillway and Outlet Works," and it's REC-ERC 73-22, December of 1973, and I'm on page 7.

Adjusting the Spillway and its Approaches at Crystal Dam as a Result of the Model Studies

You can see here on the photograph that this protrusion, we usually put confetti, just paper confetti, on the surface of the water, and you can see how it's really affecting the approach flow to the spillway, and caused very rough flow over the spillway. So early on in the study, we actually cut some of the topography, actually some of the bank, the upstream abutment, away, and benched it, I think maybe 30 or 40 feet below the spillway crest, so that we could get a much smoother approach condition to the spillway. So, actually, when the dam was built in the field, one of our recommendations was, if we're going to stick this spillway that close to the canyon wall, that we would have to do some excavation upstream so that we could have a good approach flow condition to the spillway. Obviously the larger the flow over the spillway, the larger this problem–the more serious the problem is. So that was one of the first things we looked at.

Another item was the shape of the upstream piers. At the very high discharges, the piers had sort of a ~~tri~~angular, just a very sharp radius on them, and the flow actually separated from the training wall. So we progressed from [an angular] ~~sort of a triangular~~ shape with a radius to a round, a semicircle, and then eventually to an elliptical shape, to allow the flow to come around the corner of the pier and stay right against the training wall on the spillway crest. What this does is ~~it~~ really improve~~s~~ your coefficient, because you have a much more efficient spillway, because you're using the full width of the spillway much much better.

"The whole idea is to project the jet downstream away from the dam so that it ends up in a plunge pool, not right at the base of the dam, but out some distance, so that you're not dissipating the energy right against the foundation of the dam. . . ."

Other items on this particular spillway was the exit angle on the bucket itself. I think originally it had a very flat exit coming off of the bucket, and we ended up going to a four-on-one, which gave a fairly good flip. The whole idea is to project the jet downstream away from the dam so that it ends up in a plunge pool, not right at the base of the dam, but out some distance, so that you're not dissipating the energy right against the foundation of the dam.

Issues with the Stilling Basin at Crystal Dam

Then, of course, as we move downstream into the stilling basin area in this very tight canyon, we were concerned about the wave action next to Crystal Dam powerplant. There's a road that comes up to the powerhouse, and it's in a very narrow canyon, so the wave action, we looked at that. Again, the instrumentation in those days that we were using were little capacitance probes that actually measured on a thin wire the run-up of the wave action on the wire. We had put pressure taps in the spillway itself along the profile, to make sure that we were not experiencing any low pressures that would indicate cavitation on the spillway. These were all part of that study.

Sei Fujimoto Spent a Year in the Lab Representing the Public Works Research Laboratory in Japan

I might mention also that sometime around–I think we were doing this model study in '71, because sometime around November of '71, a gentleman from Japan showed up, by the name of Sei Fujimoto. Sei was with the Public Works Research Laboratory out of Japan. It was a Federal laboratory. He was on a one-year sabbatical to come over and basically work with us in the Bureau of Reclamation, to try to learn how we model dams and different types of structures in our hydraulic laboratory.

So he was assigned to me at that time. Sei is S-E-I, is his first name. He was just a great guy to work with. He came over with his wife and their two young children. So basically this whole year that we were running these model studies on Crystal, Sei helped a lot. I suspect actually the model studies took about six months, and then he was off working on some other project in the laboratory. But we formed quite a friendship. About five years ago, in fact, I had a chance to visit Japan, and I ~~re~~visited or reacquainted myself with him when I was over there in Tokyo. It was a great opportunity to spend some time with an old friend.

Issues Addressed in Modeling the Outlet Works on Crystal Dam

In addition, though, to the spillway study, as I mentioned before, the other item that we were concerned about was the outlet works. The outlet works basically consisted of a tower on the upstream face of the dam, and then two horizontal tubes that ran through the dam, and on the downstream end of these there were jet flow gates. These were designed to operate submerged, which means they would discharge into the plunge pool below the surface of the tailwater.

We were very concerned about whether we could get by with a single tower that would serve both tubes or have to build two towers with a single tube~~, a tube on~~ each ~~one~~. We were able to save money and, I think, really improve the design by using a single tower with dual outlets on it. But there were some problems in this design, too, because the tower is ~~a~~ fairly [large]–I think it was a seven-and-a-half-foot radius. Going down into–actually on the single ones it was seven and a half foot. It was [an] eleven foot [radius] on the dual one. We would go into two four-and-a-half-foot pipes, but what we found in the model was this vortex that would actually appear in the outlet works, where a very, what I would call, strong vortex would appear just out of nowhere, right in the flow.

As we studied this, we realized that what we were producing with this very high-velocity flow and turning at sharp angle was just like a tornado, only it was in water, a very strong core that, when we measured the pressure inside the core, was actually producing cavitation pressures. In other words, [the pressure in the core was] ~~they were down around~~ 30 feet below atmospheric. In the core itself you could see where this cavitation cloud would be dissipating. In fact, you could actually hear the noise of cavitation.

"Our concern was that if we were getting this core vortex in the model, we would certainly experience it in the prototype. . . ."

Our concern was that if we were getting this [core vortex] in the model, we would certainly experience it in the prototype. So [in our test we changed] ~~what we did was actually did some testing to change~~ the angle or the profile of the bell-mouth design and ~~also we~~ found that if we raised the [tower] floor ~~from the original~~

~~[tower design from] 4.6 feet to maybe a foot and a half,~~ we could disturb the vortex enough to prevent it from occurring. In other words, we didn't allow a dead space in the tower that would allow the circulation to occur, but, in essence, turned the tower into more of an elbow shape. This proved to be very successful in the model. This was a totally different model. It was a 1-to-13 scale, and we built a separate structure to actually just look at the outlet works itself.

Again, what I really enjoyed about the Crystal study was the number of different hydraulic performance tests that we were able to look at, not only on the spillways with the pier and the shape of the crest and the bucket and the plunge pool, but then looking at the outlet works and how to solve some of those problems. It really is interesting, as we look at these models, that you can save–for instance, in the pier design we saved quite a bit of concrete.

"I've always been convinced, through my experiences in the laboratories, that we could *more* than save the cost of the model study just in fine-tuning the design. . . ."

What we find on some of these models–at this time, Crystal model study may have cost on the order of–I'm guessing–$60,000, maybe it was only 50. But it doesn't take that many cubic yards of concrete out on the prototype to spend that kind of money. So I've always been convinced, through my experiences in the laboratories, that we could *more* than save the cost of the model study just in fine-tuning the design. The designers can take the design so far, and we can help them with that. If we actually build a scale model, we can change the shapes on the fine features and make the design [safer and] more efficient.

". . . but I think the real savings, of course, is in the improved performance of the prototype once it's built. . . ."

So you save that amount of money, but I think the real savings, of course, is in the improved performance of the prototype once it's built. We certainly were able to, in the plunge pool area downstream of the dam, we were able to pre-excavate the plunge pool and develop its design to the point where it performs very nicely. The dam's been built for about 25 years now, and there's not been any difficulties that I'm aware of in the plunge pool area.

". . . what you're really doing is you're paying up front to make sure your design is proper . . ."

So what you're really doing is you're paying up front to make sure your design is proper, because to go in later and excavate after you've built the dam, you'd have to dewater the plunge pool, and the expense of doing that would be very, very expensive.

Model Studies Also Can Assist the Designers in Development of Standard Operating Procedures for the Project

Not to mention the model also, in the operations, allows you to say to your operators, “If you operate the spillway in this range or the outlet works in this range, these are some of the conditions you can expect.” It allows the designers–usually we put together a standard operating procedure, called an S-O-P, and some of that standard operating procedure is impacted by the results of the model study. “If these conditions occur, then this is how you ought to operate the dam.”

There’s probably many other things in the story of Crystal Dam, but it certainly was, I guess, the start of my career in the laboratory, in the sense of that was one of a number of model studies that I did in the period between 1971 and 1979, when I went to Peru. So it was the first one.

“Sei Fujimoto was a big help to me. In turn, his experience here in the laboratory really helped him. . . . [he was] taking notes on things like the size of our laboratory, the size of our pumps and pipes and all of our control systems. When I went over to Japan . . . I actually got to visit the laboratory that he helped build . . . in the mid-seventies, and it’s almost a replication of our laboratory here. . . .”

Certainly Sei Fujimoto was a big help to me. In turn, his experience here in the laboratory really helped him. I always got a kick out of observing him taking notes on things like the size of our laboratory, the size of our pumps and pipes and all of our control systems. When I went over to Japan here about five or six years ago now, I actually got to visit the laboratory that he helped build once he returned to Japan in the mid-seventies, and it’s almost a replication of our laboratory here.

“. . . we benefitted from some of the things that he was able to do in the laboratory . . . a baffled apron drop design. We call it the Fujimoto Crest. Basically it’s something that he developed while he was here in 1972. . . .”

So the experience for Sei and for the Japanese Public Works laboratories, they certainly benefitted from his year’s experience here with the Bureau, and we benefitted from some of the things that he was able to do in the laboratory, not only on Crystal Dam, but we actually have a–it’s a baffled apron drop design [by Sei]. We call it the Fujimoto Crest. Basically it’s something that he developed while he was here in 1972.

So that’s sort of the story of Crystal.

Jackson: Were there any discoveries or pioneering efforts from Crystal that are beyond the parameters and circumstances of Crystal that were able to be widely utilized subsequent to–in other models of dams?

General Applications to Reclamation Design That Came out of the Model Work on Crystal Dam

Burgi: I’m trying to think. That’s, again, a good question. Much of Crystal was so site-specific because of the very steep canyon walls and the very narrow canyon, so certainly most of the things we did on the spillway were fairly site-specific, although I would say some of the pier-shape design that we developed there is still being used, has been used on other design since.

The issue that we had in the outlet works, with the vortex that led to cavitation, *that* experience has influenced designs of intake structures since the 1972 model study. I can't say that there were any large new discoveries on that model study, other than the site-specific areas that we were able to improve the design.

It seems like when you do any of these studies, and that's one of the reasons the hydraulics lab is always documenting reports of studies, is you have this tremendous amount of data that you develop over time and experiences that you can go back, particularly if you have people that have been in the laboratory a long time, and say, "On this new design, why don't we go back and see what we did at Crystal," or Yellow Tail or Flaming Gorge.

Over Time the Results from Many Studies Are Sometimes Consolidated into Manuals like *Design of Small Dams* or *Engineering Monograph 25: Hydraulic Design of Stilling Basins and Bucket Energy Dissipators*

What we've done in a couple of cases, like the *Design of Small Dams*, the manual that we refer to, there's another one called *Design of Energy Dissipators, Engineering Monograph 25*,[7] where in earlier years we've taken results of numerous studies and put that all into what we would call general [design criteria.]

END SIDE 1, TAPE 1. MAY 12, 1999.
BEGIN SIDE 2, TAPE 1. MAY 12, 1999.

Burgi: *Engineering Monograph 25* has a tremendous amount of information on various stilling basin designs and plunge pools and two or three concepts for culvert outlets. Those were developed–I think Al Peterka was responsible for writing that document, and Tom Rhone and several others in the laboratory were involved. That monograph was used in *Design of Small Dams*. It's been used all around the world by water resource agencies developing hydraulic structures.

So, typically what would happen in our laboratory is that you would have these numerous, what we would refer to as "site-specific," studies. As I mentioned, Flaming Gorge, Yellowtail, Glen Canyon, Crystal. There's just hundreds of these structures that were tested in the laboratory, and you just aggregate this tremendous amount of information.

Based on that, we had [engineers] ~~people~~ like Al Peterka and Tom Rhone and others that would take some of those–they were good writers–and they would actually develop generalized nomographs and curves that designers could use in the future and say that if you're in this certain range of discharges and these certain

7. See footnote on page 22.

conditions, then this is the type of basin you ought to design. They actually had it laid out so they could tell how long the basin needed to be, how wide, where you need to put chute blocks.

How Design Money and Research Money Interact in the Laboratory

I refer today to this type of work as how we use some of our research funds. Funding in the laboratory has always been interesting, because you have a certain amount of money, like the Crystal study that is given to us by the designers. They say, "Go ahead and use this money to develop and help us improve the design." So they're project monies. They are monies that were given to us by Congress to build the structure. Of course, to build it, you've got to design it. There were monies in the package to spend on that.

When it comes time to writing up generalized design criteria or putting all this from various studies into one monograph, then you need to go to something like either what we call G-A-E funds or research funds where you would take monies that are generalized monies, and use it to bring together the results of numerous studies into a guideline or a design criteria-type manual.

We still do that today. We have studies, for instance, site-specific fish passage work, but we also have research monies that we call fish passage research money. Those monies are used to sort of fill in the blanks between the site-specific models. In other words, we might develop a test facility in the laboratory using research monies, where we would run some test ranges that were outside of whatever else we've looked at over time, and then we would spend some of those monies to bring that all together in a engineering research report dealing with fish passage.

". . . I often refer to the research as the mortar between the bricks. Often bricks are funded by site-specific projects, but in order to build a wall of knowledge or a building of knowledge, you have to have some research monies which allows you to tie all these projects together into something that can stand alone. . . ."

So I often refer to the research as the mortar between the bricks. Often "bricks" are funded by site-specific projects, but in order to build a wall of knowledge or a building of knowledge, you have to have some research monies which allows you to tie all these projects together into something that can stand alone. That would be like an engineering manual or an engineering monograph that draws conclusions, general conclusions, from a number of different studies.

I'd like to talk a little bit, too, about funding in the sense that at least in our hydraulics laboratory these numbers will vary from time to time, the proportions, but usually 50 percent or more of the work is project-funded. In other words, they are site-specific projects. Another third of the monies might come from research monies, where we're given monies to look at specific items over the years, things such as cavitation damage, fish passage, sedimentation issues, water conservation issues that deal with things like water measurement, dam safety issues. These monies make up part of our funding for a year's budget that allows us to take some of our staff and dedicate them to specific research investigations.

I've always come out of the philosophy that the best researchers are those that also have some project work, because it keeps them close to reality. So we try to mix most of our senior engineers, anyway, would have several projects during the year, and part of their funding would come from site-specific work they're doing and part of it from research budget.

But I also have this vision of research as something in Reclamation where when we first do research–let's use the hypothetical case of we're wanting to know more about how we would design selective withdrawal structures for reservoirs. We've done some of these at Hungry Horse, at Shasta, Flaming Gorge. We might start out with a project in the laboratory that would be completely funded by research monies. We'd just say, "We're going to do some investigations of selective withdrawal structures," and it would be completely funded by research.

As time goes during a project like that, say we're now two or three years into it, we've learned some things, and we have a project now that we want to actually try this on out in the field. And so let's take, for instance, Hungry Horse Dam. We might develop a study in the laboratory where we would specifically show how you would use a selective withdrawal structure on Hungry Horse Dam. Part of that might be funded by Reclamation's project monies for Hungry Horse and part of it out of research funds.

We eventually get to the stage where that's actually built out in the field. Of course, it would be funded by the project monies, but we might want to put some research monies into it to do some site-specific investigations in the reservoir once that selective withdrawal structure is placed on Hungry Horse Dam. So, over time, if we draft this out and we're looking at selective withdrawal structures at reservoirs, at the beginning of the work it would all be funded by research. In the middle, what I might call the demonstration phase, it would partially be funded by research, partly by the field monies. And on the far side or on the distance side of this research effort, we get into application.

Most of the monies would come from the project itself, where the new technology was applied, but I feel there's still the need to put some research monies in, because that's when we do the field testing and the verification that what we saw in the laboratory actually is happening out in the field. And so we actually move in research from the basis of research, the very basic work we're doing, to a demonstration level, and then eventually to application.

My fear in the past is that many times we build structures and we *never* go back out and gather some of the information that would help us bring closure to a study, in the sense of actually looking at how does this new design or this new method actually work out in the field. So I've talked somewhat to Stan Ponce, our research director, about continuing to have an emphasis in research, not only in the development of new technologies, but in the demonstration of those technologies and in the application, so that we bring some closure to these new developments and that we can say not only did we test them, but we actually demonstrated them in the field and then applied them, and then we actually went back and gathered some data in the field, with research monies, and wrote up sort of a closure on that particular research [that leads to generalized design criteria].

I think that's an important part of laboratory work, that whether it's in the materials area or hydraulics or in the electric power or in environmental or chemistry, that we closely tie the applied specific projects that we're working on in the laboratory to new technologies and new methods of doing our work, to the point where the same people that are doing some of the laboratory and technical investigations to solve problems are the same people that are also working in the research, trying to develop improvements. We find, as we tie those two together, we really can make some strong advancements in developing new technologies.

Needle Valves over Time and Their Replacement

Along that line I can talk about needle valves a little bit. Needle valves were–I don't know all the history, but they would have been developed early in Reclamation history, I'd say in the twenties or maybe even the thirties. Certainly by the time Hoover Dam came along, the needle valves were the main source of control for ~~the~~ outlet works.

A needle valve is basically a terminal valve at the end of a pipe on a dam, and it, in fact, has an upstream needle and a downstream needle. When the valve is closed, the needle progresses downstream against an orifice which closes it off, and when it's open, the needle progresses upstream in the pipe, or in the valve chamber, and allows water to go around the needle and discharge into the downstream plunge pool.

These old needle valves, some of them were quite large, certainly up to maybe 96-inch diameters. They could pass a large amount of flow. They were very complex in their operation. Usually they use the upstream pressure of the reservoir to operate. In other words, they didn't have an electrical control on them, or even hydraulic controls, as we might use today.

Over time, they lacked maintenance, and my suspicion is that people out at some of the dams weren't that familiar with how the [needle] ~~new~~ valves operated, and so not only were they not always maintained very well, which meant that the parts were getting old in them, but I think many of the operators ~~probably maybe~~ didn't understand if you had a difficulty, how you would solve that, or what you shouldn't do.

Explosion of Needle Valves at Bartlett Dam and in Idaho

So, in any case, in 1984 we started experiencing some real problems on some of our needle valves. I'm sure we had problems for many years, but Bartlett Dam outlet works experienced an explosion of a needle valve in–I think it was 1983 or 1984. And an operator was killed in that accident, when the needle valve all of a sudden just slammed shut. It slammed shut with such force that it just broke the valve. Of course, the valve just exploded and caused severe damage in the outlet works, but, of course, the major issue was the fatality that occurred as a result of that accident.

About six or nine months later, up in Idaho there was a small project, and a needle valve on the downstream end of a penstock bypass ~~that, that~~ exploded, and four people were killed. So Reclamation started looking pretty carefully at what do we have here in these needle valves. We had structures, I would say on the order of forty or fifty structures across Reclamation, that had these needle valves on them, and so we needed to either look at how we were going to repair those and put a permanent fix on them, or actually replace them.

It Was Decided to Look at Where Reclamation Had Needle Valves and the Alternatives for Repair or Replacement

Our decision was–and this was made at pretty high levels in Reclamation, in the assistant commissioner for resource management's office, probably is where that decision was made–we would investigate where we had these various needle valves located and look at what else we might use.

Reclamation Laboratory Had Been Developing the Jet Flow Gate Which Replaced Some Needle Valves

Over the years, the laboratory back in the–I'd say ~~about~~ the forties, started developing another valve called a jet flow gate. Jet flow gate was a much simpler design than a needle valve. It basically had a gate that actually just went vertically up and down to open and close, and it opened and closed against a circular orifice that put out a fairly simple jet. It was a solid jet. It looked to us like we could use those on many places where we had the needle valves. [The first large jet flow gates were designed and tested for Shasta Dam.]

So, since 1984 up to the present time, we've evaluated numerous jet flow installations across Reclamation. I couldn't tell you exactly where we are in that process, but we've replaced a number of the old needle valves with jet flow gates. For instance, at Hoover Dam, ~~both~~ the needle valves that were located in the tunnel diversions, as well as those on the canyon walls, were replaced here just recently with some very [large] ~~good-sized~~ jet flow gates.

When we built Crystal Dam, I mentioned earlier that model study, of course we didn't even think of using a needle valve; we went directly to a jet flow gate. So again, that's a case where, over years, Reclamation started out using needle valves, which grew out of an earlier valve called an ensign valve, E-N-S-I-G-N, eventually then we went to the jet flow gates. So over the history of Reclamation's activities in water resources development, the development of high-pressure gates and valves have changed.

"The laboratories have always had a strong influence in that direction of change. . . ."

The laboratories have always had a strong influence in that direction of change. Often we were involved when a problem developed. People like Mike Colgate and Bob Dexter would go out and visit these sites and try to work with the Mechanical Branch in resolving the problems. This was a case where the engineers in the Mechanical Branch and the engineers in the hydraulics laboratory worked very closely in going from the needle valve into the jet flow gate.

Development of the Clam Shell Gate

Now, more recently, in the eighties, another valve was developed called the clam shell gate, and the clam shell gate is basically just what the name implies. On the end of a pipe you just put like a clam shell design that opens and closes, so when the gate is completely open, you have a coefficient of one. It's a very efficient design. There's no head loss when the clam shell gate is open. It's been developed now so they can be used submerged as well as to the atmosphere, so you could use it either above or below tailwater level, which is a real advantage.

We have two of these now, one up at Grassy Lakes in Wyoming and there's one down on the Salt River Project. I think recently here I've heard of plans to put them at Arrowrock Dam up in Idaho.

"So . . . development work in Reclamation's laboratories over the years has been one of the foundational or key areas in Reclamation where new technologies, concepts came up, and often it wasn't just *our* staff, but it included staff in the design units, but the testing took place in our laboratories . . ."

So the various development work in Reclamation's laboratories over the years has been one of the foundational or key areas in Reclamation where new technologies, concepts came up, and often it wasn't just *our* staff, but it included staff in the design units, but the testing took place in our laboratories, and then eventually those turned out to be demonstrated and, over time, accepted as standard ways of controlling water with gates and valves. So that was another important story, what's happened in the Hydraulics Branch over the years.

Jackson: Phil, I'm finding it interesting that, in addition to doing research that applies to new and future-oriented projects, you also do research as it goes back to troubleshooting and resolving issues. With regard specifically to the models, do you ever go back and revisit and pull the models back out? What happens to the models after their use for original production?

"Very seldom do we save the models, because in many cases a lot of it is wood and concrete and sheet metal. . . . There have been cases where we actually have gone out and reconstructed a model . . . twenty-, thirty-, forty years after the original model study was completed. . . . We don't have the storage to save these models because of their size . . ."

Burgi: Very seldom do we save the models, because in many cases a lot of it is wood and concrete and sheet metal. We have saved sometimes, say, for instance, we have some molds where we have pulled plastic to represent a penstock entrance at Grand Coulee or Hoover Dam or somewhere. We often save those molds, or we used to. I think we still have a few of them.

There have been cases where we actually have gone out and reconstructed a model, let's say twenty-, thirty-, forty years after the original model study was completed. I'm trying to think. Certainly the Glen Canyon spillways in 1983, when we redid the air slots there, we redeveloped a model and constructed it similar to the first model study, only this time we installed the air slots to see how they would work.

We don't have the storage to save these models because of their size, so in most cases, no, we don't save them, but it doesn't mean– and I think we have always felt that way in the laboratories, is that, yes, we are doing some new development work, but we also recognize that in Reclamation–again, I don't know the numbers that well, but we have hundreds of dams across the western United States that have been built. We have thousands of miles of canals. We have pumping plants. We have intake structures.

Reclamation Is Still Involved in Operation and Maintenance as Well as Safety of Dam Work Which Requires the Use of the Hydraulics Laboratory

All of this adds up to a tremendous infrastructure that Reclamation has developed, and quite a bit of it is still under our guardianship in the sense that even though we may have turned some of these projects over to irrigation districts or other owners [to maintain], for instance, Salt River Project, when it came time to do the safety evaluation at Bartlett Dam or Horse Mesa or Horseshoe, we were called back in to be involved in that.

So a good part of the work in the hydraulics laboratory is not only development of new technologies, but also looking back. Whether it's a safety-of-dams issue or whether it's a maintenance issue, it's not uncommon for us to go in and restudy a structure that might have been built forty or fifty years ago.

Increasing Capacity to Release Water at Folsom Dam

Folsom Dam is a good example. It has changed quite a bit from its original purpose, and we're now going back in and looking at adding more spillway capacity, more outlet capacity. There was an old model study done years ago on Folsom, and now that we're doing a new one, we will build on that old one. In other words, we have all those reports and files on those original studies, and so we can go into this study a lot smarter because we can build on the data and on the approach that was used, let's say, thirty or forty years ago. So the advantage of having the laboratory and the history that we have there is that not only can we sometimes go in and pull out the old reports and answer questions without doing *any* study, but if we need to, we have that basis of knowledge that we've used in the past, that we can bring back to the forefront and use that in a new study.

So, yes, we have the ability to go back and restudy, but answering your question of model of the structures, we save very little, mainly because we just don't have the space to do that.

Jackson: Phil, did you mention in our last interview that Folsom Dam was originally designed and built by the Army Corps of Engineers?

The U. S. Army Corps of Engineers Designed and Built Folsom Dam Which Is Now Operated by Reclamation

Burgi: The radial gates were designed by the Corps of Engineers. I think maybe the structure, too, for Folsom, was designed by the Corps. I don't know the history that well on Folsom, but I think it was a case where it was a flood control structure and therefore it was built by the Corps, but somewhere in the past, Reclamation took over because the water stored was for irrigation purposes. So I think Reclamation has had the task of operating it, but that it, in fact, was an original design by the Corps of Engineers.

Gate Failure at Folsom Dam

One of the issues there dealt with the failure of the gates, of course. Again, I don't know all the history there, except to say that the gates, as designed by the Corps originally, were fairly lightweight and did not maybe have a safety factor that we might have used in Reclamation, to the point where when I think on this gate that failed,[8] one of the bearings that sort of froze up because of lack of grease, and when we tried to change the elevation on those gates and move the gates, the gate structure itself was so light that with this little bit of additional friction in the trunion, [they] ~~we~~ actually bent the gate or pulled it to the point where it failed.

So I don't know all the details of that, but certainly Folsom is an example of a project that I think started out as a Corps project and ended up being Reclamation-managed, anyway. So when we talk about who's going to actually do the design and the modeling on the new Folsom, the added outlet works and the increased spillway capacity, we're still in negotiations on that. I think very likely our laboratory here in Denver will do the modeling, and it might be a joint effort on the design between the Corps of Engineers and the Bureau of Reclamation.

It's a unique example of a structure where the Bureau and the Corps of Engineers are very close, as compared to a Hoover Dam, which basically was designed and operated by the Bureau. The only Corps involvement on Hoover is the flood storage.

8. See footnote on page 52.

Corps of Engineers Involvement in Reclamation's Flood Control Responsibilities

We still have, across the western U.S., an involvement of the Corps of Engineers even on Reclamation structures, where when we talk about the storage capacity in the reservoirs for power and for irrigation versus the storage capacity needed for flood control, the Bureau and the Corps have to work together on that flood control issue, because there are benefits that come to these projects as a result of the projects for flood control as well as irrigation and power.

Guard Gates on Outlet Works and Issues in Their Use

Another subject I could talk about a little bit is guard gates at outlet works. We have, over the years, typically when we put in outlet works on a dam, the idea there is that you have three releases from a dam. Often it's a spillway for floods. You have the powerhouse for power production. The outlets allow you to either drain the reservoir or to deliver water downstream when you can't use the powerhouse or the spillway.

So the outlet works are an important part of a hydraulic structure. Typically an outlet works has a control valve at the end of the pipe right before it exits downstream, and that's what you control with. That's how you set the discharge. You can control from zero up to 100 percent open. Usually, internally back in the outlet tube somewhere, you have what's called a guard gate, and often that's right in the middle of the dam.

". . . the guard gate's purpose is to be able to close that gate and do work on the downstream pipe or the control valve. . . ."

But In other words, you can hold back the reservoir by closing a guard gate and then work on the control valve or gate at the downstream end of the pipe. Then also usually at the upstream end somewhere you have the ability to actually put in what we call stoplogs and dewater the whole pipe for inspection.

One of the questions that has come up in this dam safety era in the last fifteen-, twenty years has been if you had a failure on a control valve, let's say a needle valve, on the old Hoover Dam, when we had those, how competent are the guard gates?

Jackson: I'm about to run out of tape here.

Burgi: Okay.

END SIDE 2, TAPE 1. MAY 12, 1999.
BEGIN SIDE 1, TAPE 2. MAY 12, 1999.

Jackson: Today is Wednesday, May the 12th[, 1999]. It's about twenty minutes past ten o'clock. This is tape number two of the interview with Phil Burgi. My name is Mike Jackson. We're sitting on the fourteenth floor in a conference room in

Building 67.

Phil, we'll go ahead and pick up from where we left off.

"The issue is . . . your downstream control gates or valves . . . you can't close them, the question is, could you . . . close off the water by using the guard gates. . . ."

Burgi: Okay. Continuing the discussion on the guard gates and the dam safety issues. The issue is, if you have a incident where your downstream control gates or valves, something's gone wrong, they're not functioning, you can't close them, the question is, could you use the guard gates and close off the water by using the guard gates.

"The reason that's such a serious issue is, the guard gates were never designed to close while water was flowing under them. . . . So you get into a situation where the hydraulics are fairly extreme. "

The reason that's such a serious issue is, the guard gates were never designed to close while water was flowing under them. In other words, typically when you do maintenance, you'd close your downstream control gates and then you would lower your guard gate. Then you'd open up the control gate again and drain the water out. What we're talking about is, you've got discharge going through the pipeline. For whatever reason, the control gate doesn't work. Now you're asking the guard gate to come down into the water and stop the water. Most of the guard gates were not designed for that purpose.

So you get into a situation where the hydraulics are fairly extreme. This can be anywhere from vibration of the gate to cavitation, although usually that isn't such a big issue because you'd probably get the gate closed in five or ten minutes, and the damage by cavitation wouldn't be long enough to cause any severe damage.

". . . the bigger issue . . . when you have a water column going down through this horizontal pipe and then you try to close the guard gate, you can very easily pull a vacuum in the downstream pipeline. . . . when you're pulling that kind of a vacuum, it's very likely you could collapse a pipe. . . ."

But the bigger issue probably is the fact that when you have a water column going down through this horizontal pipe and then you try to close the guard gate, you can very easily pull a vacuum in the downstream pipeline. In other words, you've introduced the gate now into the water and you're starting to close the water off, but there is this whole conduit of water [flowing] ~~falling~~ down through the tunnel, and it's going to start creating an air vacuum behind this column of water unless you have a fairly good-size air vent downstream of the guard gate.

So we, in the laboratory, were called in to help with the mechanical group and the dam safety issue folks, because we had some experiences where some of the dam safety inspectors would, during their field inspection, try to close guard gates with the control valve open downstream, just to see how well the guard gate would work. There were experiences where–there's one mechanical engineer that probably almost lost his hearing because he was in one of these outlet works when that guard gate started closing, and the noise level from the air trying to get through the air vent was so loud that it damaged his ears.

The other concern is that when you're pulling that kind of a vacuum, it's very likely you could collapse a pipe. Of course, this would be catastrophic. So Warren Frizell in our group, working with some of the mechanicals, developed a numerical computer program that really allowed us to go in and figure out analytically, if we started lowering these gates, what kind of negative pressures were we going to pull in the downstream pipeline. Sometimes those could be solved by just putting in a bigger air vent, which meant you allowed more air to come into the downstream pipe. Other times, the only way you could solve it would be to put more ribs, more structural steel, around the pipeline to keep it from collapsing.

". . . these outlet pipes . . . were designed to have high pressure. In other words, the flow of trying to press out of the pipe, not the case where you would have very low pressure and the strength of the pipe could collapse. . . ."

It would almost be like taking an aluminum Coke ~~bottle or~~ can, and if you could pull a vacuum on it, you could see that the aluminum would collapse very easily. It's very thin-walled. That's basically what these outlet pipes are. They were designed to have high pressure. In other words, the flow [is] ~~of~~ trying to press out of the pipe, not the case where you would have very low pressure and the strength of the pipe could collapse.

So that was another issue where we were involved quite a bit. Actually, we've even come up with a test program. Basically what you want to do is make sure, in a safety-of-dam situation, that, first of all, if you had to close one of these guard gates, would it, in fact, close? In other words, every ten years you might go out and do an inspection. We've come up with a program where we can close these gates, say, 10 percent into the flow or something and make sure that the control mechanisms are working, but not try to go to a full closure on a dam safety inspection.

That along with the numerical program allows us to have some assurance that if we did need to close some of these gates in emergency situations, we could close them and, again, gain control of the releases from the reservoir. So that whole guard gate issue was something that probably started in the late eighties and went up to about the mid-1990s. Today we feel we have a much better handle on which of the structures, which of the dams across the western U.S., under Reclamation's control, where we have guard gates that we can use under unbalanced head, we call it. In other words, you're actually closing them in an emergency condition.

Jackson: Phil, one of the last questions I have in mind today, I remember in our last interview you mentioned outside consulting work for domestic and international. I'm curious to hear more about that, particularly in the context of the large scope of the research that the Bureau does and [unclear] private industry.

Burgi: There's a lot of philosophical issues dealing with Federal laboratories. Let me try to at least express my opinions on some of those and what I think is where Reclamation stands on them.

Of course, originally the Reclamation laboratories were developed to help with the design of large structures such as Hoover Dam and Shasta and Grand Coulee. Their only purpose was not to do research, but, rather, ~~other than the fact of~~ coming up with confirming or improving the designs for these large structures. We were never to be laboratories where we were doing basic research.

So our research program in Reclamation has always been somewhat limited in scope, in the sense that we try to define those areas that we need to do more study, whether they're environmental or materials or hydraulics, whatever. Some of that includes numerical modeling, but where we need to develop new tools or materials or equipment for Reclamation purposes. So that's the research side of the house.

The testing side of the house deals with just that. For instance, we used to have a paint lab where the paint manufacturers would claim they had certain types of paint that would do this or that, the only way you could prove that would be to have some environmental chambers where you actually checked that out in the laboratory. So Reclamation has always had a certain part of their testing laboratory program in trying to prove to ourselves that certain materials or techniques could in fact work the way manufacturers said they would. It's just to protect our own interest.

International and Non-Reclamation U.S. Work in the Laboratory

But in addition to that, for instance, in the hydraulics area, almost all of our work has been for Reclamation, but we have had some agreements internationally with anywhere from Egypt, on Aswan Dam, to Daule Peripa Project in Ecuador, to some of the projects we're doing down in Brazil where we're helping, where we have a government-to-government agreement that basically states either because of World Bank or Inter-American Development Bank monies or USAID monies, there is some project being developed, and the engineers on that project, the design engineers, want to test in our laboratory the physical model of this structure.

So, over the years we have done some model studies that were international in scope, outside the United States. In fact, one of the very, very earliest ones that I ever worked on, in 1970, was Pa Mong Dam on the border of Thailand and Cambodia, on the Mekong River. Again, it was for development of a water project in Southeast Asia. There were monies–I think it was World Bank monies–to do those investigations. So we've done some of those.

Then in addition, from time to time we have actually, in our laboratories, had some physical model studies of structures here in the United States that weren't Reclamation structures. An example that I worked on was Beaver Creek in the state of Pennsylvania, that had a morning glory spillway. It was a dam safety issue, where they wanted to make sure that this morning glory could operate under a submerged condition. In other words, you would take the water up higher than what it was ever designed to take.

". . . the problem . . . is that we are a government agency and there are also private laboratories . . . and . . . I've always taken the philosophy of not wanting to compete directly with those private laboratories. . . ."

Since that was a dam safety issue and we were doing a lot of dam safety work in our laboratory, there was a county [Westmoreland] near Pittsburgh contacted us and said, "Could you all do a model study for us of this structure?" Well, the problem, of course, that we face is that we are a government agency and there are also private laboratories, not that many, but there are a few, and I know I've always taken the philosophy of not wanting to compete directly with those private laboratories. I think there might be some regulations *against* us competing with the private sector.

The reasons for that is that the private sector has always argued that, "You, as a Federal lab, can purchase equipment, you have research monies, you have other ways to fund these projects. In fact, if you wanted to go out and compete against us in the private sector, you would probably *win* because you could bid lower." I'm not convinced that's true, because our costs aren't that cheap anymore. But the point is, is that historically we have stayed out of competition with either private laboratories or several good university laboratories here in the United States, because our intent is not to put them out of business, but to get *our* work done.

"In those cases where another laboratory cannot do the work or where we may have some expertise on board . . . where it's obvious that we could help an agency by providing our services, then we will get involved. . . ."

In those cases where another laboratory cannot do the work or where we may have some expertise on board, maybe some individual has a certain capability in our laboratories–that could be anywhere from cavitation to air venting on structures–where it's obvious that we could help an agency by providing our services, then we will get involved.

Reclamation Can Only Do Studies for a Non-Reclamation Project on a Cash-up-Front Basis

What we have tried to do is not work for engineering consulting companies, but the parameters that we've set in our laboratory is that if another government agency, say a county or a state, or a water district, some public entity asked us to do a study, and it's obvious that we are the best qualified to do that, then we can, if they will send us the money up front, we can do those studies. We also have some laws that say that we cannot spend money that we don't have. In other words, if it's not a Federal project, we can't go on the promise that we will bill them later and do a study for a private interest or for another public entity. So we have to go into a contract agreement where we say we need monies up front to build the model. Then we can get involved with it.

". . . less than 5 percent of our workload is for either international or outside groups . . ."

So all of that said, I would say that probably in any given year, less than 5 percent of our workload is for either international or outside groups, but we have always had that ability, and, through the Technology Transfer Act of 1986, we can work with private individuals. Say somebody comes and says they've got this neat idea on how to prevent evaporation off a reservoir water surface, and they want to try testing it in our laboratory because we have a big Federal laboratory.

Under law, we can go into an agreement with them, and we have to make sure we cover issues of patents and copyrights, but we can go into agreement where they can come in and use our facilities at minimal charges or no charges, but it has to be related to our mission, where Reclamation is going. In other words, it can't be some superfluous idea that has no relation to water resources in the West.

So there are several areas where we can work with the private sector, but you can get on thin ice real quickly if you get into a case where you look in a public document and you see where somebody once bids on a model study or proposals for bids on a model study. We have never put ourselves into a situation where, say, we were bidding against Colorado State University Laboratory or Alden Research Laboratory in Holden, Massachusetts, and we were one of several bidders on a job. The reason is is that that's not what we're all about.

Basically we should be doing Reclamation's work. We should also be available to the public. If there's a need for our laboratory and no other laboratory can do it, that's enough reason for us to get involved. The third one is, if there's some public agency that says, either another Federal agency or state or local, that comes to us and says, "We need your help on this," then we have often gone into agreements with those other public agencies to provide assistance in laboratory testing.

Cooperation, but Not Competition, with University Hydraulic Laboratories

So it's a case, as I said before, where it's a small percentage of our work, but it *is* out there and it's sort of in the interest of the public to be able to provide our services.

"We do have a state-of-the-art laboratory, both in instrumentation and equipment, as well as in the size, that can do a number of different studies. . . ."

We do have a state-of-the-art laboratory, both in instrumentation and equipment, as well as in the size, that can do a number of different studies. But it's *not* in our best interest to compete with private laboratories or particularly universities, because the future engineers that we need for laboratory studies are often trained in universities such as Colorado State, Utah State, University of Iowa, Washington State, Davis, University of California-Davis. So if we're taking work away from them, then they're not able to send out the graduate students that we are going to eventually need anyway.

So we work closely with them. Many times, in fact–at Colorado State University right now we've had a huge contract over the last three or four years on dam safety, where several hundred thousand [dollars] has gone up there to build an outdoor facility to do some testing of various concrete blocks for protection of embankment dams, and there's been three or four, maybe five now, graduate, master's degrees, maybe one doctorate degree coming out of that work. So in those cases we've cooperated directly with them. And, in fact, money has gone to those universities, that university, to help in development of some of our dam safety research.

But if you were in the laboratory today, we have one outside facility in the sense of not Reclamation, that we're doing for a public utility in Nevada, but all the rest of the work is Bureau of Reclamation work, and once in a while we'll do work for another agency such as U.S. Geological Survey or Park Service, one of those agencies.

Jackson: The last question before we conclude. Since you've been with the Bureau in the last twenty-some years, just without having a lot of statistics in front of me, I know there have been a lot of demographic changes, and it seems like Phoenix and Denver and Seattle have grown very rapidly, and there's also been an outflux of people from California moving to other parts of the West. I'm just wondering if there are any broad patterns there that fit within Reclamation's roles and assignments that they've worked on.

As the Population Urbanizes Reclamation's Role Shifts Toward Municipal and Industrial Water Supply as Well as Rural and Urban Water Conservation

Burgi: Well, to the degree that the public, the population is moving, that affects values, then Reclamation gets involved. Let me see if I can explain that a little bit more. For instance, when Hoover Dam was originally built, it was a water supply for irrigation downstream of Hoover Dam on the Colorado River, but also water supply for the city of Los Angeles, as well as power supply.

At the time, Las Vegas was a very small community, but, as we know, it's grown tremendously in size. So over the years, more and more water out of Lake Mead has gone to the city of Las Vegas. Las Vegas is just one example. You can look at Southern California. You can look at the Denver metro area or the Front Range and you see where public values have changed in the sense that more and more people are moving to the big cities, and some of that water has gone from irrigation uses to municipal and industrial use.

To the degree that that impacts on our structures, and, as I mentioned earlier, one of the great things that Reclamation has is this tremendous infrastructure which allows it to store and transport water, and as public values change and the use of water changes, Reclamation is in key position to bring about that change and help do it in a positive sense. That's why water conservation in Reclamation, I think, is such a big issue, and it's mandated by Congress that the agricultural interests do a better job of measuring their water and using it efficiently, because we don't produce water, we just store it and we deliver it.

". . . we're not developing a lot of new water projects. In fact, what we're really looking at is, over time, helping the public change the use of water. . . ."

But we're not developing a lot of new water projects. In fact, what we're really looking at is, over time, helping the public change the use of water. The numbers are often given that maybe 80 percent of the water in the West is used for agricultural purposes. I think over time that's going to go down and that percentage is going to raise, be higher for, urban uses and municipal and industrial. So to the degree that that impacts on how we operate our structures or even the type of facilities, for instance, I could see in the future where we might be putting larger pipelines for water delivery for municipal and industrial on some of our structures as compared to the open canals that used to go to irrigate fields.

So there *will* be those changes, and I think the infrastructure, although some of it has not maybe been placed in the best way in the past for environmental purposes, Reclamation in total has done a fairly good job of developing the West, and we as a country ought to be proud of the way that we have brought new lands, opened them up for development over the last sixty years. But that doesn't mean that there won't be need sometimes to *remove* a dam or change the purpose of that dam, and I think the advantage that we have in Reclamation is that as long as we keep our eyes open to what the public wants, and as long as the public can come to consensus on what they want, Reclamation's in a position where we have the ability to really assist our country as we change, in what we consider to be the most important uses of water.

". . . our mission and our charge has changed over the years. We obviously were a water development agency. We are changing to a water management agency. . . . to do that, not only do we need to find better tools for operating . . . our infrastructure, but in some cases we actually need to redesign and redevelop structures . . . to use them today . . ."

So I guess as I look at some of the younger engineers coming along, whether it's in the hydraulics lab or other parts of Reclamation, certainly our mission and our charge has changed over the years. We obviously were a water development agency. We are changing to a water management agency. But in order to do that, not only do we need to find better tools for operating our structures and our infrastructure, but in some cases we actually need to redesign and redevelop structures to be able to use them in a way that we need to use them today compared to what we may have used them for fifty years ago.

We must Recognize the Public Values That Drove Reclamation's Dam Building and That Those Public Values Have Changed and Reclamation must Change with Them

So, I guess I'm encouraged as I look at Reclamation's future and the potential for making, as we always have, I feel, made positive impact on society, and I think we really do ourselves a disservice if we try to degrade ourselves today because of trying to compare what we've done in the past with present-day values. I think it's very important that as we look at our own history, we not separate the values in the times that we were building Hoover Dams or the Grand Canyons or even the Glen Canyon Dam in more recent history, from where the public was. Sometimes we've not always been on the leading edge of that curve.

"I think Glen Canyon in the sixties was maybe the start of a sense by many of the environmental groups that we were building too many dams and we were building them in the wrong places. . . ."

I think Glen Canyon in the sixties was maybe the start of a sense by many of the environmental groups that we were building too many dams and we were building them in the wrong places. I'm still confident that we can change the operation of many of these facilities to meet many of the needs, though, that Reclamation and, in general, the public is going to have in the future.

So I'm not sure I answered your question. I talked around it a little bit.

Jackson: That's was a very insightful, interesting answer. I think we're at a good stopping point today. I am anticipating at least one more interview, but we'll confirm that. Before I turn the tape off, I just wonder if there are any topics that we've touched upon today that you would want to go back and revisit and clarify any points about.

Burgi: I'm not sure about that, but I think there are a few more topics I'd like to talk about. One of them might be what are some of the future areas that Reclamation's research and investigation, testing, ought to be looking at out on the horizon, and maybe a little on the philosophy of how do we in the laboratories look at the future, and what our role is in Reclamation.

Jackson: Okay. I'll certainly make a point to follow up on that. I'll turn the tape off.

END SIDE 1, TAPE 2. MAY 12, 1999.
BEGIN SIDE 1, TAPE 1. MAY 26, 1999.

Jackson: Today is Wednesday, May 26th[, 1999.] It's almost 8:30 in the morning. My name is Mike Jackson. I'm sitting here with Phil Burgi in the east side Conference Room of the fourteenth floor of the Reclamation Building, and this is the fourth interview now that Phil and I have done.

Phil, the question I'll start today's interview with is just to tell me about some of the different jobs you've had with Reclamation.

Rotation Program and Working in the Laboratory

Burgi: Okay. It's hard to remember from one tape to the next what we talked about, but, again, starting back in 1969, when I came with Reclamation, I went into this rotation program for about six months. They used to call it a rotation engineer cadre, where basically you were put into this position. You had a home base, but you were sort of available. If it looked like there was another place in Reclamation where you could better serve and that was of interest to you, then you could move to that position.

I think as I mentioned before, I started out with an interest in the laboratory ~~that had started~~. I've always *liked* the idea of working in the laboratory, and so even though I enjoyed my assignments, I came back, it would have been probably in January or so of 1970, back into the Hydraulics Branch, and really recognized then that that was sort of a quasi-permanent position. We were renting at the time, my wife and I, and we had a little baby girl. We decided to go ahead and buy a house and make Denver our home. So I had pretty well put my lot in with the twenty or so other engineers in the Hydraulics Branch at that time, and decided to make that my home base.

Worked on the Crystal and Other Model Studies

That was a very good start. I remember, as I said before, I think in [1973] ~~1971~~ I worked on the Crystal model study. I probably worked on a number of others in those years, different models that came up because of the new structures that were still being built. Crystal was one of those new ones, but then there was also some models. I remember doing a study on Canyon Ferry Dam stilling basin. It had some problems. We had materials coming back into the [stilling] basin. So I was assigned to do that study. Ridgway Dam is another *new* dam that was built up in the Colorado Rockies that I was involved in the model study for the outlet works for that particular structure. These were site-specific structures that I worked on.

Entered Reclamation's Manager Development Program

Then sometime there in '74 or '75, Danny King was the branch chief of the Hydraulics Branch, and he had encouraged me to go into this Bureau Manager Development Program. I didn't know that much about it, but it sounded like it would be an interesting program. Basically at that time it wasn't like you took an assignment somewhere else long term. It would last for like a year and a half, and you took some classes. You might go out for, say, three months at a time to different locations around Reclamation.

Organizational Development Seminar

I don't recall how the monies were received in those days or how they found money to do that kind of training, but basically I had a number of assignments. I remember going to the organizational development seminar, which was right here in Denver, and for a week you sit in a hotel out near the old Stapleton Airport, and had various people come in and talk. There were lectures on how organizations were developed and how various people fit into them. A lot of assignments that would be crazy things, like we were in different teams and we'd get a set of Tinker Toys and we'd see who could build the tallest tower. Or we had to do an assignment where we pretended that we had been in an airplane crash and we had twenty-five pieces of equipment with us. In order of priority, what were the most important things to keep? Do you stay with the craft site or do you go back? Actually, just a lot of work in team development, doing things together.

We had to go out and write a paper, and then we had to defend it before ~~other~~ team members coming from other teams, as to why ours was the best. Some of this, you learned a lot about your own character, and you also learned something about what you were able to do and what you weren't able to do very well.

I remember one assignment, actually it was probably one of my hardest ones, where we'd gone through as a team, and these teams would be maybe eight or ten people, working through a project all day, and at the end of the day we each lined up against a wall in the order of priority that we felt we had toward the team effort, whether we thought we were number one or number eight. That became a very difficult thing, because you were trying to determine what you thought your value was compared to someone else's. And, of course, everyone else was doing this. So you'd get in this line, and then the facilitator, who was in the class, would say, "Okay, now, all of you, if you don't think this is the correct order, then you go and move people where you think they ought to be."

This created quite a bit of friction amongst the group members, as you might expect. Somebody may have said they thought they were number one, and someone else may have come in and said, "Well, actually, I think you're number three," or number six.

The whole purpose, though, was to create some transparency among us and allow us to open up and see how we really acted under stress. Again, I felt I came out fairly good on that, not because I'm all that great of a person, but I think the Peace Corps experience was really good for me in developing maybe a little bit of a tough skin, but also an understanding that people really are different and there's a lot of diversity in people. We all bring different benefits and values to an effort, and some of those may seem to be more weighty than others, more important, but, in fact, they're all important. Some of them are just more showy. So that seminar was very good.

Spent Time in the Commissioner's Office

But in addition to that, we had a boy by then, too, as well as our little girl. They would have been about five or six years old. We went on a couple of assignments, and I probably don't remember the order correctly, but one of them was back to Washington, D.C., for a couple of months. I spent some time in the commissioner's office working in one of the departments, and, frankly, I don't recall even which one it was at this time, but it was in the Interior Building. I was assigned to work there for a few weeks.

Worked in Congressman Frank Evans's Office

I also spent probably three weeks in Congressman [Frank Edward] Evans's[9] office over on The Hill, and that was a really interesting assignment, where I actually was there. He was on one of the Water Resources Committees of the Congress. I wasn't doing anything that important, but I'd help them put some papers together or review documents, to see if I could help improve them. It was really an assignment, though, to get a better understanding of how the Bureau of Reclamation relates to Congress and what goes on in a congressman's office. It's sort of interesting, the number of people that come in. Some of them are lobbyists. Others are just Joe Q. Citizen coming in from some little city out in Colorado, wanting to visit Congressman Evans, maybe getting tickets to go in on the Senate floor or something. So those were really good experiences of understanding, from a Bureau perspective, how the Washington office worked and how it related to Congress.

Worked in Reclamation's Bismarck Office for a Time

I spent some time in the Bismarck office in North Dakota. The Garrison Project was going on at that time. We had conducted some model studies in the lab on some fish screens, to make sure that we were not ~~even~~ getting fish eggs into the water that was going into the James River, which in turn went up to Canada. That project, of course, has always had a lot of political problems, wasn't very well accepted in Congress, or certainly the Canadians did not like it.

Warren Jamison

I spent some time there with Warren Jamison (phonetic), who was the project manager or the head of the office, whatever his title was, sort of a fairly young, up-and-coming manager in Reclamation. Those were really good days. Basically on these assignments we'd just stay in a motel, and Kay and the kids would go and visit museums and things during the day, and then we'd have time to do things in the evenings and on weekends.

But the Bureau had a plane up there in Bismarck, and Jamison liked to go out to various public meetings and give the Reclamation story. I certainly enjoyed those days. Three or four of us would get into a plane and fly somewhere. Just to observe his management style was really a good experience for me. He gave me some assignments, maybe, "Hey, this is some of the issues we have going on in our office. Why don't you come back in another week to a staff meeting and let me know how you think we can improve things."

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9. Frank E. Evans was born in Pueblo, Colorado, in 1923, served in World War II as a patrol pilot, practiced law in Pueblo beginning in 1950, and served as a Democrat in the House of Representatives from January 3, 1965, to January 3, 1979. He was not a candidate for reelection in 1978.

"I remember giving one of those presentations, and his comment to me afterwards was, 'Well, it seems to me like you play things pretty safe. You're not telling me anything a whole lot new here,' which gave me a little bit more insight into myself . . ."

I remember giving one of those presentations, and his comment to me afterwards was, "Well, it seems to me like you play things pretty safe. You're not telling me anything a whole lot new here," which gave me a little bit more insight into myself again. I mean, yeah, I had some thoughts there of some things he could do, but they weren't earth-shattering. Warren Jamison was the type of person that didn't mind coming up with brand-new, earth-shaking ideas. I didn't feel, as an upstart manager–I wasn't even a manager yet– that I could go in with a lot of insight and tell him how to run his office. So there was that assignment.

Spent Time in the Regional Office in Boise

I also spent some time in the regional office in Boise, and this would have been in '76. My mother had died from a stroke that summer, actually while I was on the Washington assignment in the spring of '76. She had a stroke, became very ill, and three months later passed away. I remember struggling a little bit with going to Boise because this was shortly after she had died, but we went to Boise and actually rented a little house there. We were there for about six weeks.

Rod Vissia was the regional director at the time. Of course, during this period, in fact, we must have gone just shortly after Teton [Dam] had failed, because that was the buzz of the office up there. There were a lot of people in there trying to work through the details of how do we pay back people for damages to their livestock and to their farms because of the flood that occurred downstream of Teton.

I remember talking with–let's see. I don't recall the name of the planning officer that I worked for. But Rod Vissia, the day that Teton failed, that morning had been out on the golf course, and he'd gotten the word about it and, of course, responded immediately. But there was a young engineer that worked out, was like the chief engineer or the field engineer, for the teton construction, Bruce [Buckley.][10] ~~somebody. I can't recall his name fight now either, but he~~ He was very much bothered, of course, by this whole incident. My sense was, that always affected the whole rest of his career. He died a number of years later from a stroke, wasn't that old. I don't think he ever recovered from that experience of the failure of Teton.

10. Robert Robison was project construction engineer. During testimony before the Congress he identified Peter P. Aberle as the field engineer for the Teton Project. United States. Congress. House. Committee on Government Operations. Conservation, Energy, and Natural Resources Subcommittee. *Teton Dam disaster : hearings before a subcommittee of the Committee on Government Operations, House of Representatives, Ninety-fourth Congress, second session, August 5, 6, and 31, 1976.* Washington, D.C.: U.S. Government Printing Office, 1976, 242.

Of course, there's been many books and stories told about Teton, but Teton was in its initial filling process when it occurred. The reservoir was going up fairly quickly, and it was soon to have reached the spillway when all of a sudden there was this failure in the abutment material, where the joint between the embankment and the abutment was on the right side of the structure. And it failed.

"It struck me that this was built by an agency that *I* worked for, and that life was never going to be the same in Reclamation because of this, that we would always have people looking over our shoulder, asking, 'Are you really sure that this is a safe dam?' . . ."

I remember after my assignment there in Boise, coming back by Teton Dam, returning to Denver just in our car, and stopping at one of the oversight areas above the dam, and just looking down on it, and the awesomeness of looking at this beautiful new spillway sitting over on the right abutment and this embankment with probably about 25 percent of it gone on the right side, was almost too much for me to realize that not only had there been loss of life, but this was a tremendous engineering failure. It struck me that this was built by an agency that *I* worked for, and that life was never going to be the same in Reclamation because of this, that we would always have people looking over our shoulder, asking, "Are you really sure that this is a safe dam?"

"Of course, as things played out, the failure of Teton really did influence a lot of things in Reclamation. . . ."

Of course, as things played out, the failure of Teton really did influence a lot of things in Reclamation. Certainly we were not anymore the engineering agency that the early [settlers] ~~scientists~~ talked about, "We trust in God and the Bureau of Reclamation." We were not above making errors or mistakes. Teton could always be referred to as an example of that. It was an outstanding example.

Some of the things I noticed when I got back to the office was not only all the fuss over taking care of the damages, but there was a commission that was formed to review how does Reclamation go through good review, professional review of their engineering work, to make sure that we are building things safely.

"We developed a lot of . . . technical update lectures, where we invited experts from all around the world, particularly in the U.S., to come in and talk about construction of embankment dams. . . ."

We developed a lot of what we call technical update lectures, where we invited experts from all around the world, particularly in the U.S., to come in and talk about construction of embankment dams.

". . . a lot of soul-searching going on: how could this have happened? And what did really happen? And even amongst Reclamation employees, all kinds of different ideas on what did really happen. . . ."

What I would refer to as a lot of soul-searching going on: how could this have happened? And what did really happen? And even amongst Reclamation employees, all kinds of different ideas on what did really happen. There was some concern that maybe there was a freeze thaw aspect of this, that this construction occurred over two years and there were some ice lenses that formed. I remember several groups in the labs, one of them was Chet Jones and a few others, coming up with a theory that was a little bit different than the official theory as to how the failure occurred. So, quite a bit of discussion about that.

Views on Engineers Taking Their P.E. Exam and Keeping Their Registration Current

The other thing, though, that affected some of us was that as Federal employees, we were engineers, but people in those days, when I first came, anyway, '69, '70, I don't think there was a lot of pressure on you to keep your registration, the P.E. exam, as we referred to it, Professional Engineer's registration. Of course, this is granted by each state, and you get a license. You actually have to go pass a test and then you pay to get your license renewed. But there were many engineers that were not necessarily registered professional engineers.

As Assistant Commissioner Robert Jansen Pushed Getting Professional Registration

One of the things that [Robert] Jansen, who came in as assistant commissioner for engineering and research, and who was involved in this Teton Review Commission before he came to work for the Bureau of Reclamation, he really pushed this idea of getting professional registration.

". . . I'm . . . on a team where we've been reviewing again the need for professional registration, and this became something that became more important if you were going to be in certain positions in Reclamation, particularly here at the Denver Federal Center. . . ."

So even to this day, in fact, I'm just now on a team where we've been reviewing again the need for professional registration, and this became something that became more important if you were going to be in certain positions in Reclamation, particularly here at the Denver Federal Center. If you were in a position of, say, group manager or a branch chief or even a section head or the team leader of a design project, the only way you were going to get in that position was to get registered. There was a grandfather clause for a while that allowed you to stay in a position even if you didn't have the registration.

". . . getting that registration is something that's pretty important. So that was one of the things that came out of Teton. . . ."

So one of the impacts on the day-to-day level in Reclamation was raising the issue of professional registration, getting the exam, for instance. And for older engineers, this was somewhat of a problem because that was a very tough exam that normally, if you were going to pass it, you'd want to do it right out of college, not halfway through your career. For instance, now most of our young engineers coming on board, we really make this a priority, that if they're going to move forward in their career in Reclamation, and even if they would not stay in Reclamation, getting that registration is something that's pretty important. So that was one of the things that came out of Teton.

Worked in the Lower Missouri Region Where He Shadowed Bill Plummer, the Assistant Regional Director, During His Training Program

Also one of my assignments during this time was working in the Lower Missouri office, which was here in Denver. It was one of the regions, I think at that time referred to as Region Seven. I worked several weeks over in their office, shadowing around their assistant regional director, a gentleman by the name of [Nelson W. (Bill)] Plummer. I don't remember his first name. Mike? No, I don't remember. Plummer.

President Jimmy Carter's "Hit List"

In fact, it was at that time that President [Jimmy] Carter was in office and came out with his hit list, where his administration had developed this list of projects that were, in one form or another, ready to be authorized, or were authorized for construction, but some public interest group had decided shouldn't really be built. They [had] gotten to the Interior Department on this and President Carter.

". . . this was a big issue, because . . . one of them was the Narrows Dam, which was on the Platte River downstream of Denver . . . Basically it was not to be built, and this was creating a lot of problems for the regional office there. Of course, this was bread and butter for the regional office, and now the project was on this hit list. So there was a lot of . . . trying to figure out how do we best handle this, as far as not only our own future, but in telling the public where is Reclamation on this issue. . . ."

I remember this was a big issue, because there were ten or twelve dams, and one of them was the Narrows Dam, which was on the Platte River downstream of Denver, down near Fort Morgan somewhere. Basically it was not to be built, and this was creating a lot of problems for the regional office there. Of course, this was bread and butter for the regional office, and now the project was on this hit list. So there was a lot of–I remember the public information officer and regional director sitting down together, and a lot of other people, trying to figure out how do we best handle this, as far as not only our own future, but in telling the public where is Reclamation on this issue.

". . . there were times when Congress was really our best friend, not the administration. . . . if you were working with the Bureau of Reclamation and you wanted to see projects developed, much of that support came from Congress more than it did the administration. . . ."

I've always found it interesting in my years in Reclamation and Washington office, that short detail, the fact that we *were* part of the Executive Branch of the U.S. Government, worked for the president, but there were times when Congress was really our best friend, not the administration. What I mean by that is, if you were working with the Bureau of Reclamation and you wanted to see projects developed, much of that support came from Congress more than it did the administration.

". . . when I was there working up on The Hill, the fact . . . it took me a while to get my mind set in that mode that our real friends in Washington were not in the Executive Branch or in the Interior Department, but more than likely were congressmen that wanted to see this project built in their district. . . ."

I just remember this in our meetings back in Washington when I was there working up on The Hill, the fact that it took me a while to get my mind set in that mode that our real friends in Washington were not in the Executive Branch or in the Interior Department, but more than likely were congressmen that wanted to see this project built in their district. And whether you were in favor of this development or not, it became sort of an interesting phenomena that you had this official position that you had to go before Congress and say, "We really don't want to see this structure built," but inside you, you sort of felt good when a congressman would say, "Well, we think you ought to be building that project." So there was sort of this part of us that would say, "Yes, congressman, we really want to build that, but actually our official position is that we don't want it built." A little bit of a dichotomy going on in our thinking.

"So those were great years. Our family benefitted from some of this travel. . . . and as I look back . . . I recognize sometimes that I have a big-picture look that many of our folks don't have, and it's partly because of this opportunity that I had to be in this Bureau Manager Development Program. . . ."

So those were great years. Our family benefitted from some of this travel. We were able to see a lot of the United States. I certainly benefitted from the contacts I made across Reclamation, certainly a much better understanding for the rest of my career in how a regional office worked, how a project office worked, how the Washington office worked, and as I look back, and as I've had other people working for me, and moved up into a management position, I recognize sometimes that I have a big-picture look that many of our folks don't have, and it's partly because of this opportunity that I had to be in this Bureau Manager Development Program.

I look at that as one of the highlights of my career, is that opportunity to step back a little bit from my day-to-day work, and the organization was willing to put money into some training on my part, to help me to better understand what Reclamation was all about.

In 1979 Decided to Apply for a Detail to Peru on an Inter-American Development Bank Project

You want me to just keep going? What happened then after I came back to work in ‘76, ‘77, was I continued working on various model studies and research projects in the laboratory, and I tend to get antsy. I like to travel. I remember there was a detail–and this may have actually been before I took the Manager Development Program, sometime in my career there in the seventies. I was aware that the agency, HUD, Housing and Urban Development, was doing these flood map studies for communities where you delineated where the 100-year flood would occur along rivers, and then those people could buy flood insurance. There was an opportunity to go back on a detail to Washington for like a month, and I remember going and doing that for a month.

I think it was Danny King, my Branch Chief, was aware of the fact that I was a little hard to keep challenged some days. I certainly enjoyed my work, but it’s like I saw all these other things I wanted to do. The opportunity came up in ‘79 to go on a team down to Peru. The Inter-American Development Bank had put together some money for this series of irrigation projects in Peru. The government down there wanted to keep the people out in the country; they didn’t want everybody coming to Lima. So they were trying to come up with programs in the back areas of the country to encourage irrigation and therefore get the people to stay out in the country.

Inter-American Development Bank had given money to do this, but they wanted a independent group to come down and look over what the Ministry of Agriculture for Peru had put together on these ten projects. Are these viable projects? Could, in fact, you raise crops on this land if you brought water to the land? Are their cost estimates accurate? Could you actually build these projects for the cost that they’re talking about?

So through our International Activities area, they had put together a proposal that we would have a team of five people that would go down to Peru for some indefinite period of time, somewhere around two years, and work in the Ministry of Agriculture and actually put together sort of a peer review of these proposals that the Ministry of Agriculture in Peru had put together.

Well, I dearly wanted to get back to South America. The Peace Corps experience, we had the language and the culture. Our kids were probably in fourth or fifth or sixth grade, and we thought they could probably go with this and this would not be a big deal. So finally I made the decision that I would apply for the construction engineer’s job in Peru. They had a planning engineer, they had a soil scientist, they had a design engineer, they had a team leader, they had an economist, and basically those positions were all pretty well filled.

The only position that I could even be considered for was this construction engineer, of which I had no experience as a construction engineer, other than building some bridges in Chile in the Peace Corps. But I applied for the job and got it, I think mainly because I was a known product and I had Spanish and I could work in the culture. So I think they felt, well, this will help round out the team.

So basically in–when was that? Sometime in probably the fall or maybe the spring of '79, maybe February, we went down to Peru. We were given a housing allowance to find a place to live there, and we could move some of our furniture down. We actually set up housing down there along with these other five families, and became part of that team.

"I think Danny was a little disturbed that I would leave him after they had done this training with me, etc., but he never denied that opportunity that I had, and encouraged me . . ."

So I left the hydraulics lab. I remember walking out the door and saying to Danny, "Hey, I hope to come back some day. I really have enjoyed my experience here." I think Danny was a little disturbed that I would leave him after they had done this training with me, etc., but he never denied that opportunity that I had, and encouraged me, "Go give it a try. If there's an opportunity to get you back on board, we'll do that."

So I went. I remember leaving that day and feeling pretty distraught about, gee, what have I just done? I've left this laboratory experience and certainly I'm not going to be in Peru the rest of my career. How am I ever going to get back into the Bureau once this is over? Because there would be a guarantee that I could work somewhere in Reclamation, but no guarantee that I could be in the Denver Research Labs. So this was a pretty big decision on my part, and my wife Kay really supported me in it. Our kids, they didn't know what to think, because this was going to be quite a change for them. They'd never been overseas before.

Team Leader Was Sure the Peruvian Government Didn't Want the Team There

It had its good points and bad points. The team was an interesting group of folks. The team leader at the start was very paranoid; he was sure that the Peruvian Government didn't really want us there. He didn't speak the language. We set up offices in the Ministry of Agriculture, and we're talking about–most people wouldn't know this, but overseas, like in Peru, the ministry are very poor. So we were all in one big room, with a desk, just a good old metal desk, and sort of like a folding chair, almost, and that was our office. And there were six of us sitting there. We had trouble even getting pencils and paper. You'd go in to use the bathroom and there was no seat on the toilet. I mean, this was sort of the life. Very little wattage in the light bulbs. So we–

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Burgi: We actually had this team of people assigned from the Peruvian Government working with us, so they were also sitting in this office. We had two Peruvian secretaries and there were some technicians and some engineers working with us. Of course, these projects weren't in Lima; they were out in the country. We had some interesting characters on the team. I always found it interesting, because there was a couple Mormons on the team, there was a Catholic, there was an agnostic, a Protestant, a Baptist sort of person, and I was the Quaker. I used to go home and tell my wife, "I'm ~~sort of~~ the peacemaker in the group."

The Team Leader Was Putting in Time until He Could Retire

We were sort of all thrown together in this overseas experience. None of us really knew each other before this time, but we really formed a fairly close-knit team. We soon lost our team leader because he obviously was ~~sort of–his name was Larsen–sort of~~ at the end of his career, and I think they just put [him] in Peru as his last assignment, but he literally every day would draw an "X" across the day on his calendar in his office, meaning it was just one less day he had to be in Peru. He did *not* like the assignment. He felt that, as I said before, the Peruvians were after him, which wasn't the case, but he didn't understand Spanish, nor did he understand the culture.

The Team's Work in Peru

So eventually we had another Team leader come down by the name of Val Carter, and he led us then for the next year and a half. But we each had our assignments. My main job was to work a lot with the design engineer, who was Peter Hradlick, H-R-A-D-L-I-C-K. Peter, in fact, is still with Reclamation. He's been the team leader in Brazil now for a number of years. Doug Olson, O-L-S-O-N, was the planning engineer. We had Philip Gurion, who was our economist, and a guy by the name of Taylor as our soil scientist.

As I said, Peter and I worked quite closely together. One of my main jobs was to come up with looking over these cost projections. How much does it cost to remove a cubic yard of material along a canal? How much does concrete cost placed out in these remote areas? What kind of equipment did these guys need to build these canals, and how much would it cost to rent it?

So I ended up really putting together these cost estimates over a year and a half, and we actually presented some papers in Spanish at a conference down there. I know of one conference in particular that we went to, detailing some of our results. What we would do is on each of these projects we would come up with an analysis of the planning [and] ~~of the~~ soil. Could you, in fact, raise crops on these soils? An analysis of the design. Is it a competent design? And an analysis would be fed to the of the costs. So my figures economist, and he would come up with sort of a benefit/cost ratio. Then we would present these back to the ministry. That was really our job over the year and a half, was to write up a report on each of these projects.

"Peter and I traveled quite a bit because we needed to get out to these sites and see actually where they were built. That was another highlight of my career . . ."

Peter and I traveled quite a bit because we needed to get out to these sites and see actually where they were [to be] built. That was another highlight of my career, because, as I mentioned before, I liked to travel. We'd leave our families back in Lima, but Peter and I would go out. He never liked to be away from his wife very much, so if we went out for four days, we were fortunate as far as time.

Several of these, we would get on these little airplanes in Peru and fly up into some mountain town, and literally it would scare you half to death, because you had no idea how safe these pilots were, but you'd be looking from the airplane and you're looking down on this narrow valley and saying, "Oh my God, is this guy going to be able to land this plane down on that air field?" These were small jets, Folker jets.

He'd literally go in, in sort of a dive-bomb area or mode, and put a dog leg on the end of that thing and land it on an air strip. Then you start thinking, "Well, how are we ever going to get out of here now that we're down here?"

Usually we'd meet with somebody out in these sites, and there would be like a pickup, and they would take us to a hotel. I remember going into one hotel, the door on it was five feet high, and we just got a big joke out of that, that you had to really stoop over just to get into the hotel. Of course, these were very poor-quality hotels, certainly no Sheratons. These were like a person's house that maybe they wanted to rent out a room or two.

Sometimes Worked at 14,000 Feet Altitude and Some Sites Were Quite Isolated

But on some of these, we were actually working at 14,000 feet. The Andes are very high, and we were trying to get up to some of these dam sites where they planned to build a dam to store the water. So we would go out in a pickup, and then I know in one case particularly they had horses for us at the end of the road, and we got on the horses and we rode for two or three hours. Then we actually hiked from there up to some of these sites. So this took a lot of physical effort to physically get to some of these sites.

I remember one night we were up there. We'd take along food and just plan on camping at the site. One night we were laying there under a moonlit night, and this geologist, this Peruvian geologist was with us, and Peter could speak Spanish very well, also. His wife is Chilean, so he could actually speak Spanish better than I. We were talking about the project and all, and this geologist was sitting there on his bed, saying, "You know, I just can't believe that you two Americans are way up here working on this project with us. What causes you to do this?" So we got into this discussion about how we are a developed country and, yes, we want to be able to help people in other countries, and Bureau of Reclamation supports this type of effort.

Altitude Sickness Was an Issue Also

I remember the next day we were walking along, and we were really having oxygen deprivation. We had these little–oh, they were about eight-inch-diameter little tanks of oxygen, and we'd just periodically sit down and put on a little plastic mask and breathe in some oxygen. One of the young guys that was with us had to go back because he couldn't handle–they call it *soroche*, but in English it's just altitude sickness. He wasn't prepared for it.

So those were sort of like really fun things to do. At each of these, I think it was eight or ten different projects, anywhere from Tumbus, which is way up on the northern border of Ecuador and Peru, to Ayacucho, to Arequipa, a lot of different places in Peru. We visited those sites and basically wrote up our reports.

The Kids Were in an English-Speaking School

Then I remember one day we sort of were spending more money than we should have been. I think our cost–we had kids in school down there. Karen and Jonathan went to what was called the Roosevelt School, which was an English-speaking school that met U.S. requirements. You had anywhere from embassy students to Peruvians that had money, that wanted their kids to learn English, to go to schools in America eventually. So there was about 50 percent Anglos and other nationalities– not Anglos, but Americans and other nationalities.

They benefitted immensely from this experience. They certainly could learn to appreciate the United States a lot more after being in Peru, but they also benefitted just from being exposed to a different culture and the fact that meat doesn't necessarily come in Saran wrap in a Safeway store, but you go to an open market and there's flies and everything else around, and you get your meat. You have to cut it the way you can best fix it. To [recognize] ~~recognition~~ that illness and poverty are not that far away from all of us, and particularly when you're seeing this every day. So the life lessons that you learn, not only Kay and I, but our kids, it was a great experience.

Because of Political Unrest Soon after They Left, Many of the Projects Likely Didn't Move Forward

One of the misfortunes that happens is, in these developing countries, a lot of times things don't happen the way you'd hoped. Peru went into a real period of political unrest shortly after we left, in fact, and we had high hopes that these projects, I think probably 80 percent of the ones that we looked at, we approved. There are a couple of them that were very marginal, but the rest of them looked fairly *good*. They were going to use local labor, so they were going to bring a lot of work right into the local communities where these irrigation ditches would be built and where the pumping plants would be put in.

But this group called the Shining Light, a Maoist political group, became very much a part of the rural culture in Peru, and actually took over parts of Peru, to the point where even the supplies that we were going to be using for these structures, the dynamite and other things, were used against the government officials. So these projects were just put on hold. I couldn't say today, not having been down there, as to what the status of those are. My suspicion is that a couple of them, Tumbus Pumping Plant was under construction when we left, and I'm assuming that it probably is complete, but I'm sure there are other projects that never moved beyond the planning and the design reports.

Returned to the States in 1980

So in 1980, probably the summer of 1980, we returned to the United States.

Was Able to Return to the Hydraulic Laboratory in Denver

I had been in communication with Danny [King] and the Bureau here in Denver probably three or four months before this, saying, "Hey, looks like things are coming to a close down here. Is there any possibility of coming back into the labs?" I've always appreciated the fact that Danny was able to open up a position and allow me to come back to the hydraulics laboratory. I've always considered that a real privilege that I had, of being able to return back to my first love, which was the laboratory.

Danny King ". . . didn't hold a grudge against me going, and willingly accepted me back. I felt that some of the employees in the group at the time weren't real open to that, probably felt that I was being shown some favoritism. . . ."

He didn't hold a grudge against me going, and willingly accepted me back. I felt that some of the employees in the group at the time weren't real open to that, probably felt that I was being shown some favoritism.

Shortly after He Returned from Peru He Was Made Supervisor Over a Section Danny King Created for Him

It wasn't more than a month–well, maybe six months after I returned, that Danny actually created a third section. There were two sections before, and he created a third section for me to be a supervisor. I think he knew that I had had this management development training, and may have been concerned that I might take off again, and so I think he used this as a way to get me to make a more permanent decision.

"I sort of had an instrumentation group and had six or seven engineers assigned to me. . . ."

This wasn't received real well. I remember I applied for the job and several other people in the group applied, and I got the job. That was my first supervisory position, probably in '81. Tom Isbester, a good friend of mine, had also applied, and he told me out in the hallway, after he had heard that I'd gotten into it, he didn't think I could do it, and really felt– was really hurt by the way that whole process had worked. I felt that I *could* do it, and I set out to make it work. So there were three of us then that worked for Danny. I ~~sort of~~ had [the] ~~an~~ instrumentation group and had six or seven engineers assigned to me.

After Several Years as Branch Chief Danny King Decided to Work for the Assistant Commissioner-Engineering and Research

So that went along for a number of years, and sometime not too distant after that, there was a lot of reorganization going on in the assistant commissioner's office here in Denver, and Danny King decided that he had pretty well burnt out being the branch chief. I don't know, maybe he'd been in for seven or eight years. And decided to take a staff position under Darrell Webber, who was the assistant commissioner for engineering and research. His position was one that was created to do a better job of the finances in the Denver office, keeping track of project and how much money was being spent, and whether we were staying on budget. It was called the Management Information System, M-I-S.

"I could never fathom why he left the branch chief position, because I thought that was one of the best positions you could have in Reclamation. . . ."

I could never fathom why he left the branch chief position, because I thought that was one of the best positions you could have in Reclamation. I never understand and have never really asked him, but I almost felt some days like he felt he needed to move on so that some of the younger ones in the group could have a chance at being the branch chief.

Tom Rohne, as I mentioned before, was a mentor of mine. Much of what I've learned in the lab, I learned from Tom. When I came back from Peru and became a section head, I was his equal, and that didn't go over so well. I think he was also bothered by the fact that I was so young and here I was a section head, and Tom had earned his stripes over years before he became a section head.

Decided to Apply for the Branch Chief Job

Well, anyway, he decided that he wasn't going to apply for Danny's job, and Jim Carlson was too old to do it. He wasn't interested. In fact, he may have already retired by that time. I really wasn't interested. I was just new as a section head. I'd only been in that position for a year and a half or so, but I heard rumors about other people who were going to apply for the job, and I decided that I wasn't sure I really wanted to work for some of them, and that maybe I'd better seize this opportunity and at least not kick myself for not applying for the job.

April 1, 1984, Was Selected as Branch Chief of the Hydraulics Branch

So I put in my name. I threw it into the hat. I think for nine months the Bureau at that time was really having trouble making decisions. I'm not sure whose fault that was, whether it was reorganization of the Reclamation at the time or human resources, but I think for nine months Tom Rohne and I alternated acting as the branch chief, and finally in 1984, I think it was April 1st, in fact, 1984, I was selected as the branch chief of the Hydraulics Branch. At that point that was a GS-14, and I really felt good about that. I recognized that I had a tremendous responsibility, but I spent this whole career of mine getting to this point. I think I said earlier on the tape that I once told Danny that I'd like to have his job. So I had arrived in 1984. This would have been about fifteen years after I'd started with Reclamation.

I remember thinking, can I ever influence this group like Bill Wagner and Harold Martin and Danny King had influenced it? And what would be my legacy as branch chief of the Bureau of Reclamation's Hydraulics Laboratory? I didn't have a lot of confidence that I could do much other than just try to create an environment where engineers could get their work done.

"I promoted Tom Rohne to a senior technical position, and put Cliff Pugh and Brent Mefford in as my two Section Heads. So we went back to two sections. . . ."

I promoted Tom Rohne to a senior technical position, and put Cliff Pugh and Brent Mefford in as my two Section Heads. So we went back to two sections.

"I had brought in these younger folks that I really felt could go into the future with me, so that was sort of my team. . . ."

I had brought in these younger folks that I really felt could go into the future with me, so that was sort of my team. When I look back on it, that's been fifteen years now. They have served well in those capacities. We have brought in a lot of new young engineers with a lot more capabilities in numerical modeling and in computer capabilities and instrumentation.

I haven't sat down and counted, but I may be one of the few–well, in fact, I'm the only one left in the group now that was in the group when I started in '69, so I have this bridge to all these older folks that sort of trained me as a young engineer, and then I know all the young ones that are here now. I'm one of the few, because there were so few hired in those days, in '69 and '70, that know the older engineers and yet bridging into the future with the young ones.

". . . we've hired a number of younger engineers, and I've sort of had the philosophy of trying to bring in people with master's degrees, because I feel like the master's degree is almost a necessity to do some of the research that we're doing in these days. We also now have two people with doctorate's degrees on the staff . . ."

Over the last number of years we've hired a number of younger engineers, and I've sort of had the philosophy of trying to bring in people with master's degrees, because I feel like the master's degree is almost a necessity to do some of the research that we're doing in these days. We also now have two people with doctorate's degrees on the staff, so there's things like this that I really have felt good about. Whenever I decide to retire, I feel like we have a technical staff and a team that really can do about anything that relates to fluid mechanics and hydraulics that we would ask of them.

"We have several with mechanical backgrounds, as well as electrical, and, of course, the main is the civils. . . ."

We have several with mechanical backgrounds, as well as electrical, and, of course, the main [field] is the civils.

Reduction in Force in 1994 under Leadership of Commissioner Dan Beard

The other experience in this long career story is, in 1994 we went into this reduction in force, really reorganization of Reclamation. In fact, Vice President [Albert] Gore [Jr.] gave us the Hammer Award for hammering ourselves so well, as I refer to it. But this was when Dan Beard was Commissioner.

". . . we lost a lot of our senior members to retirement. . . ."

I'm not sure what his motivations were, if he was trying to close down Bureau of Reclamation or if he was just trying to streamline us, but he almost cut our head off, in the sense that we lost a lot of our senior members to retirement.

"There was this tremendous reorganization . . . and the Denver office was no more in charge of Reclamation. It may have never been in charge, but, technically speaking, the Denver office had always had the final say in anywhere from dam safety issues to contracts, to the design aspects of building large structures. . . ."

There was this tremendous reorganization, a real change from a chief engineer, and actually the assistant commissioner of engineering and research was a change from the chief engineer, but then we even went another step, and the Denver office was no more in charge of Reclamation. It may have never been in charge, but, technically speaking, the Denver office had always had the final say in anywhere from dam safety issues to contracts, to the design aspects of building large structures.

Area Offices Took a Central Role in Management of Reclamation in 1994

In 1994, the area offices actually took over the driver's seat, so to speak, of the Bureau of Reclamation. The area offices were given the authority and the money to carry out Reclamation's mission, and that mission, of course, has changed over the years, as we said before, from development to one of management of the water resources.

Dan Beard Changed Reclamation's Mission and Constituencies

We use the language, and I don't disagree with it, that our public values have changed, and therefore Reclamation needs to change. Unlike the Bureau of Mines and maybe some other agencies that have gone by the way, one of the things I give Beard credit for is that, for good or worse, he's moved us from an agency that was involved in a lot of development to an agency now that is moving toward water management. Actually, this has affected us in many ways.

". . . we've actually asked the districts to do a better job of accounting for water

and to pay for the water on irrigation projects. So some of our old buddies, so to speak, are no longer our friends because we're asking things from them that we've never asked for before or we never were serious about. . . ."

We ~~are~~ no longer [have] the constituency that we had with some of the congressional districts and some of the irrigation districts aren't so much our friends anymore, because we've actually asked the districts to do a better job of accounting for water and to pay for the water on irrigation projects. So some of our old buddies, so to speak, are no longer our friends because we're asking things from them that we've never asked for before or we never were serious about.

We always have had a small constituency because we've only been in the Western U.S., but we've even lost some of that now because some of our western supporters see us as just another Federal agency that wants to carry out a political agenda and not necessarily to their best benefit.

". . .I think Reclamation still has a tremendous future. We have an infrastructure that is sort of the nuts and bolts of the western water supply . . ."

"We have an infrastructure . . . We'll never be able to sell that to the states or give it away to private enterprise, in my mind, because Reclamation is a Federal agency and we have Federal interests on all these western rivers that go beyond states' interest or local interest. . . ."

Having said all that, I think Reclamation still has a tremendous future. We have an infrastructure that is ~~sort of~~ the nuts and bolts of the western water supply, and whether we're talking about water supply to the city of Los Angeles or power for Las Vegas or water-quality issues on the Colorado River or the Sacramento, or fishery issues in the Northwest, the infrastructure that we have developed is the key to solving those problems, in my mind, because it's that infrastructure that is what makes water flow in the West. We'll never be able to [pass] ~~sell~~ that to the states or give it away to private enterprise, in my mind, because Reclamation is a Federal agency and we have Federal interests on all these western rivers that go beyond states' interest or local interest.

Reclamation's Work Now Tends to Be on Existing Structures Rather than Building New Ones

So I think that, as I talk to our younger engineers, that, yes, our work is changing. Where we used to put in spillways and waterways in our laboratory, now we're dealing more with fishery structures. In some cases we're doing dam safety work, so we're still doing some spillways and outlets, but it's more in a "fix it" mode than it is in new structures.

Reaction to Reduction in Force and Reorganization in 1994

I want to get back, though, to '94 for just a moment and talk a little bit about my own experience in going through this reduction in force, and it's a long story that I'll try not to go into all the details. Basically everything that we were doing in the Denver office on the engineering and research side was questioned. What I mean by that is, every group was asked, "Are you still needed? Do you still serve a function? How can we organize you differently? Can you show to these various [review] teams that were set up that you really have enough work to get you through the next couple of years?"

The Technical Service Center, as we were now called, is going to be a cost-reimbursable, which means that we don't have some big budget that we can just charge time to, but every project has to–everything we do we have to be able to pay for, or at least up to 80 percent of our work. Maybe the other 20 percent would be on overhead numbers.

So we went through a real process internally of reviewing, sort of a peer review, of each of our groups. First of all, we had to say, "Okay, how many of these organizations around the Denver office do we still want to go into the future? How are we going to organize them under various disciplines? Are we going to keep the research office separate?" In other words, for years the research and laboratory group across in Building 56 was a division, just like the Division of Design, and we had our own division chief. We sort of had our own world over there. We had budgets to do the things we wanted to do.

"I was one that tried to lead us into an organizational structure that would keep us independent. In other words, I really believe that we were better off to stay as a research group or division, because we had this common interest in that we have facility needs, we have instrumentation. Our approach to how we do our work is different than a design group is. . . ."

The research groups, there's five or six groups now that came into the new organization. I was one that tried to lead us into an organizational structure that would keep us independent. In other words, I really believe that we were better off to stay as a research group or division, because we had this common interest in that we have facility needs, we have instrumentation. Our approach to how we do our work is different than a design group is. We have more interest in professional involvement in various professional organizations than the design groups have ever had. We had just a different way of thinking about our personnel actions, our awards. Many of the things we did were quite a bit different than the other divisions.

In any case, we lost that battle. I say we lost it in the sense that the final decision by a team of three, which was Felix Cook and Bill McDonald and Don Glaser, was that we would set up the Technical Service Center in five or six discipline areas. We would call one civil engineering; we have an environmental; we'd have an infrastructure which was basically electrical, mechanical. We would have a geotechnical group. We would have a water resources group. These would be the groups that–call them divisions or whatever. These would be the discipline areas that we would put the various groups under.

We came up with forty-two groups, and we put them under these various disciplines. For instance, groups like concrete dams and waterways and structural and architectural groups out of the old Bureau of Reclamation went into now what was called the Civil Engineering Division or discipline.

Felt the Civil Engineering Division Was Not the Right Location for the Hydraulics Laboratory

One of my big decisions was, what are we going to do with our old hydraulics laboratory? Many of the people in the engineering group said, "You've always worked with us in spillways and outlets and in waterways. Why wouldn't you come under us in the Civil Engineering Division?"

Well, frankly, I had a problem with that. I had a problem with the selection of who was going to be the head of the civil engineering group, but I think more importantly I had a problem with us being pigeonholed into a future that dealt with structures, when I really felt that we *were* moving more toward water resources management in a much broader sense.

"So we changed our name from the Hydraulics Branch to the Water Resources Research Laboratory. We *chose* to go with the water resources folks. . . ."

So we changed our name from the Hydraulics Branch to the Water Resources Research Laboratory. We *chose* to go with the water resources folks. What that meant was that most of the people that we're connected with in our new organization–

END SIDE 2, TAPE 1. MAY 26, 1999.
BEGIN SIDE 1, TAPE 2. MAY 26, 1999.

Jackson: Today is Wednesday, May 26, 1999. It's about 9:40 in the morning. This is tape two of today's interview with Mike Jackson, the interviewer, and Phil Burgi. Phil, you just began talking about the name change from Hydraulics to Water Resources.

Burgi: Okay. I'll just pick up at that point. The name's almost too long: Water Resources Research Laboratory. WRRL, we refer to it. It probably better describes where we fit in the organization than Hydraulics Branch. I'll explain that a little bit more. As I mentioned, we've sort of thrown ourselves with a different group.

I think one of our problems has always been that we're a technical discipline, but we're not a functional discipline in the sense that we don't do just design drawings. The closest we come to a functional discipline is that we do physical laboratory model studies and we also do field testing. So we work for the civil engineering groups. We work for the mechanical. We've done some testing on turbines and gates. We have a lot of different clients within Reclamation, and so we were not easily placed in any one of these groups. But as it worked out, it seemed like we were closest to the water resources group, and so that's where we placed ourselves.

So on the new organizational chart, the old Research Division has various laboratories in each of the disciplines. In civil engineering, for instance, you have the materials laboratory, the old concrete laboratory. In the geotechnical discipline, we have the soils lab. In the infrastructure area, we have the power lab, the electrical power group. In water resources, we have our laboratory. In the environmental discipline, which is one I forgot to mention earlier, we have anywhere from the chemistry lab to some of the environmental and fisheries groups.

So one of the disappointments in the new organization, from my perspective, is that we have spread the disciplines of the old research and laboratory groups across all the new disciplines. That's not all bad, because now we have sort of a voice in each of these disciplines. The head of civil engineering, for instance, has an interest in the laboratories because he has a group called the materials laboratory over here, the Materials Engineering Laboratory.

Feels Research Has Lost Status Within Reclamation

The down side of it is that we have no voice for research and technical services in the sense that even though we have now a research office, which I think is very ably run by Stan Ponce, he reports to Steve Magnussen in Washington, and he comes to the various research groups as well as to the regional offices to get his research work done. But we don't have the continuity where we have somebody in charge of Building 56, in the sense that when we need to look at dollars we need for laboratory equipment, there is no one that makes that decision. Each of the various discipline leaders, the leadership team, looks at their own group and tries to decide how to fix a budget for them. But we've lost what I might call the political clout of a research group that had some power in the older organization.

The up side of that is that I have felt, at least in the water resources area, under Jim Pierce and under the other leadership team people, they do recognize the importance of the laboratories and the equipment that we have, and that we have been given budgets to support our work. So when I look back from '94, over the last five years now, I think that part of the system is working, and so I'm not discouraged about that.

The 1994 Reorganization Removed Management Layers and Flattened the Organization

The process of getting down in the number of people during the actual reduction in force was an interesting experience, and some of us have lived to tell it. (Laughter) Others just retired. But there *was* an effort to decrease the number of middle-level managers and to make the organization much more horizontal and not so vertical in the number of layers. All that to say that now I don't think there are any managers that have less than twelve people, and most managers more than that, some as many as twenty-five, that report to them. I'm talking about the group managers now, maybe the forty groups that we have here at the Technical Service Center.

What that means is that each of us have the responsibility from a management supervisory perspective of keeping track of training and whether people are charging to the right numbers, whether they're available to work on a team, looking at our resources, our equipment, for instance, in the laboratories, safety issues. Where I used to, as a branch chief, have two section heads that helped me in the leadership of the branch, now that falls on my shoulder. I now have nineteen people plus the laboratory shops, which is another eight. Fortunately, there is a foreman, a very able foreman, Mike McDonald, that, on the day-to-day basis, takes care of those eight craftsmen.

". . . getting down in the number of managers was done in some ways in a very, I think, well-organized way by offering early out and buyout authority. . . ."

But getting down in the number of managers was done in some ways in a very, I think, well-organized way by offering early out and buyout authority. Many people had the opportunity to leave Reclamation back in '94 and were given a bonus of [$]25,000 to leave. Several of them were ready to complete their career with Reclamation anyway, and so for them it wasn't that big of a decision. They took the [$]25,000 and left.

". . . I was under 55 at the time, and I could have taken a buyout at a reduced salary, but I was young enough in my career and I really enjoyed what I was doing with Reclamation, and felt that there was a future, that I decided to stay. . . ."

For others of us, in my case I was under 55 at the time, and I could have taken a buyout at a reduced ~~salary~~ [retirement benefit], but I was young enough in my career and I really enjoyed what I was doing with Reclamation, and felt that there was a future, that I decided to stay.

Told His Position Was Now a GS-14 Rather than a Previous GS-15

I was a GS-15 at that time as one of the group managers, or one of the branch chiefs over in the Research Division. I, as well as three or four others in the organization, were told that that position was no longer available, at a 15, and that I could be a 14 and I would have pay retention for two years, basically sort of a feeling of, "Well, that's all right if you want to stay, but we just want you to know that you're not worth as much to us as you may have thought or that Human Resources may have classified you as in the past. That position no longer needs to be filled by a GS-15."

"That has been something that I've had to deal with over the last five years, and I think it's a thorn in my side that I've just learned to live with, and it's not because

of the pay. I couldn't tell you exactly all of my feelings on that, except that it's sort of a feeling that I'm not as important to the organization as I once was . . ."

That has been something that I've had to deal with over the last five years, and I think it's a thorn in my side that I've just learned to live with, and it's not because of the pay. I couldn't tell you exactly all of my feelings on that, except that it's sort of a feeling that I'm not as important to the organization as I once was, that a group of Human Resource classifiers at one time decided that the work that I did was worthy of a certain grade level in the new organization that the work that I do is not worthy of that grade level, and, in fact, from my perspective, the work that I'm doing now is far more than what I did before. There's something wrong in that way of identifying how we classify positions.

". . . there is this tremendous pressure from the leadership team to keep equality in the groups. . . . so many days for training, so many days to attend professional meetings. One of my problems with that is that we are not equal in our value to the organization in what we do. What I mean by that is that there are some groups that do more field testing and they need more monies for that type of equipment. There are other groups that are involved more in professional meetings and in sharing research results than some other groups. There are some groups that need more training than other groups. . . ."

There are several other things going on in Reclamation right now that are somewhat bothersome, but in the classification area, how we define who a research-grade engineer is, some of the decisions that we make, my sense sometimes is that in order to keep our groups more or less equivalent, if I can use that word, where we're only supposed to have one secretary and one technical specialist and whatever else we put upon ourselves, there is this tremendous pressure from the leadership team to keep equality in the groups. We each have so many days for training, so many days to attend professional meetings.

One of my problems with that is that we are not equal in our value to the organization in what we do. What I mean by that is that there are some groups that do more field testing and they need more monies for that type of equipment. There are other groups that are involved more in professional meetings and in sharing research results than some other groups. There are some groups that need more training than other groups. My sense is that we have gone into a mode of management that says that we're all created equal. Maybe "created equal" isn't the right word. That we all are due the same amount of staff days for the functions of training, attendance at meetings, all these other things that groups do, and I guess my sense is that we're not equal.

"We do different work and we ought to be celebrating that difference. We may have, in fact, some people that ought to be a technical GS-15. Maybe they're a super scientist. And we have no capability to do that anymore . . ."

We do different work and we ought to be celebrating that difference. We may have, in fact, some people that ought to be a technical GS-15. Maybe they're a super scientist. And we have no capability to do that anymore because we have placed rules and sideboards on our organization that limit that.

". . . we will recognize that we're headed toward mediocrity in our employees if we don't change the way we operate, that we need to recognize there are some people that need to be exceptions, and that we're thankful to have them on board. . . . They're recognized on the outside. . . ."

So I think that eventually the Technical Service Center will see the light and that we will recognize that we're headed toward mediocrity in our employees if we don't change the way we operate, that we need to recognize there are some people that need to be exceptions, and that we're thankful to have them on board. I'm not thinking of myself; I'm thinking of people such as some of our fisheries people and others that are doing just exceptionally great work. They're recognized on the outside. We have [to] sometimes properly [recognize] ~~recognizing~~ them within the TSC.

So getting off of that little subject, I do think that Reclamation has a lot of areas that we have tremendous staff here at the Technical Service Center, whether it's in the research and laboratory services area across the street or whether it's some of our engineers and scientists in this building. I'm convinced that we have a mission for the future in water management, and that we have the people to carry that out. My only concern sometimes is that we don't mess it up with some of our management tools that we use. But again, I have great confidence that we will see the light, and these days we'll look back on and say, "There's some things we learned from this that have helped us as well as maybe curtailed some of the things that we could be doing."

Making the Reclamation Laboratory Available to the Public

Technology Transfer Act

Let me talk for a moment about patents and how that works, because that's a part of what we do over in the research and laboratory area also. We do some development work, and we have the ability–well, a couple of things. There was this 1986 Technology Transfer Act that was a government–well, I guess it was a law that was passed, that basically said that the Federal laboratories could be a resource to the general public, that people could come in and work in those laboratories. There could be these cooperative agreements written that would allow people to come in and work and develop technologies, and that there would even be ways to share the royalties of some of the licensing that might come off the patents.

Patents and Licensing Agreements

So, particularly in the last ten years, the research laboratory across the street has gotten more involved with patents and licensing agreements, and people from outside Reclamation even coming in and working and using our test facilities. So this has been a real plus.

Cooperative Research Agreements

There have been ways that we have worked out agreements with people outside of the government, called Cooperative Research Agreements, that actually just the research director can sign off. We don't have to go through all the procurement processes and the legal contract aspects that we've had to in the past.

But in the patent area, what we have to do there is to determine, as we're doing a study, are we developing something that is really unique in our technology? Probably the best way to do this would be to give an example. I'll give you an example of one that didn't work because of some mistakes we made. This would have been fifteen years ago, before the Technology Transfer Act, which that has clarified some of these things tremendously.

Tom Isbester and Development of the Clam Shell Gate

The clam shell gate was a development in the laboratory. The concept came from [an engineer] ~~a fellow~~ I mentioned before, Tom Isbester, I-S-B-E-S-T-E-R. He came out of a mechanical background. That was his education, but he was a civil engineer in the sense of what he did in the laboratory, worked on a number of different laboratory models over his career and did a lot of field testing and worked quite a bit with gates and valves. That was his forte.

"Tom had this idea that . . . you could come up with a design of a gate on the end of a pipe that would have a discharge coefficient of 1. What that means is that basically there would be no loss of energy as the flow went through at the end of that pipe. Most of our valves, like a jet flow gate, has a restriction. . . ."

Tom had this idea that in addition to the jet flow gate and some of the other gates and valves that were developed, that you could come up with a design of a gate on the end of a pipe that would have a discharge coefficient of 1. What that means is that basically there would be no loss of energy as the flow went through at the end of that pipe. Most of our valves, like a jet flow gate, [have] ~~has~~ a restriction. You might get 80 percent of the flow through that gate or that jet flow gate, as compared to just having an open pipe at the end.

What the clam shell was, is a design, if you can imagine was just like a clam shell that you see sometimes like on a crane that picks up dirt, [where] ~~whether~~ you've got two sides that come in and just pick up the dirt. If you put this on a horizontal plane, the clam shell would fit on the end of a pipe, and when it closed, the two partial gates would come together in the center and seal. When it was open, it would completely open and expose the full diameter of the pipe so there was no structure in the way of the flow just exiting the pipe, with no losses.

The challenge of this design was in the seal and in the mechanism to hydraulically open and close it. Tom [used] ~~spent–I think it's~~ an eight-inch, either six- or an eight-inch model that we have over in the laboratory, that's still on display, where he did this development work and came up with an idea of how to make the seal. It went through several iterations, and probably the ones that we build now has a little different seal design than what we originally had in the laboratory.

But the concept came from Tom and him working with other people in our laboratory, including people like Mike Colgate, developed this. Now we actually have these gates, clam shell gates, installed at several projects. One's down on the Salt River Project, probably a 60-inch clam shell gate. We have another one, and it slips my mind right now, up in Wyoming. That's the first one we put in. Grassy Lake. It's a 30-inch clam shell gate. We're talking about putting even 90-inch ones, up to a 90-inch clam shell gate, on Arrowrock Dam up in Idaho.

"The advantage of these gates, you can pass a tremendous amount of water through them, so you get by with smaller pipe than you would with a jet flow gate. We can operate them submerged or free to the atmosphere, and that's quite an advantage . . ."

The advantage of these gates, you can pass a tremendous amount of water through them, so you get by with smaller pipe than you would with a jet flow gate. We can operate them submerged or free to the atmosphere, and that's quite an advantage, because they are sometimes downstream of a powerhouse or something, where you want to put a bypass. There's advantages to discharging that below the water level. You don't have the spray, you don't have some of the other issues that you're dealing with, with an open free jet going out into a plunge pool. There's cavitation that can come off of these, but the cavitation occurs out away from the gate and, therefore, doesn't cause any damage. It may make some noise, but if it's properly designed, it will not create any cavitation damage to the clam shell gate. The Japanese have been very interested in this as well, and I wouldn't be surprised they have developed their own clam shell.

". . . when you go for a patent, there's really a way you have to go through the process that is the right way . . ."

The down side of this whole story is that when you go for a patent, there's really a way you have to go through the process that is the right way and maybe the only way. For instance, you can't publish in any way or share your notes or the theory with people within a year of the time that you go for application for a patent.

One of the problems we had back in these days when this was being developed was that we really didn't understand the process that well, so I think in some of our little news research articles that we would put out in the labs, we would talk about this clam shell gate and that we were working on it, in some ways we let that out to the public too soon, and when we went to do our search, we weren't able to completely–we have a patent on the clam shell, but we don't have exclusive rights to it.

Reclamation Currently Has a Patent on a Concrete Protection System for Embankment Dams

Tom Isbester, I don't think has the exclusive rights that he would have today. I'll probably have to research that a little bit more, because I may not be totally correct on some of this. But I do know that a patent today, if it's properly put together, and we have one now on–switching gears here, on a concrete protection system over embankment dams, that if you have a flood over an embankment dam, you can put this on ahead of time. It's a concrete block overlay, sort of like the shell of a turtle, and these blocks are placed one over another. As water flows over them, it actually creates somewhat of a suction and pulls the concrete toward the embankment and protects the surface as the water's going over it.

We have three people in our group that have put a patent on this one, and it's Kathy Frizell, F-R-I-Z-E-L-L, Brent Mefford, and Tracy Vermeyen, V-E-R-M-E-Y-E-N. They have this one properly patented and we're in the process now of trying to market it.

On Patents Involving a Federal Laboratory, a Percentage of Revenues Goes to the Laboratory and a Percentage to the Developer(s)

I don't have these numbers totally correct, but I think that in a Federal laboratory now all the monies that could be earned off of the sale of these concrete blocks, something on the order of 40 percent could come back to the laboratory that developed the device, and maybe 10 percent to the people that patented it.

We have a fellow on the research office staff, Don Ralston, who is in charge of this part. He works for [Dr.] Stan Ponce, used to be with the Bureau of Mines, and he talks about there are some people in the Bureau of Mines that are now millionaires because of the royalties they have received from the patents on some work technology that they've developed.

"So the patents . . . The way that tends to work in a Federal office is that we have a lot of work we're trying to do, and none of us have a lot of time to just sit around and daydream about patents. So we don't develop that many . . ."

So the patents are one way that Federal employees, I guess, could become millionaires. The way that tends to work in a Federal office is that we have a lot of work we're trying to do, and none of us have a lot of time to just sit around and daydream about patents. So we don't develop that many mainly because they're just not funding us to set aside and say, "Well, today I'm going to work on this idea that I have to patent."

The most easy way for us to do that is if we have research funds that we get from [the research office] ~~Stan Ponce~~ to develop new technologies, whether this is for water measurement or dam safety issues. In the process of developing that new technology or that instrument or whatever, we work early on with Don Ralston these days, and he ~~sort of~~ gives us guidance on what is the process that we need to go through to make sure that this item is patentable, that the patent search is made.

One of the big problems is, you can have a very nifty device, but how do you market it? How do you get a manufacturing company to decide that they want to build 10,000 of these or maybe only 100 if it's some device that doesn't have a lot of market? So the patent process is an interesting part of what we do in the research labs, but it's a small–I would say that the majority of the staff over there really don't get involved with patents that much, and when we do, it's been so long since we were involved the last time that we really do need to go to somebody like a Don Ralston to get help, because we're not just turning out patentable-type products on an annual or monthly or biannual basis. But it is a part of what we do in the research laboratories.

". . . we do the project-specific work where we do a model study, . . . but we do research and we also . . . conduct field tests . . ."

I do often refer to the research laboratories as Building 56, because not only do we do the project-specific work where we do a model study, for instance, of a Folsom Dam, but we do research and we also, as I mentioned before, conduct field tests where we actually go out and respond to emergencies or there's some problem that's developed and the area office says we need somebody to come out and put some instrumentation on this gate and decide why it's vibrating. And usually the project is more than willing to pay for that because they want to solve the problem.

"We do more than just laboratory work and we do more than just research work. We do what I refer to as technical services, which may be no more than consulting. . . ."

My point is that because of the testing that we do in the laboratory, we have developed a protocol and procedures for testing that allows us to go out in the field and test on our facilities. It doesn't matter whether I'm talking about the electric power group or the hydraulics group or the environmental scientists across the street or the materials. We do more than just laboratory work and we do more than just research work. We do what I refer to as technical services, which may be no more than consulting. Somebody may call in and say, "This gate is doing this. Is this okay?" And our experience oftentimes allows us to say, "Yes, that's fine," or, "Well, this sounds like you've got a problem and maybe we ought to send out a couple of people and do some measurements and check it out." It's almost like a Maytag service person that is available to go out and look at a problem.

The reason we have that capability more than some other organizational groups within the Technical Service Center is that it's sort of the lay of the land that we work with on a normal basis, and that's why, as I said before, there's something about a research laboratory environment that's different than some of the other functions in the TSC. One of the things I still miss is the camaraderie we had when we had a Research Division, because we had people coming together. We're problem-solvers, and looked at physical testing and numerical equations and theories to come up with solutions.

So that's sort of my story on patents. I think in our laboratory right now we probably have three or four. There's other groups. The desalinization group in some of the work that they've worked on, people like Andy Murphy have produced many more patents just because of the way that these can be turned around and used out in the industry more than in the area that we work in.

Jackson: I've got ten minutes after ten. I think we're wanting to wrap up at 10:15. Are there some topics that, because we're running short on time, are still in your mind and you want to get on paper?

Burgi: I think the topics of who were some of the commissioners and chief engineers and maybe the research directors that I've worked under, and some of the stories related to that would be of interest. There's also some more human stories that I can tell. One of them deals with a fellow by the name of Bruce Moyes, M-O-Y-E-S. One of them deals with a couple of situations in our own group, where one couple actually split up and another one actually found a marriage in our group. Without going into all the details, there's some human stories that take place in a workplace that might be of interest.

Jackson: Okay. We're almost at the end of this side of the tape, so with that I'll stop the recorder.

END SIDE 1, TAPE 2. MAY 26, 1999.
BEGIN SIDE 1, TAPE 1. JUNE 17, 1999.

Jackson: Today is Thursday, June 17th, [1999]. My name is Mike Jackson. I'm here with Phil Burgi. It is about 10:15 in the morning. We are on the fourteenth floor of the Bureau of Reclamation building number 67, and we are resuming with our interviews.

Phil, I guess I would want to pick up on one of the topics we left off with last time, and that was just to try to create a sense or a description of what the interactions were about the office and the social settings within the Bureau of Reclamation.

Social Activities of the Division

Burgi: Okay. And, of course, this is from my perspective of being in the old Hydraulics Branch for the major part of my career. Reclamation is just like any big organization where you have pockets of various personalities and environments. Ŧ

~~think~~ When I first came with Reclamation back in the early seventies, the Division of Research had a–maybe it was even before I came, but about that time they stopped doing it. They'd have like an annual dinner dance. I think back in those days, and probably even more in the forties and fifties, they'd get together and just everybody, of 180 or so in that division, a certain percentage of them would come out to it, but it would be an evening dinner dance.

I think maybe in the late sixties, early seventies, that sort of passed its [time.] ~~value.~~ I think the feeling was by many of the people in the laboratories was that was great for the managers who maybe had money to pay for a dinner dance, but a lot of these younger folks, that isn't really the type entertainment they wanted. They would prefer a picnic or something a little different orientation than the dancing.

So there was a period there where I think the division itself may have had a couple of large parties. One of them I remember was some kind of a reunion or a large anniversary date, maybe the lab's–might have been fifty years or something like that, where they actually barbecued a buffalo out in the yard between 67 and 56, dug a deep pit and had a lot of coals in there, and brought in a guy that knew how to barbecue a buffalo. We had just a big feast, and it was a lot of fun.

There's been various times when we've had open houses in the laboratory, where we would invite people in from the Lakewood area, Denver Metro area, to look over what we do in the laboratory. So there's been several things like that.

In our own branch, the Hydraulics Branch, it's always been interesting, and I think again the various organizational groups in Reclamation are that way, they have their own. It's almost like a family. We would usually have an annual picnic. There was a time we used to go up into Bergen Park area and have a summer picnic. A guy by the name of Kummick–I don't even remember his first name now–had some property up there, and we'd go up and just have an open barbecue. More recent years we've gone up to Brent Mefford's farm, or ranch, up in South Park. There's always been activities that have been sort of unofficial, where groups would get together during the summer.

For a Time There Was a Volleyball Game at Lunch Between Building 56 and Building 67

I think probably an interesting period was in the eighties when in the area between [Buildings] 56 and 67 we actually had volleyball games going on during lunchtime, particularly our branch. Pete Julius and Steve Young would come over, Marlene Young, Frizells, Jerry Fitzwater and others, and take some time during the lunch break and just play volleyball. That became a little bit of a problem, though, for some of the people in 67 who would look down upon us maybe and say, from the facilities perspective, that we were tearing up the lawn. There were some concerns about that, so we eventually stopped it.

[Extraneous material removed.]

We had a couple that still works for us over there, that met at the work site and fell in love and became married. He came out of–this is Warren and Kathy Frizell. We hired Kathy. She was Kathy Houston out of UCLA. Warren Frizell was out of Albuquerque, New Mexico. And over a number of years they developed a relationship. I remember one day Kathy came in to me and said, "I know in Reclamation that two people that are married should not be in the same group because of some of the conflicts of interest that may occur, but I just want you to know that we're planning to get married." I think she was a little concerned about what my response was going to be. Basically I wasn't going to say they couldn't get married, nor was I going to say they couldn't both stay in the group. They're both *great* hydraulic engineers in their own right and independently very good at what they do.

Over the years, that's worked out very well. They've been in two different groups in our branch. So it's not been a problem with conflict of interest. My only counsel to them at the time was that they continue to do their work well and not pay any special privileges to each other in the workplace, and to watch themselves as they conducted themselves as a couple.

I remember one time we had an assistant division chief when Warren and Kathy were going to the same ASCE [conference,] ~~meeting,~~ and this fellow wasn't sure they ought to both be going. I think he thought they were going on a vacation. I reminded him that, in fact, both of these were engineers and they each had papers to present on what they were doing, and they should be treated that way. He tried to get me to reduce the per diem rate since they would be staying in the same room, and just several other things that really bothered me a little bit on just the attitude of, "Well, do these people really bring equal value to the branch?" We overcame that, and it's not a problem at all, so that's been one interesting situation.

We had another one where one of the young engineers was very interested in the secretary in the group, and they dated for a while. In fact, they called me out to lunch one day on a picnic bench and said, "We want you to know, Phil, we're dating. If you're okay with that–" Again I said, "Well, you know, that's something between you two." My only requirement has always been that they act professionally at the work site and that they not pay special privileges or advantages to someone in that kind of a relationship. So those were a few of the personal things.

Bruce Moyes

Other things over the years, though, that have impacted on me, are situations like my friendship with Bruce Moyes. He was an engineer in the design group over in concrete dams when I first started with the Bureau of Reclamation in '69, rotated through that group, didn't know Bruce real well at that time, but over the years got to know him quite well because we obviously did a lot of model studies for this concrete dams group, including Bartlett Dam and several others.

In the 1983 flood on the Colorado River and my work at Glen Canyon, Bruce and I traveled a lot together. We got to the point where we had a lot of respect for each other, him on the design side, me on the testing and work with Glen Canyon Tunnel spillways. He was sort of a free thinker and often was a problem for managers because he didn't necessarily fit into the mold of an organizational person, but he was very good at what he did. He got very involved with the China work when we were originally doing some planning and working with the Chinese on Three Gorges. So he traveled many times to China, along with Sammie Guy out of [Reclamation's] international affairs [office] and a number of other people from what used to be called the Engineering Research Center here in Denver. Worked very hard.

I can't remember the year now, but really sad news one day when I'd heard that he'd had a major stroke. I don't know, at that time he was probably somewhere around forty-eight, really at the prime of his career, as far as I was concerned. He never really quite recovered from that. He came back to work for a while, and he had had some disabilities with his motor skills and speech skills, just the inability to work a regular eight-hour day. For a while Reclamation tried to have him in international affairs and a few other areas, but eventually he went out on a disability retirement.

There's been situations like that, and I know there's been other cases, which is true, again, in any area where you're working where you lose people either through accidents or through situations in marriages or work situations, and you realize that over time things continue to change and that new people come on board, and you just move forward on that basis. But those were some of the details that come to mind when I think of some of the personal relations in the group.

Another one here in recent years that has been quite interesting and that I've really enjoyed is a relationship with this particular commissioner. I guess as I look through the list I've known quite a few of the commissioners, not on a very personal basis, just–I did meet Ellis Armstrong and Gil Stamm, and I think I got an award from, maybe it was Dennis Underwood and Dan Beard, or at least I remember a picture where I was in that with them.

Eluid Martinez and the Program with Spain

But with Eluid Martinez, we have had a Spanish program going for, oh, fifteen years now with the Central Experiment Station in Madrid [CEDEX]. It's a government laboratory that includes hydraulics and environmental and transportation and structures, a whole number of things, and probably Jim LaBounty and myself have been the two main people working with the Spanish.

Well, Eluid became very interested, and, in fact, at the beginning, Dick Ives, I think, really encouraged Eluid to go to Spain back about five years ago and renew our agreement with the Spanish Government. It was due to run out, and it had this, I think, it was a five-year renewal on it. So he went along [for] ~~on this~~ [the] signing [of this] agreement. It was just interesting to travel with the commissioner and his wife. He and I and Jim LaBounty and Dick Ives, we had a great signing ceremony over there.

Felipe Martinez

As it worked out, the director of CEDEX, it's called, the Central Organization for Studies and Experimentation, C-E-D-E-X, his name was Felipe Martinez, and I've known Felipe for a number of years. He was involved in the International Association for Hydraulic Research, which I've been involved with, and he became a personal friend over the years.

Well, when we signed this agreement, we dubbed it the Martinez Agreement, and Felipe and Eluid hit it off real nicely. Felipe is a real Spanish gentleman and did everything he could to show us around the laboratories and make us feel welcomed. The social graces of the Spanish are just innumerable, and Eluid and his wife, Suzanne, were just very impressed with their time over there in Spain and asked if maybe we couldn't get more going between the Spanish and the U.S. with exchanges.

We had the opportunity here about two years ago here now to go back over, and Felipe wanted to take the Commissioner on a tour of the southern part of Spain that went all the way from Madrid down to Sevilla–we know it as Seville–down to Cadiz, over to the Gold Coast and up to Cordoba and then back to Madrid, and it was about a six-day trip.

Again, the Commissioner wanted, as he referred to, the technical people in the U.S. that had been most involved to go along just to help with not only the translation, but maybe more importantly, the context technically. So Jim LaBounty and I were able to go on that second trip. Steve Magnussen also joined us on that trip. So it was Dick Ives and Steve and Eluid and Jim and myself and the wives of Steve and Eluid.

"This is really an interesting commissioner in that he's really a people person, cares a lot about people, has trouble in social situations of knowing what to do sometimes. He's sort of an amazing character in his ability to disappear sometimes from situations. . . ."

Again, we spent many hours on the buses together and on some trains, and it really turned out to be a great trip. This is really an interesting commissioner in that he's really a people person, cares a lot about people, has trouble in social situations of knowing what to do sometimes. He's sort of an amazing character in his ability to disappear sometimes from situations. But on the other hand, you see, as you travel with him, a person that really does care about people and is very, maybe, timid and [shy] [but] ~~maybe~~ opposed to a lot of public presentations. He's sort of a private person.

I remember one day over there we had gone up to visit one of the dam sites, and another good Spanish friend of mine, Manolo, was along, and they started talking about fly fishing. Manolo was talking about fishing in Spain, and Eluid was talking about fishing in the U.S., and they were just trading stories back and forth. Eluid speaks Spanish quite well. So we were having a great conversation in Spanish a couple of hours coming back down from this dam.

Well, the next morning the commissioner shows up and asked me if we could give a drawing that he had made, a picture, to Manolo. It was a beautiful picture of a trout coming up out of the water and jumping for this fly on the end of a line. He had signed it "To Manolo from the Commissioner of the Bureau of Reclamation." It's those types of things which really came through that this commissioner is one that–he spent quite a bit of time drawing that up and preparing it for Manolo the next morning, but it shows the care and interest that he shows in people.

There were other times when he might come off with some comment at a meeting, and you sort of wondered how did that fit into where the Spanish were. At one time, the commissioner had gone on a train ride with his wife over to Italy for an ICOLD [International Commission on Large Dams] meeting, and on the way back through Madrid they were supposed to stop before they flew on over to the States, and Felipe had invited them over to [his] ~~the~~ house that evening. When they got to the train station, Eluid told Felipe, well, he was basically too tired and wouldn't be able to go. I know for Jim and I, who know the Spanish quite well, I thought, boy, how's this going to come off to Felipe. But Felipe, being the gentleman that he is and a real study of people, wasn't bothered by it at all. I think he [understood] ~~understands~~ Eluid and really appreciated that friendship.

Just more recently here we've learned that Felipe is no longer the Director of CEDEX, so we don't know how that relation with Spain will continue, but I hope we'll have many more years of cooperation between the Spanish and the Bureau of Reclamation. But it's been interesting to be that close to a commissioner and to realize that they're just a human being like the rest of us and some things they do well and other things they probably struggle with, but they're real people.

So maybe enough on the personal things, but there's been some interesting stories like that that have really influenced my career and, in most cases, for the good.

Jackson: Phil, would you care to elaborate on your involvement with the Three Gorges Dam in China?

Three Gorges and Ertan Dams in China

Burgi: Yes. I can't speak as much about Three Gorges as I can another dam called Ertan.

It's also on the–well, it's actually on a tributary of the Yangtze, on the Yalong River up near a place called Duko City. Some of our involvement, of course, with the Chinese was very much related to Three Gorges.

I personally never have gotten that involved in it, but back in the early eighties, maybe '83, '84, I was called in as a hydraulic specialist to look and review some of their model studies on this large dam called Ertan. It's a dam that was similar, only larger, than Morrow Point here in the Colorado Rockies. It had a number of surface spillways and tunnel spillways and outlet works, much more than what we would put on a dam, a lot more flexibility in the waterways.

"The Bureau at that time, through the Commerce Department, was very interested in trying to use a government-to-government exchange to help introduce the private-sector engineering companies to China. . . ."

That was in interesting trip. We went with Joe Marcotte, who was the regional director out of Billings, Montana, and he and I were the two Bureau people, and [there] ~~then~~ was a gentleman from CH_2M Hill, one from Bechtel, and a third company, ~~all of which–I guess it was~~ Harza–all of which were interested in doing work in China. The Bureau at that time, through the Commerce Department, was very interested in trying to use a government-to-government exchange to help introduce the private-sector engineering companies to China.

Visited Chinese Hydraulics Laboratories

So we traveled over there probably for ten days, went to Beijing and then eventually down to Chengdu and then ~~down~~ to the dam site [on the Yalong River]. At that time the dam *hadn't* been built. They were doing some geological investigations. But we visited laboratories, hydraulic laboratories, in Beijing and Tianjin, which is the harbor city for Beijing, and in Chengdu. I was quite impressed, not only with the friendliness of the people, but with the [scientific] ~~engineering~~ competence of their engineers. They didn't have a lot of instrumentation, certainly not much in the way of computer programming, but their basic understanding of physics and modeling were excellent. So I was quite impressed with their laboratories and the studies that they were conducting.

~~I was particularly talking about the hydraulic studies. There was another fellow there on construction techniques and geology.~~ Down at the dam site we gave seminars where we presented to the Chinese some of our concerns about their construction techniques, the hydraulic modeling, the design of the dam, and had some really good [discussions] ~~interrelationship~~ between the Chinese and ourselves.

Again, very cordial people. They did everything they could for us. I remember one day we went out for a lunch in the open air, and they talked about they were going to do this lunch, and I said, "Oh, it'll be a picnic." They said, "Oh, no, no. It's not going to be a picnic." They were really taken aback a little bit by my use of the word "picnic," because, in fact, they had china and they had butter out for us and fresh fruit, and it turned out to be a very nice meal. Again, it showed me how sensitive we need to be when we're dealing with internationals.

The Chinese Were Friendly and Interested in the Group

One of the funniest things in that trip was the fellow from Bechtel that was along, name of Semel, a very burly guy. He'd been involved in construction for years, real hairy arms and chest and all. We were all walking across the bridge in this Duco City one day, and you have to recognize this was way back in China where they had not been exposed to Americans at all. So people would follow us around on the streets when we were walking through town, and little kids, particularly, would just come up and wanted to listen to us speaking in this language that they didn't understand. So they had a lot of interest in us.

This one old gentleman, as we were crossing this highway bridge on the sidewalk, he just stopped us, and he looked at–his name was Rick Semel–and Rick sort of had his shirt open, and he actually put his finger on Rick's chest and said, "Mao, mao." Of course, we didn't know quite what was going on. Okay, we knew who Mao Tze-tung [Mao Zedong] was, but we didn't know what he was trying to do. Well, the translator very quickly said, "Well, mao means hair." Well, this Chinese fellow was quite impressed with all the hair on Rick. Actually, I think he was pointing to his arm, saw the hair on his arm. So Rick just sort of pulled his shirt open, and, of course, he has this really hairy chest. This little fellow, this Chinese fellow, almost fell over. He'd never seen anything like that, with that much hair on someone's chest. So not to be outdone, he pulls his shirt open and shows one little hair on his chest. We just laughed over that situation, both the Chinese people as well as us. Again, it reminded me of how much as human beings we have in common, even though we come from different cultures and we have these language barriers. There's this interest amongst people [no matter] ~~in~~ where they come from and what they're doing.

The young people would stop us when we were up in Beijing, the university people, and ask, "What's dating like in the United States? Do people actually get to go out by themselves with no chaperones along? Do you actually get to choose who you're going to marry?"

And they wanted to know about work. This was back in 1983. We kept talking about, "When you get out of school, do you actually get to choose who you want to work for and where you want to live?" They'd heard this through news reports in China, but couldn't believe that you could actually have that much freedom. They were pretty well preselected as to where they were going to work, and of course their marriages are quite a bit different than in the U.S. When you were in the back country you didn't hear much about that, but in towns like Beijing or Tianjin, where you have universities, the university students were very inquisitive about what we were doing.

I did have another opportunity some ten years later to return to China, to Beijing and then on down to Wuhan, visited the site where Three Gorges is being built. It was more of a technical tour and I really wasn't involved in a consulting capacity to the Chinese on that one.

Ertan Dam

I've enjoyed following the construction of Ertan Dam. In the latest *Engineering News-Record* I saw a picture where [the reservoir is] ~~it's~~ up to its full height and they're starting to ~~store water behind it and starting to~~ produce power. They have an underground powerplant back in the rock on one of the abutments. So it looks like they've been very successful in continuance of the work.

It's interesting, the chief field engineer when we were there at Ertan was a very competent Chinese gentleman that was very gracious, showed us around, and took care of our needs. We found out that three months later he was killed in an accident at the dam site. He was driving along in a car with some of the other engineers, and a big boulder from high on the canyon wall came down and just crushed the car. He was killed instantly in that accident. But again, you realize that as you go through life you have these opportunities to make friends, make contacts, recognizing that when you say, "We'll see you the next time," that there may not be a next time or it may be under totally different circumstances. But those have been some interesting experiences.

If I can go on a little bit, I've been involved quite a bit with international activities, maybe–

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BEGIN SIDE 2, TAPE 1. JUNE 17, 1999.

Jackson: Okay. We're beginning on side two, tape one now.

Visiting Egypt, the Delta Barrage Dam, and the Hydraulics Laboratory

Burgi: We were talking about China. I've also had opportunity to travel to Egypt. I was there for a week, where we were–I was really visiting the Delta Barrage Dam and the hydraulics laboratory that they have in Egypt, and then I went on down to visit Aswan Dam while I was there[.] ~~, basically to give~~ [I gave] them some input on hydraulic modeling at the hydraulic laboratory there. It's a very old laboratory. Their director at that time of the hydraulics area was Dr. Gasser, a very nice gentleman that, again, I had gotten to know through international activities, both ASCE and IAHR [International Association of Hydraulic Research]. He invited me over to give him some input on their laboratory, some of their laboratory techniques, the instrumentation they use, and so I went.

Again, a great opportunity to meet a different people group, to see how work is accomplished.

"Most of their laboratories are in a number of large . . . Quonset huts, . . . corrugated metal, and in the summer it's very hot underneath those. They just are open air, but they're covered, mainly, I think, to give shade to the models. . . ."

Most of their laboratories are in a number of large–we would call them Quonset huts, these half circles made out of sheet metal, corrugated metal, and in the summer it's very hot underneath those. They just are open air, but they're covered, mainly, I think, to give shade to the models.

"Most of their work was sediment studies, open channel flow, both for bridge pier erosion and dams and spillways, outlet works-type studies. They were doing a powerplant intake structure study with a mechanical engineer background leading that study. . . ."

Most of their work was sediment studies, open channel flow, both for bridge pier erosion and dams and spillways, outlet works-type studies. They were doing a powerplant intake structure study with a mechanical engineer background leading that study. I was quite impressed with the quality of the work they were doing. They were really looking for some credibility in the international market. I think the Egyptians would like to be conducting more hydraulic model studies in their laboratory for public work projects in the Middle East.

For instance, Adnan Alsafar, who is a good friend of mine that works for Bechtel Engineering here in the United States, had set up some studies. Actually, they were studies for Egypt that Bechtel was conducting, and instead of doing the laboratory studies here in the States at a university or, for instance, at our laboratory, they had taken that work to the Delta Barrage Lab in Egypt and were performing the studies there. The quality of the work may not be quite as good, the detail. I think some of the engineering judgment they were still learning quite a bit. Even in the papers that they present here in the States, they don't have quite the engineering meat in them, in the theory versus the empirical work that you might see in a paper coming out of the United States, but they're really growing in their ability to do good modeling. Gasser had this idea that as he got more of his engineers involved in some of these international meetings presenting papers, that it would really help them, and I think it has.

Visited Laboratories in Lahore, Pakistan

I also had the opportunity to visit laboratories in Pakistan, in Lahore, Pakistan, a number of years ago, again on a study tour with several professors. We gave a series of lectures on hydraulics structures, and some dealt with design of the structures, others dealt with the laboratory modeling, which was my main involvement.

Again, we saw outdoor laboratories there in Lahore that might be similar to the old Corps of Engineers laboratories at Vicksburg, where they would model a whole river basin outdoors. You lose some of the quality control in those laboratories, but in a big-picture sense they were able to conduct studies that helped them develop their water resources.

I think in all these experiences one of the things that comes to mind is the words "appropriate technology." We in Reclamation, I think historically, if we look at some of our old designs, we built very good structures that were, I would say, cream of the crop. If you go down and look at Hoover Dam and you look at some of the old concrete work there, the quality of it, it's just great.

"Over the years, some people might say that we have built Cadillacs instead of Chevys, that our work–we've almost over-engineered them in the sense that we have done very high-quality work. Some of that has been very expensive. . . ."

Over the years, some people might say that we have built Cadillacs instead of Chevys, that our work–we've almost over-engineered them in the sense that we have done very high-quality work. Some of that has been very expensive.

In more recent years, I remember during Dan Beard's time here as Commissioner, we were really trying to get the designers in Reclamation to think in terms of anywhere from risk analysis to a different approach. Maybe we don't need to build something that will last for 500 years. Maybe if we say the life of a structure is 50 or 100 years, we ought to be looking more in designing it for the short term and not long term.

". . . the appropriateness of a design needs to be looked at carefully. . . . in Peru, our first team leader down there told the Peruvians . . .that you can't build canals on these steep slopes because you can't put a service road along the side of the canal. . . . The Peruvians, basically their response was,'We've been doing this for a thousand years, and we know it works, so what do you mean we can't do it?' . . ."

What I gathered as I've traveled overseas is this concept that some of the technologies that we [developed] in the U.S. [we] have tried to export aren't always usable or useful in other countries, that the appropriateness of a design needs to be looked at carefully. When I was in Peru, our first team leader down there told the Peruvians–I may have mentioned this–that you can't build canals on these steep slopes because you can't put a service road along the side of the canal. You just don't have enough cross-sectional space. The Peruvians, basically [responded,] ~~their response was,~~ "We've been doing this for a thousand years, and we know it works, so what do you mean we can't do it?" And they would build a little trail along the side where their workers would just *walk* to do the maintenance. They didn't think about driving a truck or a vehicle along that.

That's what I'm talking about when I talk about appropriate technology, that we have a certain mind-set here in the United States that we've used for years in our design and in our construction, and it's very difficult to change from those, and we've exported that in *Design of Small Dams* and other manuals all across the world. Much of that, the majority of it, is very, very useful and has been very helpful in development throughout the world, but I think in more recent years, we really do need to look at–and we have been forced to do that, not only in designs here in the United States, but [also] ~~in~~ overseas ~~countries~~. In some of these cases there may be a cheaper way to build, and we can learn a lot from the experiences in these other countries.

We never *have* been official in our international work. We don't belong to USAID or the State Department. So when we have worked overseas, it's been at the request of the country, and we've sort of set up a government-to-government agreement. So we've had involvement in Brazil and Ecuador and Peru and, of course, Egypt and all over the world. But sometimes I think we really do need to look carefully at how do we look at the experiences in these countries and try to conform our designs and our concepts into something that is appropriate for the culture that we're working in.

And, I think, vice versa. As I said, in more recent years it's come back to the United States that maybe we don't need to build a spillway or a spilling basin that's going to last for 500 years, and I think that's what risk analysis is all about. We've sort of come up to the conclusion of saying in safety of dams there are some things you can't compromise and you have to make sure that the design is competent and that there will not be failure, but if a basin fails downstream and it doesn't impair the safety of the dam, maybe that's okay, you take that risk with the idea that you might have to rebuild something.

I know we ran into this in Peru, and I've seen it in other countries. So to the degree that that becomes an issue, I think Reclamation's involvement internationally, whether it's in ICOLD conferences or IAHR [International Association of Hydro-Environment Engineering and Research], or international exchanges have been very beneficial in not only helping us in the international scene, but also helping us to maybe reconsider what kind of criteria do we need to use on our designs here in the United States as we go into the next millennium.

Jackson: Any other philosophies or idea structures oriented toward the future that would add into this discussion?

". . . I think that Reclamation has done an excellent job of moving from . . . a development agency to one of management of the water resources. . . ."

Burgi: Well, I think we are moving, and again some of this may be repeat, but the Bureau's had a long history. In fact, we're coming up on our hundredth anniversary here in another year or two. There would be some that would say that we've outlived our purpose, but I think that Reclamation has done an excellent job of moving from, as I've said before, a development agency to one of management of the water resources. That is so much centered around the infrastructure that we've developed over the years. Our ability in the West to manage the water is very much related to the structures, whether they're storage structures or conveyance structures or diversion structures.

“. . . I think our future is going to lie in . . . reviewing . . . the infrastructure that we have and how do we make that work better to meet the values of today’s society as we move more to urban water and away from agriculture. . . .”

So I think our future is going to lie in that area of reviewing, almost project by project and river basin by river basin, the infrastructure that we have and how do we make that work better to meet the values of today’s society as we move more to urban water and away from agriculture.

As we do that, we, of course, go to a more efficient way of using water agriculturally, which provides the water for the urban uses. So I think that we will continue to revisit–I noticed recently here the commissioner has asked for us to, as general employees of the Bureau of Reclamation, to review our strategic plan that we put together in–maybe it was ‘95 or ‘94. Do we still hold those values, or are things changing and do we need to change it?[11]

“. . . I think we’re moving into a period where we’re becoming much more responsive to the politics of the country and to the needs of the country that are changing much quicker than they were back in the thirties and forties. . . .”

So I think we’re moving into a period where we’re becoming much more responsive to the politics of the country and to the needs of the country that are changing much quicker than they were back in the thirties and forties.

I think the future for the Technical Service Center is very much there, probably in smaller numbers than what we have right now, and I think that we will turn more into a service center, which, in my mind, and it’s a biased opinion, means that the laboratory staff will become a more important picture in the future, probably more so than design, because of the need to provide technical assistance to irrigation districts and to the area and field offices.

“I think those that are involved in research and laboratory and field investigations have a mind-set that is experimental in nature and are basically problem solvers . . .”

I think those that are involved in research and laboratory and field investigations have a mind-set that is experimental in nature and are basically problem solvers as issues come up where [it’s] ~~we’re~~ sort of key to say, “Well, let’s define what the problem is and let’s look at how we can best study that to come up with a solution.” And I think that mentality feeds itself very well into providing technical assistance.

11. The document probably referred to was developed during the tenure of Commissioner Dennis Underwood and was titled *Reclamation’s Strategic Plan : A Long-term Framework for Water Resources Management, Development and Protection.* which Reclamation published in 1992.

Nimbus Dam Fish Hatchery

So, as I've said before, when we get calls that deal with–right now we're dealing with one with a fish structure for Nimbus Dam where we're trying to divert fish over into a fish ladder and up into a hatchery. This structure has been there since early fifties. They're looking for ideas on how to resolve it, and there's a value analysis team that's been set up. I'm really pleased to see that we do have representation from the laboratory on that team. I think when you're looking at brainstorming and trying to look at different approaches, those people that have been involved in the experimental side of the house tend to be able to come up with, I think, better problem analysis and proposing solutions.

Obviously we will always need our operation and maintenance and design and planning functions in Reclamation, but I do see us changing from where we were in the past so heavily involved in design of new structures which went anywhere from geology up through design of structures. The design of structures now is becoming more of a design of reconfiguring. Maybe we need to put outlets at a different place in the dam or we need to change the spillway configuration. There will be a lot of attempts, I think, in the future, to take the structures that we already have and reconfigure them just to better meet the needs of the public.

So is there a future for Reclamation? Yes. I feel very strongly about that. For one thing, the Federal presence alone is important for us. Will that role be the same as it has been in the past? I'd say most definitely not, that it's changing all the time, and I think one of the successes of Reclamation, the reason that we're still in existence, is because maybe almost in spite of the government bureaucracy, some of the leaders in Reclamation have recognized the need to make changes, and we've *made* those changes to meet those changing values in the public.

Jackson: We've mentioned the Corps of Engineers and Tennessee Valley Authority. As you talk about Reclamation's past mission and role, I'm just curious if you're aware of how the Tennessee Valley Authority has had to change and the Corps of Engineers' missions have had to change. When you put all three organizations together, are they all three merging on the same path, or are they still serving separate roles?

Burgi: That's really a good question, and I'm not sure you can talk about it without mentioning politics, because one of the things that I've learned in my short career is that all three of these agencies, and many others in the Federal Government, are very much a result of the politics, and I would say particularly of the congressional districts.

Corps of Engineers

The Corps of Engineers is certainly–of all the agencies in the public works area, probably has the best constituency ~~out across the country~~ of congressmen [out across the country]. So when you talk about consolidating Corps of Engineers offices or closing laboratories or redefining the Corps' mission, you have these special-interest groups that are worried about losing the number of staff in various towns all across the United States. It's a little bit like closing the military bases. All of a sudden, the congressional groups in the United States become very concerned about that, and even though they may say it's best for the country to do something differently, they still have to go back and face the voters in their local district, and those voters can oust them real quickly if they don't pay attention to what those local politics are.

Thinks Reorganizing Executive Branch Bureaus and Creating a Department of Natural Resources Would Be a Logical Step

So I think, if I were king, I would look at doing something like President Nixon encouraged a number of years ago where he would [have liked to] set up a Department of Natural Resources and ~~you would~~ bring a lot of your public works activities into the same department. Now, Transportation might still be a separate group, but certainly in the water area, to have a Corps of Engineers reporting to the Department of Defense, and the Bureau of Reclamation reporting to the Department of the Interior, and the Tennessee Valley Authority set up as a separate administration, and the Forest Service set up in the Agriculture Department, Parks Service set up in Interior, you have a number of agencies that I think in some cases are duplicating some effort, and to bring them together in some kind of a formal executive agency that could put more focus on water resources and the environment, I think would be an excellent idea.

I don't think it's going to happen. Tennessee Valley Authority basically has lost maybe all of its congressional appropriations. They've always been an agency that earned a lot of their income from power sales, but they always had a part of their income from the Federal taxpayer, and I think in the last two years the president's budget has knocked that down to zero, and some of the local congressmen have got, you know, like 500 million put back in, or maybe it's 30 million, some number.

The Corps of Engineers is going through changes, and they're consolidating some of their laboratories at Vicksburg, just as the Bureau of Reclamation has downsized. So there has been some attention in all these agencies. There's a lot of interest in the Department of Energy when you have the Bonneville Power Administration and the Alaska Power Administration, WAPA, the Western Area Power Administration. There's a lot of interest there of maybe privatizing those agencies and letting the private sector basically produce and sell the power. I can't tell you exactly where that is right now.

So just like the Bureau of Mines this past year sort of went by the way and there is no Bureau of Mines anymore, I think a lot of agencies in the Federal Government are being looked at pretty closely, and the question is being asked, what is the benefit and value to the American public of keeping this agency?

"I think it'll go down in history that Dan Beard . . . may have done more good for Reclamation than was ever thought at the time. . . . he forced us to look at

ourselves and say, 'What are we doing and how are we going to change . . . in order to get the public acceptance of this agency?'. . ."

I think it'll go down in history that Dan Beard, as the commissioner of the Bureau of Reclamation, may have done more good for Reclamation than was ever thought at the time. I think winning the Hammer Award from Vice President Gore and some of the other good things that he's credited for and that many of us looked at as very negative may turn out to be our salvation in the sense that he forced us to look at ourselves and say, "What are we doing and how are we going to change from the way we used to do things to the way we're going to need them in the future in order to get the public acceptance of this agency?"

"Reclamation has always had a very small constituency in the West, and we upset most of that constituency a few years ago when we decided to manage our water and require the districts to be more accountable in the use of the water and look for water conservation. . . ."

And probably Reclamation, more than the Corps of Engineers, has been able to change its flavor. The Corps of Engineers has a lot of people looking over their shoulder and requiring them to do things. Reclamation has always had a very small constituency in the West, and we upset most of that constituency a few years ago when we decided to manage our water and require the districts to be more accountable in the use of the water and look for water conservation.

". . . combining some of the natural resource functions within the Federal Government would be a good move. . . "

I wouldn't be surprised if in the future TVA will be totally private, and I think there is still that possibility that some future president may decide that maybe combining some of the natural resource functions within the Federal Government would be a good move. Soil Conservation Service changed their name to the Natural Resources Conservation Service, but certainly that agency, the Park Service, the Forest Service to a lesser degree, the Bureau of Reclamation, and the Corps of Engineers, Fish and Wildlife Service have some major areas where, if they were under one authority, I think we would have much more efficiency in our development of water and environment and some of the issues related to that.

So that's my own political statement on that. My gut feeling is that nothing much will happen, that Reclamation will continue to be a separate agency, and, as I said, TVA may not be a Federal agency anymore, but probably the Corps and these other agencies will continue in their individual departments.

Jackson: You mentioned earlier having visited China in the early 1980s, and you talked about some of the cultural differences and some of the interactions, then you mentioned going back about ten years later, in the early 1990s. At risk of possibly addressing my questions away from the Bureau, I'm interested to hear how China compared in the ten-year interval, both in terms of cultural issues and then also their progress in dam building and water conservation.

Changes in China Between Visits

Burgi: Okay. Being there for that short of a period, I think both of those were less than two weeks, so it was a very quick look-see. The first one I traveled much more, visiting Tianjin and down at Chengdu and down at the Ertan Dam site. The second one was mostly in Beijing and then down to Wuchan. I guess we did get out to Chengdu.

There were some things that you noticed, and maybe most of those would best be looked at in Beijing itself. Certainly there was more development. There were more hotels. I would see some changes in the–maybe a few less bicycles and more cars and trucks. Let's see, I think it's probably been six or seven years since I've been to China, and I would say in that period between the first two trips that there had not been a tremendous amount of changes. I was there before [Tiananmen Square] ~~Tianjin,~~ and my sense is that they were still a very controlled society in that although there was some news about the rest of the world in China, that, at least in the little English newspaper that they would have there that was basically put out by the Chinese News Agency, they would really control what the people were hearing, it appeared to me that you have this huge amount of people, and we're talking about, I think almost a quarter of the population of the world in China.

The Chinese Government has this tremendous responsibility of trying to hold them together as a nation. The more exposure they have to the West in what they see, particularly in material goods in the rest of the world, the more they're going to become unrestful in how slow China's progressing. I just sensed a very strong feeling while I was there both times that to the degree that they can keep information from the Chinese people that might incite them to want huge changes, that they were going to do everything possible to do that.

In their defense, they're probably correct. It seems to me like you're not going to be able to move a mass of people that large from the very rural, low-income society to the materialistic society that we see in Europe or the rest of the West. So in some ways you almost have to encourage them to control their people in a way that allows them to develop along a path that makes sense for the Chinese.

I know in more of the political realms of human rights that that is a tough issue when you're trying to put your values on another country and say this is the way they ought to be treating their people. I didn't see a lot of abuse. Of course, I didn't expect to, because we were very much controlled in where we went and who took us around. I'm sure that in China there *is* a lot of hard-handedness in trying to control their people.

But to answer your question, I would say that there is a slow progress toward bringing China up to speed with the rest of the world, but they're years and years away from that. As I traveled both in–I mentioned Pakistan, but I've also traveled in India and Nepal, in all of these countries their standard of living is very low. You may be talking about an annual income of less than 300 dollars, which is almost inconceivable for us to think about. You have hundreds and millions of people with no cars, transportation. So their progress is in terms of maybe telephones and televisions and radios that they have available to them. A lot of them still have outdoor plumbing. So as you get away from Beijing and out into the rural areas more, you see progress being made, but they have huge steps to make to bring their society–

SIDE 2, TAPE 1. JUNE 17, 1999.
BEGIN SIDE 1, TAPE 2. JUNE 17, 1999.

Jackson: Today is Thursday, June 17th[, 1999]. My name is Mike Jackson. I'm here with Phil Burgi. It is about 11:15 in the morning. This is tape two, and we're on side one, and Phil is [unclear].

Burgi: So I was talking about sort of the standard of living in these countries, and you were asking me about China. It is improving, but it's a slow process. I guess I'd also mentioned Pakistan, Nepal, and India being very similar. And you do get into issues like–I know this is a World Bank issue, too, is how do you define progress, and certainly if you do it with some of the material things that I mentioned, radio, television, telephones, well before you would do automobiles, probably. But maybe even more basic is, do they have indoor plumbing and what is their sanitation systems like, and even if they do have indoor plumbing, is there any kind of a central treatment plant to treat the sewage before it's returned to the river.

I guess, as I've said in previous interviews, the whole subject of water and water treatment runs through all of these countries and all of life, and I think that's what's been one of the neat things that I've enjoyed in my career with Reclamation. It's only one part of the water in the sense that we have been mainly involved in providing water supply. Somebody else does the treatment and all. I think, as I've looked around in my travels, that's still a very serious issue across the world, is managing water.

Issues and Benefits of Three Gorges Dam on the Yangtze River

We can take China, for instance, on the Yangtze, and there's this big political debate which the U.S. has come out saying we oppose the Three Gorges Dam for a number of environmental issues, not to mention several others. But the Chinese have decided they're going to go ahead with it, and I probably think they're making the right decision. They are looking at a huge river, the Yangtze, that floods quite often. Often there's hundreds and even thousands of people that lose their lives in these floods. They understand the importance of trying to keep things natural, but they also understand that as their population develops, they need to try to manage their water resources.

In that case, the building of Three Gorges helps them in a couple of ways. It provides a water supply. It improves their navigation on the Yangtze. It provides a tremendous amount of power, hydropower, and when we think in the world's situation of trying to encourage the Chinese not to use so much coal, the development of hydropower through Three Gorges is a tremendous *increase* in the amount of power that will be produced in China. I don't remember the numbers, but it's somewhere on the order of maybe ten or fifteen percent, maybe higher, of the total power presently produced in China.

So in addition to the flood and hydropower, there are these other benefits, and those have to be weighed against the impacts of moving people from their villages along the river, of the environmental issues, of the sediment issues. My impression is that they're very much aware of all these issues, and they're trying to do the best job they can of working through those in a way that allows them to give the most benefit to the public in China.

". . . I sometimes talk about when I leave Reclamation I'd like to go overseas, and I'm seriously looking at Ecuador, where there are some projects to develop small water supplies for villages. . . ."

But there's other major steps around the world that need to be taken in water, and that's why I sometimes talk about when I leave Reclamation I'd like to go overseas, and I'm seriously looking at Ecuador, where there are some projects to develop small water supplies for villages. We're talking about villages that may have a hundred families in them, where people, particularly the women in these cultures, carry the water on their heads or in jugs to the village, and where sanitation is probably in a ditch going back to a creek or something with no treatment.

These are issues that deal with public health and in many ways really increase the standard of living for people in a very basic sense. So, yeah, water is a very important item, and people know how to raise food, and they'll always be able to bring along agriculture, but, to me, probably one of the most important things that we have as human beings on planet Earth is water. It's important to our existence, and our understanding of how to use it and how to develop it in what we might call today a sustainable method is crucial to man's future development and maybe, in a more basic sense, to peace on Earth. If we don't help people with using some of our technology toward the development and management of water resources, then I think we really fall short, particularly we in the Western countries, whether it's the U.S. or Europe or Japan.

Jackson: As I listen to that answer, I'm wanting to compare and contrast the historical development of Reclamation and how it helped bring water to the undeveloped world–rural West. It's obviously very timely. Is there any way that you can juxtapose present-day cultures in other parts of the world with, say, the United States in the early half of this century and how it developed water?

Burgi: Well, it is possible in some ways. I don't know all the issues, but I do know, like on my assignment when I was in Peru in the late '70s- early '80s–I guess 1980–I was enthralled with this term of when we bring water to this community near

Tumbus, Peru, we'll open up another hundred thousand acres of farmland. My thought was, this just sounds like the Old West, the Bureau of Reclamation, that basically without water this land was useless, but once you determine that land is irrigable, which means that if you brought water to the land, you could actually grow crops on it–not all land is irrigable, even *with* water–but once you determine those lands that you could irrigate if you could get the water to them, you provide a tremendous service to the country *if* it's designed and built in a sustainable fashion.

Basically what you're doing, and what they were doing in Peru, was keeping this migration of people from the rural areas into the urban areas, where they somehow had this idea that they were going to make big money and that they could change their whole lifestyle [by moving to the big cities]. Well, at least what happens in South America, from Mexico on south, is that people moving into the urban areas, they were poor in the rural areas, by far the majority of them are poor[er] in the urban areas, and not only are they poor, but they've lost the roots to the land. They tend to build houses along railroad right-of-ways or near dumps, and in many ways they're worse off than if they'd stayed out in the rural areas.

So you take countries like Peru that are trying to develop more irrigation–I've heard recently of an attempt in Egypt now to–I think it's more than an attempt; I think they're doing it. They're building a huge pumping plant on Lake Nasser behind Aswan where they'll pump water up into a canal that will take water out to some new lands, and, again, the Egyptian Government is trying to provide another place of development for people to live instead of in Cairo.

You can look in Brazil, and some of the development there has not been good news in the destruction of some of the Amazon forest, but there's other places in the northeast where they're developing irrigation that's going to be a tremendous help to that population. I think this is happening in Turkey with the Attaturk Project. The Libyans have worked on it. I think all around the world we're seeing attempts to bring water to the land, not only to increase the amount of agricultural production, but, maybe even more importantly, to sustain and to encourage a way of living that doesn't have to be centered around urbanization.

I'm sure the statistics of recent years, the last fifty years, of populations moving to big cities would be a very interesting statistic, but I *know* in some countries in South America that anywhere from a quarter to a third of the population of a country lives in the capital city, and you have to recognize that a tremendous amount of those people are living in very poor situations. Unemployment is high. So the idea of developing sustainable areas where they would be based on an agricultural lifestyle with a community, and there might be hundreds of these and thousands of them around the country, is certainly, in many ways, a better way to live than the urbanization that we see in our country now or in the world today.

So to the degree that these projects can be developed, and certainly there have been many across the world that would be excellent examples of projects that aren't working well– maybe they weren't designed right, they didn't take into consideration some of the environmental concerns, the mitigation that's needed, but there have been a lot of those projects that have been very successful and have helped in keeping rural communities in a sustainable fashion compared to what many people would look at now as a unsustainable lifestyle in the large urban areas.

Jackson: Phil, these are [unclear] concluding questions now, but before wrapping up, I just wanted to make sure there weren't some thoughts that you had that were still hanging that you want to bring to the discussion at the end of the interview.

Research Directors in Reclamation

Burgi: I don't think so. I know we did–there was one time we talked a little bit about the various research directors in Reclamation, and in my time with Reclamation they've included Grayden Burnett and Howard Cohan, Frank [Francis G.] McLean, Wayne Marchant, and then Stan Ponce. Then in '94, as I said before, Reclamation's research labs sort of fell into the various disciplines across the Technical Service Center.

These gentlemen were all really interesting personalities. By far the one that I served under the longest was Howard Cohan, and he did an excellent job of holding the laboratories together, particularly during the development phases in the seventies and early eighties. Frank McLean and Wayne Marchant and Stan Ponce all came along and had much shorter terms in those offices as division chief, but they all added to the quality of the life that we had in Reclamation's research facilities.

". . . I see that as a wrong decision in '94, to not have the research laboratories under one head. . . ."

I think, as I made a statement earlier, I see that as a wrong decision in '94, to not have the research laboratories under one head. But in any case, I just wanted to mention that those individuals all brought their own perspective to what the Division of Research is today, or was until '94.

I don't have–I think that concludes my comments.

Jackson: Okay. Well, I believe this may be your last interview. I'll be sure to follow up and schedule another one if we need to. I want to thank you for the series of interviews, and I notice I did not do nearly as much talking as I've normally do. I think that's the sign of a good interview.

Burgi: Well, I thank you for the opportunity, Michael, and your interest in Reclamation and the work you're doing. So thank you very much.

Jackson: Well, I sure appreciate it, and I know this will be used for a lot of good purposes.

END SIDE 1, TAPE 2. JUNE 17. 1999.

END OF INTERVIEWS.

Appendix 1: *Centerline* News Story on Award of Meritorious Service Award

FALL 2000 **CENTERLINE** VOLUME 55 NUMBER 4

PHIL BURGI RECEIVES INTERIOR'S MERITORIOUS SERVICE AWARD

Philip H. Burgi, recently retired Group Manager for the Water Resources Research Laboratory, was honored with the Department of the Interior's Meritorious Service Award in recognition of his outstanding contributions in the fields of management, hydraulic research, and engineering, while employed by Reclamation.

For the past 16 years, Phil was the Water Resources Research Laboratory Group Manager. While overseeing the laboratory, the research program focused on hydraulic structures and equipment, dam safety, environmental hydraulics, and water conservation.

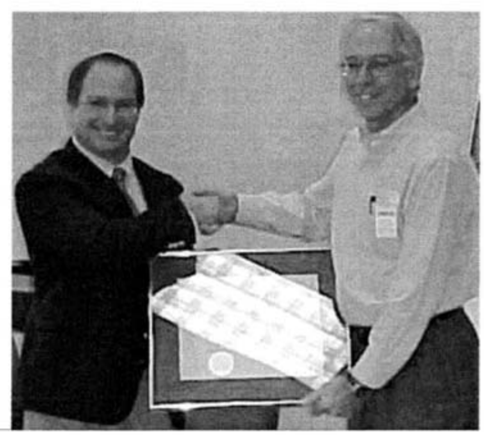
Principal laboratory efforts during Phil's tenure included performance evaluations and design improvements on numerous spillway and outlet works structures, such as the flow emergency at Glen Canyon Dam, and associated energy dissipaters. Other structures included in this category are Crystal, Canyon Ferry, Bartlett, and Ridgway Dams.

Several innovative technologies, including labyrinth and stepped spillways, fuse plugs, and overtopping protection, were introduced under his leadership. Phil was actively involved in research and development work on the vertical stilling well and multijet sleeve valve designs. His findings are published in the *ASCE Journal of Hydraulic Engineering*. Phil was one of the inventors of the Horizontal Multiport Sleeve Valve. He also authored chapters in two technical books and numerous technical reports.

As recognized by the National Society of Professional Engineers, Phil was named Reclamation's Federal Engineer of the Year. He was awarded the 1999 Hydraulic Structures Medal by the American Society of Civil Engineers (ASCE) for outstanding contributions in the areas of hydraulic jumps, energy dissipaters, outlet works, and topics related to environmental fluid mechanics.

While Phil was the head of the Hydraulics Laboratory, he played a significant role in the success of the United States-Spain International team to exchange technical information on hydraulic structures and measurement techniques.

TSC DIRECTOR, MIKE ROLUTI, PRESENTS PHIL BURGI WITH INTERIOR'S MERITORIOUS SERVICE AWARD.



Appendix 2: Retirement Announcement

Phil Burgi

Here's to Retirement!

**After more than 32 years of Government service,
Phil Burgi,
Manager of the Water Resources Research
Laboratory is Retiring.**

**Please come say farewell to Phil on
Wednesday, September 29,
from 1 to 3 p.m. in the Rio Grande Room**