



# RICHARD LUHNING

Date and place of birth (if available): May 22, 1944. Lumsden, Saskatchewan.

Date and place of interview: Monday, April 9, 2012. Mr. Luhning's office, Suite 3000, 425 - 1st Street SW, Calgary

Name of interviewer: Brian Brennan

Name of videographer: Peter Tombrowski

Full names (spelled out) of all others present: N/A

Consent form signed: Yes

Initials of Interviewer: BB

Last name of subject: LUHNING

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INTRO: My name is Brian Brennan. Today on Monday, April the 9th, 2012 I am speaking with Richard Luhning for the Petroleum History Society Oil Sands Oral History Project. We are conducting this interview at Mr. Luhning's office which is located at Suite 3000, 425 - 1st Street SW in Calgary. Also with me today is Peter Tombrowski who is recording this interview on video. Mr. Luhning is the manager of Pathfinders for Enbridge Incorporation and the former vice-chair and acting chair of AOSTRA, the Alberta Oil Sands Technology and Research Authority. Good afternoon and thanks for coming here today Mr. Luhning.

BB: Maybe to begin with you could just give us a very brief biography of yourself, where you were born, where you went to school, that sort of thing.

LUHNING: I was born in Lumsden, Saskatchewan in 1944; May 22, 1944. I started at the university at the Regina Campus of the University of Saskatchewan. Did my first year there and then transferred to Saskatoon where I finished my degree in chemical engineering. After that degree I accepted an Athlone Scholarship to the UK to London and went to Imperial College of Science and Technology. And I did my PhD in chemical engineering at the Imperial College. I graduate there in 1969 and went from there to Imperial Oil in their research department in Sarnia, Ontario. So that's kind of how I got educated and got my first job, first permanent job.

BB: Okay... And you went from Sarnia then, from Imperial Oil to...



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LUHNING: After Sarnia, I moved to MacMillan Bloedel in Vancouver, to the pulp and paper and worked on a pilot plant project, a new pulping technology in the Harmac Mill on Vancouver Island. After that I went to Great Canadian Oil Sands in Edmonton and worked on surface mined oil sands and upgrading and GCOS, and was there a few years. Then I had a call from Clem Bowman who I had met in Sarnia in the research department with Imperial Oil and he asked if I would like to join an organization called AOSTRA. He said he had \$50 Million dollars to spend and we'd probably take maybe five years to sort out the technology associated with recovery and upgrading of oil sands. I was in with AOSTRA, that five years stretched out to be about 20 years. And then AOSTRA was closed down and after that for a period of time I had my own business called Arkril Enterprises, one of the clients was Enbridge and at one point Enbridge offered me a permanent position. And things were kind of turning down in the industry at that time, I thought, might be nice to have a permanent paycheque and I accepted the offer at Enbridge in the Pathfinders group and I've been in permanent employment now for six years with Enbridge.

BB: So is Arkril then on hiatus, shall we say at this point, or have you shut down the operation?

LUHNING: Well basically it's not shut down, it still exists but it's not aggressively active.

BB: Okay, yeah. So let's jump back then to when you started with Great Canadian Oil Sands which eventually of course became Suncor Energy.

LUHNING: Yes.

BB: Tell me a little bit about the work that you were involved in when you were with Great Canadian Oil Sands.

LUHNING: It was actually very exciting because at that time there was just no end of challenges and difficulties that were going on. While I was in the Edmonton office, I spent probably the majority of my time at site and so I got in my objection there and assignment there was to come up with potential solutions and identification of problems. And that ranged right from the rapid wearing out of the teeth on the bucket wheels that were in operation. The difficulties with the tailings pond that was always sort of getting failed at that time, we weren't building a dyke fast enough. Involved in the hot water process operation there, actually sat in the control room there for quite a while and learned about the process. Also was sent down Marcus Hook in the US, Sun's research department there and worked on related challenges and technology with regard to improvements on the operation and GCOS.

BB: So that was kind of your first time experience then with the oil sands when you were with the...

LUHNING: Well, I don't know if it was first-hand. The first time that I got directly involved with oil sands products is when I was with Imperial in Sarnia. And my job there was to formulate commercial lubricating oil formulations for marketing. They kind of... you developed them, tested them and they went almost immediately to commercial use. And one of the concerns that they had in Sarnia at that time, is that oil sands was going to be coming on, and it's got a different type of oil;



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different than the normal oil that's produced and used for the lubricating oil. So I was given the job of basically reformulating and testing every product with base oils that were coming out of the oil sands. And that was very interesting, some of the challenges you come there are ones you wouldn't expect. One of the toughest ones to reformulate was a cleaning product. And they told the customer we were going to be formulating it potentially. And they said, "Well if you do that you won't have our business anymore. We don't like change." So it all is a good introduction to quality and the customer needs along with the technical part of the business.

BB: What did you know about the oil sands before you got involved in that work with Imperial Oil?

LUHNING: Basically nothing. The only things I kind of knew about it is that there was some large resource that was potentially going to be coming into production at some point in future. But I only knew really about Cold Lake and that was because of the description that the Imperial folks gave when they were recruiting me. They talked about what the future might be and Cold Lake was one that was mentioned.

BB: And what was happening at Cold Lake at that time?

LUHNING: At that time, they had some pilot operations in production and so that's why they wanted to have a look at the implications of a different type of crude coming into the system, particularly for the lubricating oil usage.

BB: So by the time you got to Edmonton then you were somewhat versed in what was happening with oil sands?

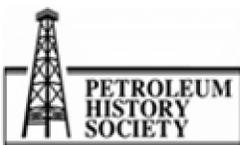
LUHNING: Well the first time I... I wouldn't say that. Well the first time I came to GCOS and got to the site, I had a look at it and said, "My goodness are we this desperate to get oil?" And then I thought, "Well, maybe we are." Because, it is certainly different than what expect out of the normal production that was going on for oil.

BB: Was your feeling that this was going to end up being a practical proposition or how did you feel when you saw the draglines and the bucket-wheels for the first time?

LUHNING: Well as I said, I thought we must be extremely desperate for oil to be doing this. But after you get into it and you begin to understand the process it is relatively straight forward process in a way. You dig it up, then heat it up with water and off-load say the bitumen and you run it through a delayed coker upgrader which is not an unusual operation. And I did have some experience with the... and the research department in Sarnia is attached to the refinery, Imperial Refinery in Sarnia. So I did know some things about upgrading. And it was a very, very kind of exciting because there was no end of problems, no ends of opportunity to take on these activities.

BB: How many years then were you with GCOS?

LUHNING: It was two years.



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BB: Two years, right.

LUHNING: Well I would've stayed longer but at that point they wanted to get some of their financial things in line. So one day they announced to all of the staff, none of you have a job.

BB: Oh, really?

LUHNING: Yes. None of you have a job. And over the next little while, we will be signing on people that we're going to keep. Well I'm with the... young guy starting out and I had just had my first child. We moved here from Vancouver, we took on a nice mortgage on a new house. I thought, "Hm. Maybe I should look at something else." Talked to folks at Syncrude, they seemed to be kind of... in their research department they weren't as closely, at that time, amalgamated into the activities. And that's when the phone call came from Clem Bowman and said why don't you join me in this activity with the \$50 Million bucks and we'll do this research and have it done in about five years.

BB: What was his position at that time? What was Clem Bowman doing?

LUHNING: Clem Bowman, he was chairman of AOSTRA.

BB: Right.

LUHNING: Basically started up the organization, of course with the direction of the Alberta Government. Now he had been in an upper management position in the research department of Imperial in Sarnia. So that's how I got to know him and he got to know me.

BB: So AOSTRA then was up and running at the point that you joined it?

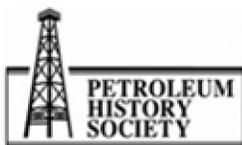
LUHNING: It had one office and an empty room and Clem Bowman and Morris Carrigy and support service and that was it. They had no projects running and the objective was to start things up and get it rolling.

BB: What was your understanding? What role then were you going to be playing with AOSTRA when you joined on?

LUHNING: He said... I guess that was left a little bit open. He said, "You're not going to be chairman because it's already taken." So it was going to be developing, broadly stated, as being in developing new technology to address the problems that are coming forward in oil sands. Specifically with the mine oil sands was to be the initial direction.

BB: Was that work then, what would happen to that research work then as you were going along? Would that then go to companies like Great Canadian or to Syncrude? What was the intent?

LUHNING: The intent on it was to work with the industry, companies in sort of a direct manner, sort of in an cooperative manner rather than AOSTRA setting off and doing projects on their own.



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And just sort of coming up and announcing, "Yeah, we have achieved this." So the plan from the beginning was a close relationship and a cooperative relationship with the operators and the owners of the resource.

BB: Right. So they would identify issues that they wanted to have dealt with? Is that kind of the way it worked? They would say, "Okay, we've got a problem in this area here. But can you guys come up with a solution and then it would..." Give me an idea?

LUHNING: Yeah, coming up with problems is not difficult. And so the challenge was, you're starting with a new organization, etc. You are going to be amalgamating with other, on-going research organizations in the province. You need to set up a method under which you're going to ask for project applications for joint funding on projects, get that up and rolling. So that was how it went forward. And the, I guess, the launch of it was asking companies to make an application to do joint research with AOSTRA. Separate from that AOSTRA set up a direct funding with the Alberta Research Council, for example, started to launch research projects through the universities, etc. in the area and this sort of thing; and then just built over the years as things went forward.

BB: Can you think of any particular challenges, give me an example of some major challenge that you found yourself on... on your plate, after you joined AOSTRA?

LUHNING: Well I would, I guess there weren't a lot of major challenges because you're getting things rolling. But if I wanted to pick one particular, very important challenge that came up for AOSTRA. This was after AOSTRA had gone forward and put down the shafts for the underground test facility and put in the horizontal wells for the SAGD operation. Had the **Haz Drive Process** that Chevron brought also running at that facility. Had, at that time, five companies involved. And at around that time the Alberta Government decided to... the whole province was in a situation where they wanted to cut back on expenditures. This was at the beginning of, I think, Ralph Klein's tenure. So things were cut back and we were in a difficult situation where with the existing money coming in from the companies and what was left for the funding, we would've had to shut down the Underground Test Facility. Stop work on the development SAGD process.

But fortunately, in the years before that we had been aggressive in developing international relationships, particularly with Japan and China. And we had gone over to visit them, have a look at their needs and the resource particularly in China. And we were able to, through discussions with the Chinese folks and Japanese folks; they came up and decided that they would like to join the work on the Underground Test Facility. And that happened and they signed up and the money that came in from those two sources, China and Japan, allowed the project to continue. And an interesting sort of tidbit on that is the one from Japan, the person that was dealing over there was **Dr. Hakimi Fujita**. But we went over, negotiated and this sort of thing on the agreement back and forth and this sort of thing and then came back to Calgary and nothing happened, nothing happened. Then on December 25th of that particular year, something arrived and the agreement was signed on December 25th, along with a Christmas card, you know, here you go, nice touch by Dr. Fujita there. And so we got



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across that and if we hadn't done that I know there certainly would've been a delay on the development of the SAGD process.

BB: So, because there was industry money happening, I presume that that had some impact on how government looked at the situation, in terms of expenditure going forward?

LUHNING: Well, yes, from a government point of a view and also from AOSTRA point of view, you wanted to have industry folks involved, helping to shoulder the load financially. But more importantly, you had the direct movement of the technology from the source into the possibility of going into a commercial operation. That sort of was always the drive on the Underground Test Facility one as well. So the Chevron one that they were working at, there was a horizontal well with a vertical well at the end of the horizontal well that put steam into the horizontal well and produced oil into the mine that way.

It worked quite nicely at the underground mine but they moved forward and tested it in the field north of AOSTRA's site on their own lease there. But unfortunately, the challenges at that time on drilling horizontal wells from surface, they had a lot of difficulty doing that as just about everybody did when you're starting to learn how to drill horizontal wells. And that project didn't turn out the way that they would've liked it to turn out. So that was the one of the two technologies that was tested at the Underground Test Facility. And then SAGD continued on and eventually moved forward into horizontal drilling from surface.

BB: Were you in the field then while some of this work was going on?

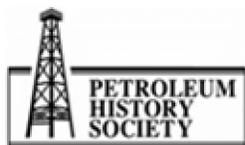
LUHNING: Yes. We were up there a lot, yeah, yeah. Particularly to the Underground Test Facility, etc. And at that time, we were also supporting other technologies for recovery and oil sands, in-situ combustion, cyclic steam, steam drive, etc. And, basically all of the oil sands areas.

BB: So this was practical hands-on work happening in the field, not happening in isolation, not happening at the University of Alberta or sort of thing. You're actually out there in the field while this was going on?

LUHNING: Yeah, it was run by... it was designed, built and operated by AOSTRA, obviously with people with the skills to do the mining and that part of it.

BB: And then would the people from industry then, be sort of seconded to work on different challenges as they came along? Is that how it would work?

LUHNING: Not the operating people, they were not involved in that. But they of course were... because they were involved in the project they had the on-going information, etc. But as far as hands-on, actually turning the valves and pumping the oil and putting the steam in the ground, no, that was entirely AOSTRA's staff that did that and contractors to AOSTRA.



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BB: So you started out then with one almost empty office and a chairman and by the time things were up and running and rolling, how many people were actually working for AOSTRA then, over the years?

LUHNING: Well when I was the acting chairman and I got the nod from, at that time, it was Minister Pat Black, our Minister of Energy. There were 100... My job was to work out movements of people to other places in the government or termination packages. And there were 107 people at that time that got a cheque from AOSTRA. Now they were all employees, they were contractors and etc. And so that went forward and at the end of the day, I got mine as well.

BB: All good things come to an end.

LUHNING: Or a start, somewhere else.

BB: Right, yeah. So then obviously, regular reports would be going to the government then throughout the process. So the government would know what was happening with AOSTRA?

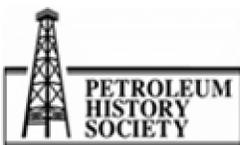
LUHNING: Oh yes, yes they definitely would.

BB: I mean, aside from the challenge of where the money was going to come from, as you mentioned on that occasion, what was the reaction generally would you say, from the government to this work that was going on jointly with AOSTRA and the industry?

LUHNING: Now I've only focused on the UTF because that was the core one and that was probably the crowning achievement, the SAGD achievement. I mean that technology is, as you know, is used widely in Alberta. And it will probably produce more oil than there is in surface mining. Surface mining is maybe 10% to 15% of the oil sands. And then after that it's in-situ recovery because it's too deep to be mined. So of course, they were very, very interested in that. And besides the Underground Test Facility there was joint funding on a whole variety of other... cyclic steam, steam drive, in-situ combustion, operations that were operated by the companies with financial support from AOSTRA. And one of the things that AOSTRA did was assigned a person to be in the offices with the operating company basically to understand what was happening in the technology. So that when the time came there could be an organized technology transfer to the next group that wanted to use that technology.

BB: Right, yeah. Who were some of the key people then that were involved in that process?

LUHNING: I have the AOSTRA 15 year book here. And in here we have all of the folks that were working at that time and through this period of time, in here. And there's a whole variety of folks in here and a lot of them would be people who are still around and have become highly set up in the industry and this sort of thing. And so, if you look at, for example you should take... let me pick a person here, for example, Cameron O'Rourke, he was the site manager at UTF. So he's now at Husky and still involved in oil sands. Then you had Neil Edmunds. Neil Edmunds, he is an expert in numerical simulations and so he sort of took the SAGD technology that Roger Butler had invented



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at the University of Calgary, and Roger was on the UTF Project when it began with the start-up with the UTF there.

BB: Sorry, if I can just interrupt. Did you have any involvement yourself with Roger?

LUHNING: Oh, yes.

BB: You did, yes?

LUHNING: Yeah, in fact, this would be when AOSTRA kicked off in Calgary, we had offices in the RCB Building and Roger was next door to me in the offices there. So, yeah I had a very close relationship with Roger during that period.

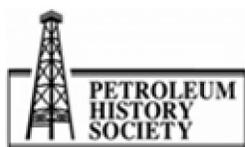
BB: Right.

LUHNING: Then of course, Roger was involved in the project as we went forward on the UTF to do SAGD. And Neil Edmunds was a person who is very expert at numerical simulation of oil production. So he put together the nuts and bolts and a numerical simulation to actually predict how the SAGD operation worked; how to control it in the wells at the UTF, etc. And Roger stayed with the project, but Roger's a scientist and this sort of thing. And he found that when you're operating in the field, it just goes to slow. So he had other things to do and he went on to do more inventions at the University of Calgary.

The next one that he came up with was **Vapex**, so we'll be talking about that at some point there. So we have a whole range of people that did things from work at the site, were involved in actual cataloguing and putting the technology that was developed in a situation where it was there permanently, it could be transferred to people. We had people that looked after the other types of operations, the surface mines from the surface. I had operating projects going, etc. And all of those had people that were involved in them. And it's a number of pages of folks here that were involved at that time and I might mention some, for example, Bob Turner. Bob Turner was a person who was involved in the upgrading part of the operations and directed the upgrading projects that we invested in. Doug Komery, he was a person that was expert in mining and extraction. He followed along those lines and went into that. Dr. Ernie Wiggins who is former chair of the Alberta Research Council was there and he was the "Grey Eminence" to keep us on the track.

Roger Bailey, Roger was an upgrading expert and looked after the upgrading projects. Brad Anderson worked in technology transfer with AOSTRA at that time. And Brad Anderson now is the head of the Alberta Chamber of Resources in Edmonton. John Scott, John was involved in basically a good understanding on operational aspects on the pilots, etc. Jack Aston, he was the manager in Calgary of the Underground Test Facility. I can't remember if I mentioned Cameron O'Rourke...

BB: Yes, you do it.



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LUHNING: ...I think I did. Cameron was the man on site and he ran the place. So if things happened, he fixed them. Good things happened and he got the praise for them. Who else should I mention here? Bill Good, Bill looked after the... not SAGD but sort of steam drive and projects as well that needed investments in. The others that were quite important were the library and information services. And Helga Radvimi was the head of that. So when the information came in, it had... we knew this was going to be around... this wasn't going to be a short-term project and you wanted to have all of the information that came in, readily available, so that when the time came to transfer onto others it was in place and Helga looked after that operation. The other person I should mention is Chu Chsi. And Chu was a manager of institutional programs, but also he was our person who did the international. And he was the one who had the different languages to help us out when went to Japan and China. And what he did there was sort of instrumental on having that money come in when we needed it, from China and Japan, that saved the SAGD process from having to go into hiatus. So it was an integrated group.

BB: Over how many years does it take for the process to be developed from the time, shall we say, that it left...

LUHNING: From the day of the empty office until productiveness?

BB: Right, yes.

LUHNING: This is one was the status at 15 years.

BB: 15 years, okay.

LUHNING: And of course, it lasted for 20 years. So at 15... Well the other great thing that happened around that time, around that time there was a lot of negative feedback from industry about the Underground Test Facility, and why you're down there and what are you actually doing down there. And on July 3rd, 1989 in Oil Week (there it is, an original copy of it) they put together a while issue, a whole entire issue of, in this Oil Week here, and they went through all of things that Enbridge had basically done. Including, AOSTRA and the future, talking about the CO2 projects, mine-assisted, AOSTRA overcoming the problems of water usage and addressing tailings difficulties and this type of thing. So after this issue came out, a lot of the sort of negative feedbacks, the talk from industry kind of turned around and a lot of people had a different attitude towards the technology development and where we were going from there.

BB: Why had the talk been negative?

LUHNING: People thought that it was a dumb idea of going down, in the bottom of a mine and drilling horizontal wells. Why don't you drill them from surface? The reason you didn't drill them from surface is because people didn't know how to drill them from surface. You could not drill horizontal wells from surface. In fact, there used to be an organization in the US that when you drilled the horizontal well, they sent a something to put on your wall that says, "Congratulations, you drilled a horizontal well." So whenever we put in one of our ones from underground we got one of



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these plaques that you had achieved actually drilling a horizontal well. And of course, one of the real difficulties that came when you had to drill the horizontal wells, if we're SAGD from surface, given that it was an emerging method to drill horizontal. The first ones that were done like that, they basically failed. They just didn't get them long enough; you didn't get the accuracy, etc. Imperial helped us out and they drilled a couple of SAGD wells at the UTF. They didn't turn out that well and they had difficulties. But because we followed along with those, we had had some ideas on how to drill SAGD wells. And so we drilled I think the very first full length, SAGD well with some different technology we used that actually allowed it to operate as a SAGD well at the UTF site. And these are wells from surface, drilling wells from surface. And there were two patents that came out of that, one was on the method to do it and the second one was how to drill SAGD wells that are close to a heated reservoir in the arch of descent.

BB: So that clearly was a major achievement of developing that SAGD technology during the time that you were there?

LUHNING: I think if you had to point at one major achievement, if you look at where the oil comes from today and the future and this sort of thing, SAGD is... and you look at the number of companies that are now operating with SAGD and expanding with SAGD, every company goes with SAGD or some variant on SAGD. There were other variations that were tried, the Vapex one that Roger Butler came up with and solve, etc. And so there are variations on it but the base sort of SAGD one, inject in the top and produce from the bottom, it sort of stays popular.

BB: Yeah, yeah. What is the name of that book by the way?

LUHNING: This is AOSTRA's 15 Year Portfolio of Achievements.

BB: Now is that an internal document, then?

LUHNING: No, this was put together internally but this was distributed widely.

BB: So we could find it in the library or?

LUHNING: Ah, yes you could.

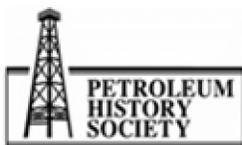
BB: And 15 years being from when to when?

LUHNING: That was from when it started until...

BB: About 15 years later.

LUHNING: ...15 years later, yeah exactly. From the day that Clem Bowman kicked it off until 15 years later when Bill Yorke was the chairman at that time.

BB: Right, yeah.



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LUHNING: And so they... it looked like 15 years was a round number and it was time to do this.

BB: But as you say, it didn't stop there, like 20 years later it was, it was continuing on?

LUHNING: Yeah, continued on, yeah. There is a couple of reasons, one is you put it an organized format so people could see what you've done. And also, the other part of it, it was a good time in order to sort of say what you achieved in that period of time so that maybe funding would be available for the next few years, which it was.

BB: So why was AOSTRA then eventually phased out? How did it sort of... was its work done? Was that kind of the situation?

LUHNING: Well, I think you got into a situation where more and more and more companies were coming into the oil sands in a more aggressive manner. They were actually putting a lot of money into their activities. SAGD was taking off and doing well. The surface mining was that were going were doing well, etc. And around that time, again you're in a situation in the province where you're getting a little short on money and this type of thing. So I guess the decision was made that, okay this was a great thing that you've done. There were other spin-off organizations that a lot of them were created through AOSTRA and that could carry the load. And so the decision was, okay we're going to make the investments instead of going into the central AOSTRA, and then AOSTRA funding this, and this, and this, they would have direct control of the funding to these new organizations.

BB: So AOSTRA sort of kick-started the thing and now it was time for government to kind of pull back and let industry kind of carry on?

LUHNING: Industry was going to carry on, there's no question about it. And you know why industry's carried on; thank goodness they did, because now I guess we're the dryer of Canada's economy. And it is oil sands that does it. And the bulk of it now comes from the SAGD process, that's the ones that are going forward there. So I think that part of it that kind of worked out a whole bunch better than people thought and may have gone quicker than they thought as well. Going from ground zero to having a widely commercial process in 15 years is a pretty good charge.

BB: And you have been involved with it pretty well since day one?

LUHNING: Well, when I walked in the office there was Clem Bowman, Morris Carrigy, Betty (sorry), I can't remember Betty's last name, I'll have to go in here. And that was it. Clem had an office; the rest was set in an open room until we got offices and this sort of thing.

BB: So how did you feel when eventually it was the day to sort of shut things down, close the door and that's that?

LUHNING: Well it's a ... let's put it this way, it hurt a lot. It hurt to be now out of the center of the hurricane, if you like, on the technology side. But, nothing lasts forever. And you move on to other



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things and continue to be involved in the business of a new technology and new oil sands technology as well through my Arkril company. Things that Arkril did... basically... it was kind of also... sort of a same mould that was used at AOSTRA. You start a multi-client group, do the operation there, develop the technology and go forward from there. That worked out well.

BB: Now you mentioned SAGD, of course as being kind of the biggie in terms of what AOSTRA did during that time. You mentioned some other processes that AOSTRA was involved in as well. Maybe you can tell me a little bit about those?

LUHNING: I guess the whole range of them and let's just go back to the oil... they've got a nice one there. The other one that AOSTRA brought in early was with enhanced oil recovery. Yeah, one of the first ones was with using carbon dioxide for enhanced oil recovery and, at that time, launched through **Vycor**, an enhanced oil recovery operation... first enhanced oil recovery operation with carbon dioxide in Canada. It was done just outside of Red Deer there, using the source of CO<sub>2</sub> and into that and that one. So that was one that kicked off that was on the enhanced oil recovery side.

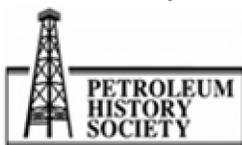
There was the Taciuk Processor. And the Taciuk Processor was basically a rotating kiln in which you could put the mined oil sands and it would generate its own partial combustion heat to separate the oil from the sand and to upgrade it as well. That process also had oil shale come in from Saskatchewan; that was run in the Taciuk Processor. And it was also taken by Sunoil to Australia; very large shale deposits there and the Taciuk Processor was operated there in Australia. So we kind of got some coming around the world. In-situ combustion, we did in-situ combustion project with BP at Marguerite Lake. We used both air and oxygen. That was an adventure, using oxygen for in-situ combustion. And one of the most exciting points we did there was, it's called like cyclic steaming with combustion, it was like cyclic steam but do it with combustion. It was called the Burn Turn Process. Except when it was done at the site and you started having that fire come back to, it was called Burn Turn and Run Process. So it was interesting but kind of hard to control and it always went to the standard type of operation with in-situ combustion dry part of it there.

Here we are here, the AOSTRA vision of the future, right in the one from Oil Week, "Priority given to the tailings ponds problems." And this right back in 1989 and all of the things that we had kicked off there working on oil sands tailings; there were university people working on it, companies working on it, etc. And it's a tough one. CONRAD, Canadian Oil Sands Network for Research and Development was created around that time. And one of their pieces of work that was going on through CONRAD was with the companies involved there, was to keep pushing on the tailings pond of it. CONRAD exists to today and one of the longest running efforts in that organization was on the tailings ponds part of it, how to get around that difficulty. Quite a few years ago, we still haven't got it perfect. It's getting better and closer.

BB: So these other processes are identified in that Oil Week article.

LUHNING: Yeah.

BB: Did many of those, end up having a commercial application?



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LUHNING: Oh yeah, the different ones from the cyclic steaming and the cyclic steaming improvement ones, those carry on. The SAGD one became the most favoured one, basically because it was easier to operate and the production rates were steadier and went for longer periods of time because your wells were covered for a longer period of time. Of course, Imperial in Cold Lake; they have been extremely successful with their cyclic steaming method and they've come up with different patterns, etc. to improve the recovery on it. Imperial, at that time, was the operation that was commercially producing Cold Lake oil sands. And still are. Here we've got the CO2 injection and we've talked about that and the upgrading part... Upgrading was a difficult one to make advancement on because it takes so long to develop upgrading technology. You have to set up the operation, have years of operation running it, so that's it's predictable and controllable and makes the product.

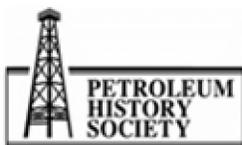
So we did work through the universities on upgrading, but never went to large pilots on it. The other part of it that I really should push is that when we began this we wanted to increase the number of people that would be working technically in the oil sands area. So it went very aggressively right from the beginning into having the university funding there. And there's two reasons: one, they do good research and come up with good ideas, and the other part of it you sort of had the vision that as the industry grew you needed to have people that were knowledgeable in the oil sands area. And so you wanted to have people that were doing their work and learning at the university, getting their degrees at university, doing things related to oil sands. So when they graduated they could go directly into the oil sands industry. That part of it worked out well, in fact, used to give masters degrees for oil sands projects and this sort of thing that AOSTRA had set up.

So as to have the next generation that comes along that had already started on oil sands, because this was obviously going to become, if it was successful, it would become just a major employer as it has. **Avact Process**, I like this one because, myself and Ken Ronaghan here we co-invented this **Avact Process** and it's a method for stopping water invasion into oil wells; particularly, the type of oil wells that are on the bombing range in the southern part of the province. And this one, it was a little bit, fairly popular. And Ken was one of the seasoned folks that followed along with the field projects that we were funding and was in the office with some of them, basically to do two things: to follow along with the technology and help out on the project.

So we were very lucky to get kind of senior technical people that had technical knowledge and had been a long time in the oil industry in Alberta. Because a lot of folks that were working on the oil sands projects, making oil from the surface, they were kind of younger folks so we wanted to have a steady hand there representing us. And also, given that you had an experienced person like that on the project directly with the companies, it kind of reduced the critical feedback saying, "Well you're all a bunch of government office sitters, what do you know?" Well here's a guy that's got 40 years in the business.

BB: And you were part of the invention of that process?

LUHNING: Yes, we were co-inventors with that sort of thing.



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BB: Well we definitely have to make sure that we have a copy of the book too.

LUHNING: Oh yeah, yeah.

BB: I'm sure it's already at the Glenbow, but we'll have to look into it as part of the history.

LUHNING: Dr. Ernie Wiggins, Ernie was the chairman of the Alberta Research Council when he joined AOSTRA. I mentioned Bob Turner he was the person in charge of the upgrading technology. Douglas Komery and he was manager of the mining extraction portion for surface mining. I mentioned, I think, Roger Bailey and he was manager on the upgrading project. I didn't mention George Villett and he was registrar, he was the person that got all of the incoming applications and made sure they got through the process correctly. Oh yes, Walter Kowaluk, Walter was in charge of the finances. So he kept a tight rein on the financial part of it and made sure that when we got audited everything was "tickety-boo" and nobody got any sleight of hand. So Walter was a hard-nosed financial guy, so nobody got away with any shenanigans.

BB: If I can just jot down the point, you mentioned the figure of \$50 Million dollars to begin with, what was the annual budget then after that initial seed money, shall we say?

LUHNING: I think all of 20 years I should know that number. But I think we probably hit close to \$200 Million, but I'll have to get back to you on that. That part of it, what the actual end date number was on that.

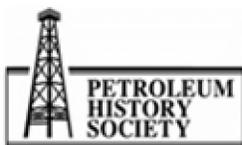
BB: You mean the amount that spent over that 20 years or so?

LUHNING: 20 years, yeah.

BB: Yeah, right.

LUHNING: I mentioned Brad Anderson, Brad is the chair of the Alberta Chamber Resources. John Scott and he was the manager on in-situ projects. Mike Carleton, now Mike's job was to collect all of the information that came in, in digital form from the operations and put it into a database system, a retrieval database system. So that when you wanted to know what that well did, on that day, on that project then it was there. So every piece of data was taken care of that way. Jack Haston, Jack was the project manager for the Underground Test Facility, so he was a... Cameron O'Rourke, Cameron at the site and Jack Haston was the manager in Calgary. Bill Good, Bill worked on a variety of projects basically looking at the economic side of it to see how close we were getting to commercialization. Jack Suggett, he was a facilities engineer and worked on the UTF and our other projects. And Jack is, I don't know which company he works for but he's certainly set up comfortably in one. Ken Kisman, reservoir engineer and Ken started his own company after Enbridge, not Enbridge but ah... after...

BB: AOSTRA.



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LUHNING: ...AOSTRA ended and he's acted in the business. Did I say Neil Edmunds already? Neil was the guy that had developed methods for predicting SAGD performance and the numerical simulations for that there. He and Roger Butler used to butt heads over this a lot, but it was back and forth and they both... that. Oh yeah, Dave Redford, Dave was a scientist from the Alberta Research Council and he was a real good resource on the detailed side of oil sands and behaviour of bitumen. Chu Chsi I mentioned. Ted Cyr, Ted was in charge of the funding for the university research program. Ted is a really sharp guy, Dr. Ted Cyr. So he'd go out and he'd challenge those university professors and this sort of thing about their projects and spur them on or get to understand exactly what they were up to and did.

I mentioned Helga Petri, now Helga she married and got a different last name but her original name was Petri. And she kept the library part of it and they insisted on having both digital and paper copies in there and she had quite a number of folks working on that part. Harry Gunning, Dr. Harry Gunning. Yeah, I think he was the president of the University of Alberta at one time. And so he was involved in AOSTRA of course, and the university side of things. Sort of cutting down the back and forth on the financial side between AOSTRA and who was getting funded. He was a nice intermediary person that made sure things ran smoothly.

BB: So what happened, you mentioned the databases, the digital materials that were saved and that sort of thing, what happened to those databases?

LUHNING: That was transferred over seamlessly; I guess it's called AITF now, Alberta Innovates Technology Futures. These are I think still housed in the Edmonton office of AITF. And some of the folks that are in here, they also went to AITF and they are in the AITF in Calgary. So not everybody got a termination package, they got a transfer to other places in the Alberta Government organization. So that's not everybody, but ah...

BB: There are some of the key people. Did you mention if Mr. Bowman's picture is in there?

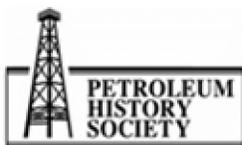
LUHNING: No it isn't, not in this one, it should be. There it is, right here, there's Bowman. Dr. Bowman is right here, sort of a little later in life, a grey haired eminence. And Clement is still active, he has developed a technology that he licenses that allows you to, in an organized fashion, evaluate applications for funding; particularly ones who are coming from the universities and this sort of thing. And actually, Clem visited here less than a year ago and we got together and had a good chat about the past there and it was quite nice.

BB: I believe we've interviewed him, actually.

LUHNING: Oh yeah, so you have his...

BB: And that looks like Dr. Karl Clark.

LUHNING: It is, that's the man.



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BB: Yes.

LUHNING: That's the man. Karl Clark, now how can you believe that he's getting onto, I don't know, 70 years since give or take since he invented the... heat up the oil and oil sands and it'll float on water at certain temperatures and not other temperatures and nobody's improved on it. But there are things happening that are hopefully going to come through with a different kind of process to replace the hot water process. There is one that will work similar to the hot water process but will not produce the tailings difficulties and it eventually will happen.

BB: Who is working on that aspect of it?

LUHNING: I can't give you that name.

BB: Is that right?

LUHNING: They've got a takehold.

BB: Okay, that's fair enough.

LUHNING: However, if you leave your name and you want to make an investment, we can maybe make an introduction. Shares are going up though.

BB: So somebody is working to improve on the work of Dr. Clark?

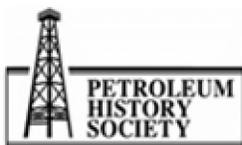
LUHNING: Oh yeah. Well it's been a while, you've seen 50 years at least.

BB: 1930s I think somewhere, or 1920s actually I think?

LUHNING: Well yeah, it's a long way back and surely you can come up with something that will do better than that, maybe.

BB: As an engineer yourself, are you impressed by the...what Dr. Clark came up with?

LUHNING: Hey, it works and nothing else works as well and it's simple, it's understandable and this sort of thing. When I was in GCOS and I sat in the operating room with the fellow that ran it, one of things, it's kind of interesting but one of things that he did that time, he put a little caustic in with the... when you're doing the separation with the hot water process. And at that time, GCOS wanted to cut back on costs and all this sort of stuff and what have you. So the operator in charge there, well he said, "Well, we'll save some money and this darn caustic cost a lot." So he stopped putting caustic in. And during that period, that month it was off, they had the best production ever. But when management found out about that and said, "You did what? You turned off the caustic. My God you're not supposed to do that, that's the Karl Clark process, you've got to put the caustic in there." So there are things like that that can be adjusted.



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BB: Okay, well that gives us a great kind of a rundown on the AOSTRA years and so on. And then you moved on from there to establishing Arkril Enterprises. Where does the name Arkril come from?

LUHNING: Well my wife's name is Arlene Janet Kuiak, so A-R and a K is the Ark and it's Richard Luhnig, R-I and an L, so it's Arkril, just made a combination, part of it there. And it was not used by anybody else which is helped out when I needed to do a search.

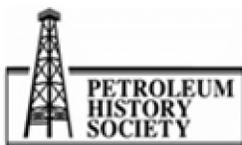
BB: What are some of the key projects, oil sands projects that Arkril was involved with?

LUHNING: Actually, I'd like to have CV thing there, then I can get it in order more easily. It's like looking at this part and then I have a memory of it. It started off with a lot of ones that kicked off on Arkril. I guess one of the ones that had the... When I left, I got involved in two organizations. When AOSTRA shut down, the UTF Project was taken over by Gibson, a trucking company. And so Gibson was running the operation at the time and Cameron O'Rourke he was in Gibson. So, one of things that Gibson wanted to do is, that they wanted to have a SAGD well drilled there and one that would work, actually one that's not going to fail, that's the big problem.

So I got involved on that part of it and we went and drilled that well up there using some new technology on that there. And the technology we used was waxing the open part of the well with wax such that you were able to have a circulation of the mud to keep the drilling muds and drilling muds come back to surface. And that was the process that was used on the underground drilling and it was invented by a fellow called Cal Bohme. And Cal, he came up with this idea for the underground wells, a way to circulate it and get the cuttings out. And also Cal Bohme, he designed the drilling rig, the underground drilling rig. That you haven't got any weight to push it down, so he had the thing organized to put the piston up against the far wall and drive the cutting head of the operation into the oil sands. Then of course, pull it out and put in the liner. And those were very, very... and he came up with the method to follow the trajectory up and to make sure that it was on course, etc.

Now in here, I think somewhere in here we have... we call it the picture of the happy driller and this was a fellow who was... maybe I can't find it here, it doesn't matter anyway. And it was the fellow that was running the rig there and he had a big grin on his face when I had the picture taken there, so we call him the happy driller, the happy driller picture and it got used quite often. So the wells actually got put in very nicely, very easily. As I mentioned earlier, we got the plaque for drilling a horizontal well from the US company. So Cal was also the co-inventor on the one we talked about here. And he was... what he did there was remarkable, because without him coming up with the method to do that, the method to measure the trajectory and the design of the rig, I mean wouldn't have had the opportunity to develop SAGD and underground that way. So that part of it, that worked out quite well.

The other ones I worked for, Nexen. No, I was Petroleum Recovery Institute. It was an institute that was actually started through ERCB. The ERCB at one time was not happy with the slowness of



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technology development for the oil industry and created Petroleum Recovery Institute at the university. So I was a contractor there and got involved in Vapex, development of the Vapex process which Roger Butler had invented. And Roger is an inventor but he doesn't want to spend time doing it in the field. So we picked it up there and we promoted it through a number of companies getting together, I think we had 18 companies or so and Vapex. And eventually got it into the field with North Star Energy Corporation and it was done at the UTF and it was called the Dovap Project, and that comes from Dover was the location where the UTF Project was and vap or vapour, Dovap Project. Put the wells in there and got a lot of funding out of the federal government on it and ran the Vapex Process there. And it's a non-thermal one where you inject propane. It dissolves in the oil, so that you can... the oil drains into a lower well and you can pump up at the surface. It worked well but not well enough to become widely used.

Actually, Enbridge invested in a similar one like that called Ensolve. And that was one where they used a propane cocktail to test that. And they tested that one also at the UTF Project on surface mine part of it. And it kind of worked, but it needs some more effort there. Now Nexen, Nexen took me on through Arkiril. They wanted to put two Vapex pilots in heavy oil, not oil sands, in Saskatchewan into the Winter Field; largest heavy oil fields in Canada. And I led the design team and construction team for those projects and started them up and then I moved on and they continued operating them themselves. Then Petrobank, Petrobank wanted to do the toe to heel in-situ combustion project. Chevron had their **Haz Drive one**. They injected steam at one end and into the horizontal well. And this one is the toe to heel air injection. It was combustion at the end of the well for heat instead of steam. Same thing; pushed it along the well and produced it. So they put that in on there and their operation in Cold Lake, on that part of it there. It was a technical success, I think.

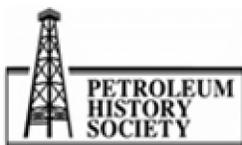
BB: Commercial success, too?

LUHNING: Not yet. That part of it was taken over by Petro-Canada they were a participant in that. And so Petro-Canada asked me also to write the final report on that one, which I did and they had funding from the Federal Government on that. And then Suncor, Suncor asked me to come on board and start a... they wanted to have a joint industry project run by Suncor but they wanted to invite other industry folks into it. They asked me to set that up and develop their thermal solvent process. And that one, again, an in-situ process and that's one that they are now running off their in-situ side in Athabasca. Let's see, Rising Phoenix, that was a SAGD plant in operation in Wyoming and I worked on that one. Alberta Department of Energy, they contracted me to write a comprehensive marketing report on SAGD development, this was a joy. I did the same thing. Nordic Acres were interested in knowing about SAGD so I did some work for them on that.

BB: Sorry, would you have a copy of that report that we could probably have for the...

LUHNING: You'd have to talk to the Department of Energy on that.

BB: Oh, I see.



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LUHNING: Actually, the way to get it, it's no longer Department of Energy. It would go to the Alberta Research Council in Edmonton and they are the licensing folks for the technology now. And so they would have that and they use it to promote people to understand and to buy and licence the technology, so it's available.

BB: So this was work that you did for the government.

LUHNING: Yeah.

BB: So it would be up to the government to release it.

LUHNING: Yeah, they use it for that. Then Arkril was an investor in CHOPS, Cold Heavy Oil Production with Sand Process. And that's where you use a down hole pump that can do both heavy oil and sand production, it works quite well. The other partner in there was a company called the Predators. It actually worked out well because it was on native land there, and it worked well and then they wanted to buy us out and have it go over back to the band, that part of it. Revenue Canada on their Scientific Research and Experimental Development Program to look at what people were asking them to fund and to see is this worthwhile, so that part of it. The Petroleum Technology Alliance Canada worked on upgrading process for the course, and this was an interesting one, it was one that industry wanted started; coordination of university research for Synergy and Effectiveness.

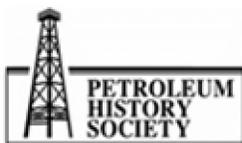
So what they wanted they wanted to do there was not run their funding through government side, they wanted to directly pool their money and directly invest it with the researchers and so I was the person that was getting the applications come in for this particular funding course. And the newsletter we called On Course. And Petroleum Recovery Institute, we did a number of wells there, not wells but water abatement type processes that were developed at PRI and also the removal of piro-bitumen from productions, it was called a **Pristi Process**, part of it. So a whole variety of things there and pretty well all of them were heavy oil or oil sands related.

BB: You mentioned the Vapex, did you have some involvement with the Vapex technology when you were with AOSTRA then, or before that? Or, was it more with Arkril that you would have...

LUHNING: Oh, no well Vapex was... that was kind of developed through with funding from the government and through Roger Butler and moved on from there. And it was done outside of the AOSTRA funding part of it. On the one that I was involved with the funding came from the Federal Government, the Dovap one. That was done with Northstar and Petro-Canada and Nexen.

BB: Before we leave AOSTRA behind, shall we say, is there anything else that we should perhaps know about AOSTRA? Anything else that you can think of that we haven't talked about that we should perhaps mention?

LUHNING: I guess the one thing that I didn't mention that was important and I should've mentioned, is that the Alberta Oil Sands are very large, one of the largest in the world. The Grossmont carbon is even larger yet, larger yet. So AOSTRA did projects in the Grossmont



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carbonate and they worked relatively well initially, but then when you expanded them you get some successful on site expanded. The problem with the carbonates is that they have like small tunnels in there in the carbonate. Very difficult to get the spread of the heat and the production to go out in a manner that's controllable, and so that's the big difficulty that... We've got great production for a period of time on some wells, but when you tried to move up in a larger pattern it got to that problem. Now I see that CCMC has given funding to companies to go back into the carbonates and have another shot at it. So if in the next 400 or 500 years we deplete the Alberta Oil Sands, we'll have another 1,000 years in the carbonates. I think that was the only one that maybe I didn't mention, it was important because it is a massive, massive reserve.

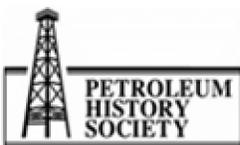
BB: You mentioned funding or the lack thereof, this sort of thing, a challenge that came up at one point. Were there other crises along the way or was it all fairly smooth sailing would you say?

LUHNING: When you have funding then you get technical difficulties and this sort of thing. Things may work and may not work. But when you go into these projects, you recognize that not everything is going to work and not every one of these is going to be a winner that's going to be commercial. Like SAGD was one that went all the way and became commercial, another promising one like Vapex, okay it has some positives on that but it has its spread out and this sort of thing. The co-production of sand and oil, that is still practiced and it's a good kind of a process. But again, used on smaller resources. It's just like when you're playing ball you're not going to hit a homerun every time you're at the plate; if you get a couple in your lifetime, maybe of this type in your lifetime, that's pretty good.

BB: Well, right now with Enbridge, since you left Arkril behind, have you been involved with oil sands projects through Enbridge?

LUHNING: Yes, yeah, dragged Enbridge into oil sands. Well we got involved in the Ensolve Process and so that one is one that Enbridge is funding and that is continuing technology development and we've got a location to test that out. It's kind of slow in happening but it's one that Enbridge invested in, an early one. The other one Enbridge invested in, is Value Creation. They have a thing Value Creation had a very interesting upgrading process. And with Value Creation, their approach was that in order to sell something to refineries, what you want to give them is the minimal pre-refining, because the refineries make money on refining. So they don't want things coming in there that are over re-refined. So the Value Creation had a process that did that and actually started to build, with some Enbridge input, BA Refinery in Fort Saskatchewan. It did not... it got built, there is still a fence there and some remnants of equipment, but like every other new refinery in that area they had a lot of difficulty.

The interesting thing with that is it also came with a large holding in in-situ oil sands so Enbridge actually has added to a pretty good position in the oil sands part of it there. The other thing that Enbridge did was looked at on CO<sub>2</sub> capture and sequestration. They kicked off a project there that had 38 companies come into it, looking at capturing CO<sub>2</sub> and pipelining and sequestering it. One of the earliest ones they got involved there was just after the Kyoto thing came out, Syncrude, Suncor



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and Enbridge had a look at how much CO<sub>2</sub> could be captured. And got the pipeline route to where it would go to be sequestered, cost estimated that, came back with a toll on moving the CO<sub>2</sub>, worked with enhanced oil recovery people that would get it to see how they enjoyed it, or that type of toll. But, the CO<sub>2</sub> never got captured and we haven't built pipeline yet. But the other one that's going forward on that one is one called a CO<sub>2</sub> slurry pipeline. In Fort McMurray Syncrude, for example, has a very large amount of sulphur that's piled there because there isn't enough rail transport. And if you're going to build a CO<sub>2</sub> pipeline, then it's going to have a flow in there, maybe you can do something else with it other than move CO<sub>2</sub>. So the idea there and we started a group with 18 participants to put small particles of sulphur into the CO<sub>2</sub> pipeline, move it down to CN Rail, separate the two and put the sulphur on CN Rail out to the coast and sell it to the market. So we have 18 participants on that and we're just rapping up that project now. So there are a couple of ones there that we've done that are oil sands related.

BB: Yeah, indeed. Just before we leave Arkril, is there anything else you should mention about Arkril's work with oil sands?

LUHNING: No, Arkril is basically dormant right now other than for a few little things, but certainly not a major part of my life right now.

BB: Let's move on to... how are we doing for time here?

PT: We're an hour and a half now.

BB: We're an hour and a half?

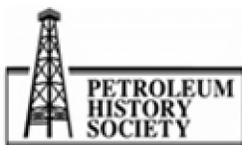
LUHNING: How long do you usually go?

BB: Usually about an hour, so ah.

LUHNING: Okay, well I've exceeded it already.

BB: If it's okay with you, maybe we can just maybe carry on with some general questions and then we can kind of wrap it up. You talked about... during your time with AOSTRA, of course there was research and development was a key focus. Just looking generally, are there different directions perhaps that the science and technology might've taken over the years, or should take perhaps in the future as you look back on the work of AOSTRA and what will be needed in the future? Is there anything that sort of jumps out?

LUHNING: Well I guess the things that are needed in the future are obviously all the push-back on the oil sands on the environmental side and this sort of thing. The CONRAD organization is one that was launched through AOSTRA and I was one of the signatories assigned to create that. And I think I mentioned it earlier, that they had been, over the years... that has been the one that industry has kind of... the surface mine oil industry, has been having a sort of a role in looking at coming up with solutions on the tailings ponds; how to settle it and this type of thing. And that's going on and



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the new one that the oil sands industry came together, the COSIA, Canadian Oil Sands... I forget what "I" stands for.

BB: I'm familiar with that, yeah.

LUHNING: So that's going to be a real good, new start in that area to kind of share a little bit more the technology that they want to share on these particular problems. I think the two big ones are the tailings ponds and CO2. So I think they have to put a good push on the those two elements.

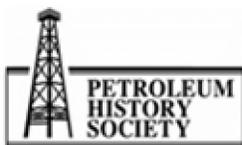
BB: And that's going forward and I guess I asked it, is a two part question. In terms of the way that the science and technology has taken things up to now, what's your feeling generally about what has gone before?

LUHNING: Could you have done it faster, better and cheaper. Sure knowing what I know now, I could do it a lot faster, better and cheaper but when you start, you start with a resource, a huge resource that people don't know a whole bunch about. There were some... it had GCOS going, Syncrude was just being built. Back when I was in GCOS, one of things I did was helped in small part to actually write part of the technology package on the tailings ponds that went on to Syncrude. So, that was kind of a long way back, so you're starting at a pretty low level. There was in-situ recovery in the Cold Lake oil sands with cyclic steam with Imperial, but that doesn't work in the Athabasca for various reasons. And people tried it; Shell tried it for several years and didn't have any success on in-situ recovery in the Athabasca.

So you're starting off with one mining operation, the second one being built. You've got this massive in-situ possibility none of which has worked before and a lot of smart people tried it beforehand. So you're starting pretty far back on the learning curve. So what would you have done better, what would you have done different? Well, if you hadn't done the putting the mine down there and actually being able to put the horizontal wells in there. If you tried doing that from surface, I think would then delay for a long, long time; because even when horizontal wells were starting to be recognized, even though you've got award if you happened to drill one, it certainly wasn't one that there was widely spread. And anybody that saw the initial idea of drilling one well above the other, man how can you drill those possibly. What do you mean it's just going to drool down there, drain down there? You've got to be kidding, you know? You can cycle it and pump it to the surface, cyclic steam.

So I think that if you didn't have someone who was willing to take the risk on doing these things, you'd wait a long time. And I don't see why industry would've taken that risk as quickly. In particular, since companies like Shell spend a lot of time trying it in Athabasca and came up... they're not... they're a highly qualified and very strong technical organization and they couldn't come up with something.

BB: Well I think you've kind of answered the question for me, that when you develop something like SAGD and it turns out to be very effective, it turns out to be a terrific method. Why is it



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necessary to keep working on other methods to achieve the same results, because conditions are different I suppose from place to place.

LUHNING: Yeah, one size doesn't fit all.

BB: Yes.

LUHNING: And SAGD probably wouldn't work in Grossmont carbonates. And SAGD isn't a particularly good choice when you're in heavy oil as well. And then SAGD, it has got its drawbacks, you have to burn a lot of energy to heat up the reservoir and you make lots of CO<sub>2</sub> and it costs a bunch of money to do that. Maybe you can have a non-thermal method like the Vapex method; you use propane to do it. And you do it more efficiently and cheaper, this type of thing. And as I mentioned earlier, CCMC are now giving funds to folks that want to try out what you consider even now radical approaches to improving SAGD. So the fact that you've got one kicked off in very simple form, through AOSTRA, that isn't the end of the improvements. You have to get it cheaper, more environmentally acceptable, less CO<sub>2</sub> emissions, all these things.

BB: Thanks Richard. I think we'll leave it at, I get a sense my batteries are probably draining down a little bit, but that's been very comprehensive and thank you very much for taking the time to do this.

LUHNING: Well thanks for listening so long.

BB: Well the time flies, when Peter said, "Oh we've got time an hour and a half." I thought, "Oh my goodness."

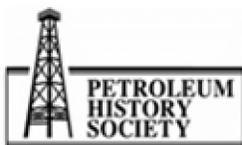
LUHNING: Actually that one I mentioned when Clem Bowman came to town, Peter Lougheed had the three of us get together and had a chat about how things got done in the oil sands.

BB: Is that right.

LUHNING: But well, I'm sure Clem mentioned that.

[END OF INTERVIEW]

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