Keith Firmin

Date and place of birth: Feb. 4, 1947. United Kingdom.

Date and place of interview: June 1, 2012 at Mr. Firmin's residence, Calgary, Alberta.

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: FIRMIN

BB: My name is Brian Brennan. And today, on Friday, June the 1st, 2012 I am speaking with Mr. Keith Firmin for the Petroleum History Society Oil Sands Oral History Project; and we are conducting this interview at Mr. Firmin's home in Calgary, Alberta. And also with me today is Peter Tombrowski who is recording this interview on video. Mr. Firmin is a principal consultant with Snowden Mining Consultants of Calgary. He was employed by Shell Canada for more than 30 years, starting in 1974 and held several positions primarily in the area of oil sands and coal development. So, good morning Keith, and thank you for participating in this project.

FIRMIN: You are most welcome.

BB: Let's start with you giving us the three-to-five minute brief biography of yourself: where you were born, where you went to school, that kind of thing.

FIRMIN: Well, I was born in England. Just outside of London, in the county of Essex. I grew up and went to school there. And, the interesting thing is that people from that area didn't typically get into the area of mining. So, my father was in the civil engineering business and, as part of my initial introduction, I worked during my summer holidays on what was to become the new part of the London Underground. That involved tunnelling. But, it was also a civil engineering project. So, when I decided that I wanted to go to university and was able to do that, I had this challenge: what did I want to do? Did I want to do civil engineering? Or, did I want to do mining engineering? Well, when I looked at mining engineering, it had the opportunity for me to go all over the world and be challenged that way instead of just being challenged within the UK. So, it had a great appeal for me being a young man to be able to travel across the world. So, I ended up going to the Royal School of Mines, which is part of the Imperial College. And, it's located in London. And, students from the Royal School of Mines, typically, went out to the different areas of the British Commonwealth to take up positions in the various mining opportunities that were there. So, once I'd gone through the Royal School of Mines – and part of that was to take some interest and experience in actual mining

– I had to do 200 hours of actual experience. And, that took me to Australia, where I worked in the lead and zinc mines in Broken Hill. Broken Hill has a long history of mining about it.

So, that was my first introduction, my first real introduction to mining. And, it was underground. And, once I got my degree, the company that I was working for as a student, decided – for whatever reason – that I was somebody that they'd like to bring on board. So, it was a company called, RTZ. And, RTZ became one of the largest mining companies. And, it meant, at that time, Rio Tinto Zinc. And, they got their name because they initially started mining in Spain for the Rio Tinto Group, and they developed some new technology to be able to recover zinc from ore bodies. And, the ore bodies at Broken Hill initially were silver. But, as they went deeper, the silver sort of panned out, and they got into ores that were lead and zinc. But, at that time, there wasn't the technology to recover the zinc. So, this company brought along that technology and that's why they are called Rio Tinto Zinc. And, the other company, which will have a bit of a history with the oil sands, was called Broken Hill Proprietary, Broken Hill being the company and the place where they were extracting the minerals.

So, that really got me interested in mining as well as taking my degree. And, then once I got my degree, the people from RTZ, as I said for whatever reason, decided they wanted to hire this young man, and they took me back to Australia. And, I just recently got married so I took my newly wedded wife with me to Australia. And, we found ourselves landing in Perth, and then being taken to this remote area called the Pilbara, which is about 750 miles north of Perth, in the outback. But, fortunately, it was a brand new town and it was built to support what was then going to be a very, very large iron ore mining industry, and still is.

BB: And, that's the name of the town, Pilbara?

FIRMIN: No, the name of the town was Tom Price. And, Tom Price was one of the founders, if you like, and developers of that area. And, the area that we mined was called, Mount Tom Price. He was an American, and was very much involved in getting that area going, so it was Mount Tom Price. And, we spent almost four years there, getting some experience.

BB: Was this, then, "hard-hat" work that you were doing?

FIRMIN: This was hard-hat work. I started off as a young geologist, if you like. Although I'm a mining engineer, I got involved in the geology. And then, they decided I needed some practical experience, so they made me a mine foreman. So, there's my interface with the guys that drive the trucks and operate the shovels, and I really had a good relationship with those people. And, I went from there to get into what everybody would love to get into, which is blasting. So I was responsible for blasting all this material so that the shovels could come along and dig it. And, that was great fun. So I enjoyed that. And, in the last part of my career there they made me an assistant mine superintendent, which was pretty good because I had only been there four years. But then, both my wife and I – and by that time we'd got two young children – decided that the outback of Australia was very interesting, but we wanted to move on.

BB: A lot different from London?

FIRMIN: A lot different from London, yes. But, it was very enjoyable. We didn't have any television in those days. And, it was a very brand new town. I think the average age of the people there was

around 28 years old. So, it was a very close and very young community, and a lot of fun. We very much enjoyed it. One of the promises I made my young wife was that after a period of time, if we wanted to, we would go back so she could see her parents, and we could go from there. So, we decided to go back to England, and I wanted to take some opportunity there.

So, I was fortunate enough to be accepted back into the Royal School of Mines to do a master's degree. And the master's degree was very much focussed on the business side of mining. And, it was called, Mineral Production Management, very posh title. Basically, it was like doing an MBA but focused on the mining industry. And, it was while I was at the latter part of doing my master's degree, somebody had advised the people in Shell in Australia, who were very much wanting to develop their oil sands deposits, asked a gentleman in Europe who was working for Shell at that time, who happened to be one of my lecturers when I was doing my bachelor's degree. "Did you know any mining engineers, young mining engineers that would be interested to come to Calgary and work on the oil sands?" And, he said, "Yes, I know a couple of chaps." And, one was myself, and one was a good friend of mine who had done his undergraduate course with me. And, we were both doing our master's.

So, we got interviewed and prior to the interview, I don't think either of us had heard of – at that time it was called – tar sands. Neither of us had ever heard about tar sands. And so I decided to look this thing up, what was called tar sands. And, it turned out to be very interesting. And, the only company that was involved in that was the early company that became Suncor. They were using some mining equipment that came out of the German coal industry. They were called bucket-wheel excavators. I read up a bit, before the interview, so that I was prepared. I think my friend just decided just to wing it. So, at the end of the day, I was offered the job with Shell, in Calgary, to look at trying to develop the oil sands deposits that they held just north of Fort McMurray.

BB: So, when you were doing your homework, before the interview, had much been written that you were able to find?

FIRMIN: Not a lot. I went through some of the mining magazines, and some of the background. But, I didn't find a lot that had been written at that time. But, what I did find out gave me some background. I could talk about the mining scheme that was being used, and some of the challenges around that. So, that must've proved that I did know a little bit about it, but not too much. So, that's how I became involved with Shell Canada, to start to investigate ways to develop this huge deposit of oil sands that they had entitlement to. If you look at just the in-situ resource, it was around ten billion barrels of crude. That was what was in the ground. It was not what you could actually recover, but it was a significant amount of resource. And so we wanted to look at ways that we could mine this, develop it, and then turn the bitumen into crude products that could be used later on.

BB: The mining part of it already existed then. So was there anything on the horizon, at that point, as to how the in-situ resources might be tapped?

FIRMIN: Not at that stage, in the early 70s. That came later on. Shell got involved in testing technologies and building what they call an in-situ project. And, that was in the Peace River Area. They had an entitlement to some of the leases around the Peace River area. And, they were also looking at, "How do you get this material from deeper resources than just mining it?" And, I did get involved in some of that later on, as things didn't go well on the mining side. But, part of one of the

early jobs that we had was, at that stage, these huge bucket-wheel excavators were being used to mine the oil sands. But, they came out of the German coal industry, and coal was a lot easier to mine than oil sands. Oil sands was a very abrasive material. And, it was basically sand but it was held together by bitumen.

So, when you got into rotating equipment, it tended to wear the equipment out very quickly. And, some of the stories that I heard about these bucket-wheels when they started up, is the teeth on the buckets would only last about four hours, and then they had to be changed. And, of course there are a lot of rotating parts to a bucket-wheel excavator. Although, they were effective in mining the oil sands, there was a lot of cost, a lot of maintenance that had to go into keeping these big machines going. They would deliver the oil sands onto conveyor belts. And, of course, conveyor belts have a lot of idlers and, of course, there were a lot of challenges keeping those conveyers going as well, because of this abrasive nature of the oil sands.

So, at the time, we were looking, when I came on board, at other ways to mine this deposit. And, coming out of the coal industry were these huge mining machines called draglines. And, draglines were what they say. They were huge machines that had a very large bucket that was dragged through the overburden. It came out of the coal industry and was used to uncover the coal seams, so the coal seams could be mined. And, it was thought this could be effective in not only mining the overburden to the oil sands, but they could mine their oil sands, pick it up and put it in a pile, and later on it would be recovered. And, that was recovered by bucket-wheel reclaimers. Not as robust and big as the excavators, but these would mine the loose sand and put it onto a conveyor. And, that was the mining scheme that Syncrude went ahead with and that Shell was looking at as well to develop its resource.

BB: So, were you on site then?

FIRMIN: Yes, I came on site in 1974 and Shell was doing what they called the "test pit." And that was to test this technology of using draglines to mine the resource. And at the same time, Syncrude were also testing out draglines. At that time, we weren't allowed to talk to each other, so we did our own thing.

BB: Why was that?

FIRMIN: Well, I think it really did come out of the oil industry, not the mining industry. The oil industry tended to be quite secretive about the technologies that they would use to refine the oil. And, I think that that was really what drove them. They weren't used to this more open business that was mining. And, people in mining would share their experiences to improve the ways that materials got mined at that time.

BB: Did you envisage the potential, then, as to what would ultimately be happening with this resource as a commercial proposition? Or did this seem to have, perhaps, more of an experimental testing aspect to it?

FIRMIN: As I came as a young engineer, I was fascinated by this and it was a very large deposit. And, there were a lot of challenges about it. But, I think the big the challenge wasn't mining, particularly, but what do you do with this oil sand that has the bitumen in it, later on? And, how do you extract that bitumen? Of course, there were techniques that had already been developed using a

hot water process to float the bitumen. But once you've got the bitumen, how do you upgrade it? So, then there's this whole area of upgrading the bitumen as well. And, there were challenges around how you did that because the bitumen came along with sand, so it was contaminated. But a lot of the refining business had never dealt with sand-contaminated oil resource. So, there was a challenge to how do you clean up this bitumen before you take it into refining? And, one of the ways that came out of the oil industry was called coking. And, that was able to drop the heavy end of the oil, the bitumen, out through the deposition of coke, at high temperatures. And then, you would take the light ends and further refine those and make those into a synthetic crude oil for further refinement at different locations.

BB: So, was the plan then, at that point, that there would be a plant there?

FIRMIN: Yes, there would be a plant. There would be a mine. There would be an extraction plant. And then, there would be an upgrader. And Shell, at the time, had also looked at building a refinery outside of Edmonton, which eventually would be called The Scotford Refinery. It would take this bitumen and then upgrade it into the various products. And, as we'll go on we'll talk about what happened to both the mining scheme and the refinery as well.

BB: So, when did you hope that the actual plant would go in?

FIRMIN: Well, the hope was that we would do these mining tests to see what mining scheme we would go ahead with, and then that would follow directly onto a project. At that time, it was a Shell project. The two components of it were Shell Canada, which was a Canadian company. It had partly public ownership as well as the Shell ownership. And, the other company that was involved was Shell Oil. And, Shell Oil was the company that was in the United States. They also had a public shareholding as well, and it was a 50/50 joint venture. And, those two companies jointly held the leases that were held by Shell. And, the original leases were initiated back in 1956. So, Shell was a very early introductory company to the oil sands deposits. At that time, they had looked at different ways to recover this resource. And, they held these leases, they were 21-year leases.

And, the first period, there were three parts to it. The first part was an exploration phase, where you got a better understanding of the resource that you had. The second part was that once you knew what this resource looked like, you should start developing it. Then it was another 21-year lease. So, you had time to look at the various ways to develop it. But, at the end of the lease, you had to have at least recovered a portion of it. And, a lot of these leases had a minimum recovery of around 25,000 barrels a day. So, the challenge was to do the exploration, develop the technology, and then start to produce from it. And then, the third term would allow you to just carry on, and extract the bitumen and grow your business.

BB: One reason the Syncrude consortium came together as a group was because, I guess, they felt this would be too big for any individual company to take on. This would be a huge, expensive project, and that's why the four original companies got together. Shell, on the other hand, decided to go on its own?

FIRMIN: Yes. And, I think, at that time, the capital investments were as huge as we had envisaged that they would be later on. But, unfortunately, what happened was that the government brought in their National Energy Program, which really said: "Canadian oil for Canadians." So, our joint-venture partner was an American company and obviously – given the investment they wanted to put

in – they wanted to have title to some of this oil coming out. But that's not the way the Energy Program was meant to be. So, they said, "Well, we can't continue to invest in this resource." So, there was a bit of a hold on what we were doing to develop the oil sands, from a Shell perspective. Meanwhile, Syncrude was going ahead and having their challenges: getting partners together, getting the financing together, governments were involved to help with that financing, and their project moved ahead using similar technologies, or the same technologies, as we had proposed for the Shell leases.

BB: Tell me a little bit more about the impact of the National Energy Program.

FIRMIN: Well, I didn't know very much. I was just a young engineer, doing a lot of experiments about it. And, I only saw the results of it, which was to almost stop development by Shell, because it lost a 50% partner. And, at that time, Shell was also looking to develop coal resources. Shell had this view that it was an energy company. And, energy meant not only oil, but also coal. So, at that time it was doing some exploratory work, and buying coal leases, and wanted to have some mining engineering input into that.

So, some of the group that was involved – mining engineers and some of the process guys – moved over into the coal business, and things went on hold on the oil sands. And, once we'd wrapped up the test pit work, I also moved over to the coal business. And, we were looking at thermal coal, which was an energy project, as Shell was an energy company. But, we also picked up some interesting coal deposits in the Fernie and Sparwood area, which is in the southeast part of British Columbia. And that was a metallurgical coal. And it derived a higher price than thermal coal. And it gave Shell the experience of developing a coal resource, and exporting that coal. So the men that were involved, including myself, that had been involved in the oil sands, moved over to developing these coal resources. And then, as time went on, of course, the National Energy Program didn't take on as much power as it had before, and Shell became interested in reviving its projects. Syncrude had been going ahead.

So, in 1977, Shell started to look around for potential partners. And, at the end of the day, there were six companies that were involved in developing the project. That was called the Alsands project. To the best of my recollection, we had Chevron, the two companies that formed Petro-Canada – another government initiative to get Canada involved in the oil business – Shell Canada, and Shell Explorer, which was the US arm. And, Petrofina was involved at that time, as well. And, so they wanted to develop the resource again, and they had to go to the government – to the Energy Resources Conservation Board – and make an application. I was asked then, since I'd been involved prior to that in the initial project, which was called The Lease 13 Tar Sands. Not oil sands, but tar sands. And, they asked me to go back and put together the mining component of the application for this huge project, which was going to be called the Alsands project. It not only included Lease 13, but a lease to the north of that held by Petro-Canada.

BB: So, you came here in '74. Was Calgary home, then?

FIRMIN: Calgary was home. It wasn't as large as it is today. So, there were things that were new to us, as a family: the Calgary Stampede. We had learned a little bit about Calgary before we came here. Friends of ours told us, "Well, it's a marvellous city. You're right next to the mountains." So, that enticed us some more. But, it did have this aura around it being a cowboy town. And, that was, rightly or wrongly, the sort of thing we saw as well, when we first came here. Coming from London,

which was a huge city, of course, coming to this town called, Calgary, in the mountains. The cowboy town, if you like. It wasn't an oil town at that time.

BB: So, you lived in Calgary, but then you were back and forth quite often to Fort McMurray?

FIRMIN: Yes.

BB: And then, when you moved into coal for a while, you were still in Calgary?

FIRMIN: Yes, for a while. And then, when we developed the coal deposit, and it was called the Line Creek mine, we moved down to Fernie. We took the family down there. And, I had a son and a daughter at that time, and they were put into school. And, we did the engineering to get this coalmine going. And we got approval at that time from the British Columbia government to proceed with this. And, I was put in charge of the coal mining part of that. There was a coal preparation plant, and then we ran all the coal out to the port, and then it was shipped to the customers from there.

BB: So, how long was the oil sands part of Shell's operations on hiatus before you were able to get back into oil sands again?

FIRMIN: The consortium started to get formed in 1977-78, and they had to make an application to the government to proceed. And so, we had to go back and put together a new mining scheme, because we'd got this extra resource which was to the north of us. So, it did not only involve the Shell lease, but involved other leases as well. And, from there, we had to make a new application under the title of Alsands. And, one of the interesting things about that is, today, if we put in an application to the government to carry out an oil sands project, this takes a significant amount of time to go through the regulatory process. And, when I look back, it took us about a year to get the application put together. We submitted the application and we received approval from the government, from the Energy Resources Conservation Board, within a year.

So, we were able to proceed. Meanwhile, from a personal point of view, I'd put together the mining side, and provided advice to the panel, and we went through the process. And, the people that were involved in the coal development said, "Keith, we'd really like you to come back and help to get this mining operation going, now that we've got a resource." So, I had this challenge in my mind: Should I stay with the Alsands project and develop the oil sands, or should I go back and start to develop the coal business? And, when I looked at it, there was the opportunity to go into the coal business and get a mine going. At the same time, the Alsands were being developed, and I had the opportunity to go back. So I'd get experience on that side of things, and take that experience into the oil sands development. But, as it turned out, it was a very good decision because the Alsands project collapsed.

BB: Oh, okay.

FIRMIN: The challenge that they had, initially, was that the capital costs were thought to be around five billion dollars. But, in the early 80s, the rate of escalation, monetary escalation, was around 20%. So, the cost of this project escalated substantially from five billion to thirteen billion dollars. Well, this was really out of the reach of some of the companies that were involved. And, actually, they started to pull out. And, the project collapsed, I believe, around 1982. So, although that was a great

initiative to get through, to get another mining project going up there, because of the world financial situation, the project wasn't able to proceed.

In the meantime, of course, Syncrude was going ahead. Oil prices were increasing, and they had developed their project at a time of low cost. They came on board when the oil prices were starting to increase. It was unfortunate, but that project collapsed as well. So, my involvement started with one project, which was the Lease 13 Tar Sands project. Then I got involved in the Alsands project, which didn't go ahead. But, meanwhile, I was going ahead developing coal for Shell. And, I went on to be the manager of the mining operation. And, we got the project going very successfully, and we started shipping coal out to Korea and to Japan. And, the project was going on ahead very well. And then, I got an invitation to go to London, to be part of Shell Coal International. And, Shell Coal International was developing coal projects around the world, in South America, in Australia, in the US. And, they wanted somebody who had some mining experience to go to their London office and look at some of these opportunities, provide advice, and look at the investment challenges and talk about whether or not that was a good idea. And also, provide advice to some of the Shell companies that were developing these coal deposits.

So, again we were on the move, the family was on the move. But this time, it was good because we were going to England. And, I was going to sit in the office in London, and the family was able to see their families, and the children were able to see their grandparents, whom they hadn't seen for a long time. So, it was a real opportunity for us to go to London, and it meant a lot of travelling for myself around the world, to see these various operations and challenges. But, it was also providing me with more experience, so it was very good. And, we were in London for just over three years, and the call came back from Calgary, saying, "Keith, we want to look at the development of the oil sands again. We would very much like you to come back." And, the people in the London said, "Keith, we would very much like you to stay." So, again, I had this choice. Should I stay in London, or should we go back to Calgary? And, if you looked at staying at London, the cost of housing was tremendous, and I'd already got this house in Fernie, B.C., in the mountains, and it was very nice. So, that was part of the decision to go back. But, it was a family decision. We sat around and we talked about it.

BB: So, you kept your house in Fernie?

FIRMIN: We kept the house in Fernie. After we made the decision to go back to Canada, to look again at the opportunities to get the oil sands going, I was located in Calgary. My daughter wanted to go back and finish her schooling in Fernie. So she went to Fernie with my wife, and I stayed in Calgary with my son. But that worked out okay.

BB: So, the fact that the Alsands Project had collapsed didn't deter you from coming back?

FIRMIN: No, because the challenge was then to look at, can we find ways to get this huge oil sands resource developed? At the same time, there were other developments going on. You talked about in-situ earlier on. There was another project called the Underground Test Facility. And, that was part mining and part drilling and oil sands development. So, Shell got involved in that. It was a research project and I was Shell's representative on that. And, what was happening is you would drill a shaft down to the limestone, which was underneath the oil sand deposit. And then, from there, you would drill up into the oil sands. And, that was the first test of what was to become a very interesting way to develop oil sands. It was called steam-assisted gravity drainage. And, you drove two wells into the

oil sand and you would put steam into the top well. And, that would liquefy the bitumen, and then it would come down to the bottom well, and then you were able to pump that liquid bitumen, hot liquid bitumen, up to the surface.

So, I was the representative because of my mining background. In-situ development, drilling, hadn't been my area of expertise. But, I was gradually getting to learn about that. And, Shell decided this might be a technology that they would like to try out at their Peace River operations. Up to then, they had gone from what was called the PRISP – Peace River In-Situ Project – to a larger project which was called PREP: Peace River Expansion Project. And it was going up to 10,000 barrels a day. So, they were very interested in looking at this new technology of drilling horizontal wells. But, they weren't going to put in a tunnel or anything like that, so this had to come from the surface, to drill the well from the surface and then go horizontally into the deposit. Which was a challenge. It was a real challenge to drill a well, going down and then gradually going horizontal. Not only was the challenge to drill one well, but also then you had to drill the second well that was above that. And, that had to be in line, at a certain distance away, to be successful. To do this, Shell had brought a technology along that had been developed in the North Sea. Which was to put an electric, a very, very small electric charge into the casing of the bottom well, and then be able to measure where that was as they drilled the top well.

So, they were able to align it as they went along. And, that technology that Shell brought became the technology that was used by others to develop this steam assisted gravity drainage process from the surface. So, we didn't need to dig tunnels, or whatever, to come from the underground.

BB: So, you would've been working hand-in-glove then with AOSTRA?

FIRMIN: Yes. AOSTRA was involved, and I became very much involved as Shell's representative on that. We came to know some of the people that were involved from AOSTRA, from the government's side, very well.

BB: So, how many years were you involved with the Underground Test Facility?

FIRMIN: That was about two years. We were also trying other things to develop the oil sands. One of the things that we were looking at was, at that time the energy equilibrium between coal and natural gas and the cost of that were coming to the realization that to use coal, to burn coal to provide steam, was looking quite interesting. So, we started to develop technologies. How could we modify these big steam boilers that were, basically, driven by natural gas? How could we then modify them to burn coal? And, that meant by pulverizing the coal, and then putting that into the boiler and burning it in the boiler. That technology I got involved with in from the Shell point of view. But, it was being driven by Imperial to use at Cold Lake. We did do the trials, but it never succeeded in coal replacing natural gas as the fuel. So, that was a very interesting part of it during that era as well. And, Shell got involved, through myself, in looking at that.

BB: Why didn't coal ever become part of the equation?

FIRMIN: Well, I think, reasonably, the cost of the energy unit was almost equivalent. But then, you had this huge cost of modifying the facilities from natural gas to coal. And when we looked at the economics of that, they weren't quite there. So, it didn't continue as a change in resource.

BB: Plus, you'd have to transport it in from Sparwood or Fernie, or wherever?

FIRMIN: Well, no. One of the things about Alberta is that it is endowed with a lot of coal resource, thermal coal. And, the power generation at that time, 90% of the power generation, was through burning coal into electricity. So, there's a lot of coal resource within Alberta that's called thermal coal. And, the coal wasn't that far away from where you would need it, both in the Peace River and the Cold Lake areas.

BB: So what was the next step for you after that?

FIRMIN: Well, while I was doing all this research stuff, we were looking at ways, how could we reduce the capital costs to make the oil sands become a little bit more economic? So, we started to look at technologies. And, at the time, this was in the early 80s and then we came into the 90s, it became evident that the oil industry in Alberta and North America was struggling a bit; making very low returns. And so, the large companies like Shell and Exxon were looking at ways, how could we reduce our costs? And, at Shell we got a new president. He was an American. And, his job was to try and take Shell Canada from a low earning company to a higher earning company. And, one of the ways that you can do that is to start to get rid of non-performing assets. Over time you have invested in oil fields, you have a couple of wells here, and a couple of wells there.

So, one of the ways that we looked at was to have Shell Canada divest itself of some of these non-performing assets. That was the mandate of the new president. So, when we started to talk about, well we've got this huge oil sands resource we want to develop it, and this is how much it's going to cost, he would say, "Whoa! Let's put a hold on that thinking." Because, his idea was to stop spending capital, and try and get the return on the original capital up as high as he could. So, that went into hiatus, developing the oil sands. So, we went into a program where we would just keep the lease going and look after it. And then, Shell Canada thought, "Well, there's some value in this resource we've got. How can we get the value out?" "Well, one of the values you could get out by selling it, do you think?" "Well, whom could we sell it to?" "Well, Syncrude, of course!" because, they were the only developer.

So, we investigated the opportunity to sell this very, very endowed lease to somebody, to get some return, some financial return. So, I was with others who were told to look at this opportunity. So, we put a value on the lease. And, we had some initial discussions with the Syncrude people. But, that never occurred. Syncrude wanted to pay a lower amount of value, and Shell put a value on it, and we never quite saw eye-to-eye on that. Meanwhile, the people in Holland, the Shell International people, said, "This is a huge resource. We need to keep hold of this thing. Look at ways to develop it." And so, there was this requirement that we had to produce 25,000 barrels a day of bitumen to hold on to the lease. And, we had to do that in the second term of the lease. "How are we going to do this?" So, one of the thoughts that I had was, let's bring in a mining company that had the resources to mine it, and also bring in a company that was used to taking the bitumen and then turning that into crude oil. So, I knew some of the people in the mining industry, of course, through my coal experience.

So, I introduced a coal company, and we started to look at that. And then we looked at one of the US companies that had a refinery that could take the heavy oil. And then, we started to think that, how could we develop this resource to at least 25,000 barrels a day so that we can hang onto the thing? Meanwhile, things were changing. Syncrude were having discussions with the government around fiscal arrangements. And, we started to look at this thing and we were running out of time. The second-term lease ran out in 1998. And, these are oil sands projects that took a long time, both

to get approval and then to start developing and producing. And, so we went to the government and said, "Well, we're running out of time. But, Shell is really keen to develop this resource. Can we extend things?" So, the government said, "Yes, we'll allow you because we're keen to get the oil sands developed." And, so they put a three-year extension on our lease, but they also upped the 25,000 barrels a day to something else, so the minimum requirement was that. So, my challenge then was, "How do we reduce the costs to develop this project?" And, our friends in The Hague said, "Look, well we really don't want others to develop this. Find ways to develop it yourself." So, this idea of putting together a relationship with the mining company and the refining company was not supported. When the mining company and some friends that I knew in that company said, "We're not going to go ahead with this," somebody whispered in my ear and said, "Keith, go and look at a technology that is being looked at by Syncrude and Suncor at the research facilities at CANMET. But before you do this, I want you to talk to this gentleman called Dr. Bob Tipman who is at the research facilities of Syncrude in Edmonton."

So, I made arrangements to go and see Dr. Tipman. And, he showed me a test tube, and in this test tube was bitumen that was at the top, and then there was sand or water at the bottom. And, one of the challenges around developing the resource was to get clean bitumen. You could then sell it to the refineries down in the States. So, I thought, "Wow, this is interesting. Perhaps, we could develop a good 40,000 barrels a day and sell very clean bitumen, and not have to put an upgrader in, which would be a good way to keep the resource."

So, then they took me to the CANMET facilities where Syncrude and Suncor had started, at a very small scale, to develop a vessel that did this. And so, okay, that was very, very interesting. So, I was down in Calgary, and walking the corridors in Calgary, and I bumped into one of the experts in Shell, who was an expert in refining. He was a chap called Columba Yeung. And, he said, "Keith, what are you doing?" So, I said, "Well, I'm trying to find ways to save this lease and produce very clean bitumen, and I've come across this technology. If we add this very light hydrocarbon, we could produce a very clean bitumen." And he said, "What?" So, I say, "We can produce a very clean bitumen with very low particles, no water." And, he sort of looked at me and, he said, "Can you really?" I said, "Yes. We're at the very early stages of researching this, but yeah, we can." And, he said, "If you can do that, we could put a front end into the Scotford Refinery. It wouldn't cost a lot of money. And we wouldn't need to put in these cokers. We would go to adding hydrogen and instead of reducing – if you take carbon out, you reduce the volume – we would increase the volume." And, sitting right next to Scotford was the Dow Chemical Plant. And Dow produced excess hydrogen. So, all the things started to fall into place. There was this technology that could produce bitumen.

There was a way that we could then put a front end to the Scotford Refinery and we could get this hydrogen coming in. So, things started to fall in place. At the same time, Syncrude and the government had come to agreement on financial terms and the royalty was then brought in that you wouldn't have to pay out on your project. You just had to pay a 1% royalty and then after that, once you've paid out your project, you incur a 25% royalty. And then, the federal government was also, from their taxation regime, helping out from their perspective.

So, the financial side came in, as well. And, so my task was then to take this new technology, test it out, and see whether or not we could make a commercial project from producing very clean bitumen. Well, Syncrude and Suncor, of course, weren't interested in this, but they'd already made huge investments in their plants to take the bitumen and try and clean it up. And, that was through

centrifugal technology. And, for them to change completely new technology was going to be very costly; they'd have to change their whole thing. So, what they did was they just added on more centrifuge and capacity. Because, they had a challenge too because the water that they had within the oil sands deposit was high in chlorides and was very corrosive. So they were looking at ways to try and reduce that water, and they'd had some problems. And, I said, "We're very interested in this technology. I'd like to take over the research of it." And they said, "Well, go ahead." So, Shell took over the development of this technology and we, with the cabinet people, started to carry on and develop the technology that produces very clean bitumen. And, at that stage, I was just a mining engineer. I was just learning all along.

So, we rolled in some of the Shell expertise to help me develop this technology. And, one of the concerns was that if we had just had a single vessel, we would produce this very clean bitumen, but we would lose some bitumen as the material came down. And, this bitumen was in the form of asphaltenes, which are long-chain molecules. But, we also lose some of the oil. So, the challenge was, "Well, how can we now recover this oil that was being precipitated out in the first place." But, the technology was such that when the asphaltenes got deposited, they would also get hold of these very fine clay particles that were in the bitumen. And, they would start to deposit. And as they deposited, the water that was contained in the bitumen was able to come out as well. So, that was the breakthrough that we were looking for. And, at the same time, we were looking for partners to come in to develop the resource. We were looking at large mining companies because, from a mining point of view, there is only myself in the company. So, we needed to bring in some mining companies.

So, at that time, we were looking at that aspect. But we also, there was an opportunity that came along. And, I'm sitting in one of the board conference rooms with Neil Camarta. And, Neil is giving this presentation on the oil sands. And, he'd brought in a financial company to look at how we could bring in a commercial project. So, one of the chaps that I was talking to, who was in this consulting business, I told him about this new technology. But, I'd also realized that the company that was pulling out of the oil sands was Amerada Hess, and they had conventional oil and gas resources. But they also had these oil sands leases, which were right next door to Lease 13. And, so the opportunity came up to buy out Amerada Hess. And, the chaps in our conventional side of the business looked at where they held these conventional resources. They said, "Well, they don't really fit." But, then I knew about this other resource.

So, we were sitting in a large meeting, and Neil is giving a presentation, and I get this nudge from the side. It was one of the consultants. He says, "Keith, you should bring up this opportunity." Because, the opportunity was these Amerada Hess' leases timed out at a much future date. So, if we weren't able to develop Lease 13 in the timeframe that the government wanted, we had a backup from these leases. So, he nudged me and he said, "You should talk about this." So, I was sitting in the background and I said, "Well, we've got this opportunity to purchase these leases that Amerada Hess has." He walked around and said, "Well, what's going on here?" I said, "Well, the opportunity is that these leases don't time out as long." So, Neil was given the opportunity to look at these and see whether or not it was viable to purchase these leases. So, low and behold, he was given the nod: yes, put in an offer. And, I thought, "Wow." Going from a company that wasn't interested to developing oil sands leases, to one that now wanted to increase their holdings in oil sands, this was a good sign. This was a good sign. Meanwhile, while that's going on, we started to increase our interest and develop this new technology. And, then we got the go-ahead to start looking at this. But, as I said, we needed mining partners. And, Neil came to me and he said, "Keith, do you know

anybody that might interested?" So, I said, "Yeah, I know two companies and they happen to be the companies that I was involved in during my very early days in Australia." Rio Tinto Zinc had grown in size and become one of the major mining companies of the world. And, BHP, Broken Hill Proprietary, had expanded their interest. They were now in South America. And, they were also developing the first uranium mines in northern Canada.

So, we went to London as a group, and we talked to the people in RTZ, and they were lukewarm. So, then we went to talk to the guys at BHP, and their ears pricked up and they said, "Oh, let's go have a look at this thing." And so, we took them up to Lease 13. We showed them the test pit and picked up some oil sands and showed them that. And, they squeezed and, of course, they got their hands dirty with the bitumen. And, they became very, very interested and thought this was going to be a good investment. And, so they did. So, we started to then develop a commercial project. We had a technology. It hadn't been fully developed then, but we produced this clean bitumen, and we could modify the Scotford Refinery to take the front end. And, when we looked at the capital investment, it was a lot lower than building a brand new project up in the north, which had all the components like the Syncrudes and the Suncors. We could take advantage of the capital investment that we'd already made.

BB: When you say, the front-end, that would be the cleaning component?

FIRMIN: Yes. So, this would make the clean bitumen. And, then we would be able to not have to put in these big cokers, which initially would take out the solids and the waters, and then provide a lighter crude that would go into the refining side; to produce a crude oil that was coming out of Syncrude and Suncor. So, that was the opportunity. Now, could we develop this technology that produces clean bitumen? So, we started to look at it. And, we had a project, but we wanted to go from the very small scale to a larger scale. It was going to cost almost a million dollars to do this. So, I always remember having a corridor discussion with Neil. And, he said, "Oh, you know, we should look at this. Yeah, go ahead." Well, that surprised me. That's a $400,000 investment. In the early days, I wasn't allowed to spend any money. And so, I went to Suncor and they were interested to look at this technology. So, between the two of this we went to CANMET again. We built a larger scale pilot.

Meanwhile, we got the BHP guys on board. And, we had this challenge around how do we clean up the bottom end once we've got all this material, got this clean bitumen? But, we had this mixture of sand, asphaltenes, and more bitumen and water. So, how do we get that bitumen out, recover that? So, one of the guys from BHP said, "Well, Keith, we can do this in three stages, and recycle and recycle." And, I'd been thinking about that myself, about putting more of these in. And, when we looked at it, we could probably make very clean bitumen, and recover all the bitumen from this mixture of bitumen and asphaltene, and water and sand. But, we weren't fully convinced. So, we built a new facility up at Lease 13, which was a larger-scale pilot that would look at methods to do this. One of the methods that we could do was to take this bottom end and then add some centrifuging that was similar to what Syncrude was doing. Or, we could we go ahead and put these other stages in. So, we built a facility that would be able to test both of them. One of other challenges we had, of course, we've got this light hydrocarbon that we've added that's worth a lot of money, and costs a lot of money. And, when people had looked at similar things before, if you'd lost a lot of it, if you couldn't recover this very expensive light hydrocarbon, then the economics of the thing just fell apart. So, then we had to come up with a way of recovering this very light hydrocarbon. And, Dr. Tipman, who was now on board with us, he'd retired from Syncrude and

come on board, he said, "Well, we can develop a vessel to do this." Nobody had developed a vessel like this before because the conventional oil guys had never had solid particles to upgrade things.

So, we developed a vessel to do this, or Bob had an idea how to do this. So, we were also testing that. And, lo and behold, we could recover over 99% of the light hydrocarbon, and things were looking good. We made an application to the board for a project, and the basis of this application was taking one vessel and centrifuging. But in the meantime, we were going ahead with this pilot. And, when we looked at this three-stage process, it worked. We could recover most of the bitumen. We lost some of the hydrocarbon through asphaltene. But that was good, because it was the very low end of the hydrocarbon chain. And, we never did go to the centrifuging.

So, the pilot was very, very successful, and we were able to determine how much light hydrocarbon we would need to put in. And, we knew how to recover that. And, again, one of the opportunities was that we could use this light hydrocarbon also to transport the bitumen. Because, you had to make this bitumen, this very thick bitumen, lighter so that we could pump it down to the Scotford Refinery. Then, we would put in a front-end, and recover this very light end and ship it back to Fort McMurray. So, from Shell's point of view, this was a very good integrated solution. And, lo and behold, everything worked and that's how we got going on a commercial scale.

BB: Wow!

FIRMIN: And, there were some other things new that we were doing, and that we tested out. I brought together Dr. Tipman, from his perspective, who was a bit of a guru on this new process. But, I also brought in one of the people that were involved in the Alsands Project who was a process engineer, from the mining point of view. And, we started to look at the front end. One of the challenges that we had was that in the oil sands during the winter you have this frozen material that you have to break down. And, there was a new technology that Syncrude had brought in, which was called, hydro transport. The idea was that if we could make a pipeline long enough, and add hot water, we could break down these frozen lumps. So, that was the front end. But, to be able to do that, hydro transport, we had to break down the frozen material to a lump size where it would work.

So, we had to take these huge lumps of oil sands that were being mined, and break them down to a smaller size, which was about two inches in size. And, we started to look at technologies. How could we break these huge lumps of oil sands? So, again, we looked at other technologies. And we brought in what was called, a rotary breaker. And, this was basically a big drum that had holes in it, and it would just turn very slowly and it would break up the lumps. And, you had holes in the vessel, and the two-inch lumps would come out. But, nobody had tried this before. So, Bob Tipman, Dr. Tipman, came to me and said, "Keith, I've found a drum. We can put some holes in it; let's try it out." "Well, where are we going to try this thing?" We got this Suncor guy who was very interested in it, and they were looking to expand as well. So, we built a little drum. Put a lot of holes in it. Put it on Suncor's property, and both Shell and Suncor tried this thing out. It worked, it worked.

BB: Oh, good.

FIRMIN: And Suncor became very interested in this.

BB: So, just referring back to what you had said earlier, Shell, Syncrude and Suncor were now actually talking to one another?

FIRMIN: Oh, yeah, we were talking to each other. The doors were open.

BB: As opposed to the earlier days.

FIRMIN: Well, I'd say we were talking to each other, but there was a bit of a cost to do that, of course. Syncrude had developed their technologies, and I'll talk about another technology that we applied. And, the hydro transport technology they'd developed. And, although Suncor was very interested at the front end, and I'll talk a little bit about their mining schemes that were being developed, they had the new project going and they wanted to use this rotary breaker. And, I'm going to back-step a little bit now into the mining technology. I've sort of talked about the back-end where we can get this clean bitumen. Now, I'm talking about the front-end. Meanwhile, we were looking at different ways to mine the oil sands. And, coming out of the coal industry, of course, we used these big mining shovels and trucks. And, they'd been tried in the oil sands before, but they weren't at a scale, and they had some challenges in the way that they'd been constructed. But, we were looking at big machines.

BB: Even bigger than the ones used for coal?

FIRMIN: Bigger than the ones they used for coal. And, the manufacturers had started to build, for the metallurgical industry and for the coal industry, mining trucks that were now up to – originally from about a hundred tonnes capacity – two hundred and thirty tonnes capacity. And so, Suncor at that time were still using the bucket-wheel excavators and their economics didn't look very good. So, they brought in a new vice-president of mining from the coal industry, who just happened to be a friend of mine, and that's how we got them enthused about this rotary breaker as well. So, we started to look at using the trucks and then transport from bucket-wheels to a shovel and a truck thing; which became more flexible with the bucket-wheels and the draglines. These were huge machines, and you only needed three or four trains, or three or four of these machines, to give you all of your capacity. But, if one broke down or the system broke down, you've lost 25% of your capacity. So, that was a bit of a problem. With a truck-shovel operation, you could put these mining shovels and these trucks in different locations. You had a lot more flexibility as well. So, if one shovel broke down, it didn't have a big impact. And, if one truck broke down, it had virtually no impact. So, that was a bit of a breakthrough on the mining schemes. And, when Syncrude went into their expansion, they used shovels and big mining trucks.

One of the problems we had, though, was that the mining trucks weren't built for an oil sands application. They were built for hard rock mining. And, what was happening was, because the oil sand was so soft, there were a couple of things that were happening. One was you had to push against the oil sands so you had a lot more rolling and resistance on the trucks, and you had to put in larger engines. So, we went to the maximum size engines that we could. So, that was one challenge, but it was easily overcome. You just put in a bigger engine to overcome this rolling resistance. But, as you go through the oil sands material, the frame of the truck would start to flex. And, that would start to crack the frames. So, the equipment manufacturers saw this, but they were also looking at how they could improve the design of these big trucks. And, they started to use finite element analysis to look at how all these things are welded together. And, that was really the breakthrough then. They could build a truck with a frame that was designed to flex. And, so they were able to produce trucks that were more suited to an oil sands application.

So, I think that was the breakthrough. You had a breakthrough in the mining. And then, we had a little bit of a breakthrough that Shell and Suncor had looked at: taking these big frozen lumps that happened in the winter, breaking them down to size using the Syncrude technology of hydro transport, which could break the lumps down even further. And, then what would we do with it? Well, in the early days, to release the bitumen, you would put hot water, and you'd have these big vessels that had shallow bottoms to them but had a big rake inside them to move the oil sands in. And, Syncrude, to improve their performance, had started to develop another vessel. You took the material from the first vessel and you put it into a second vessel. And all the second vessel had was just a big vessel. And, if you designed it right, the bitumen would float to the top and the sand would come to the bottom. Why don't we use this? Rather than putting in this mechanical facility, let's use what later would be called a primary separation vessel. It was basically a big vessel with a long cone, and the bitumen would float to the top and the sand would come to the bottom. Of course, you had this problem: In the middle we had these clays that were combined with the oil sand, and they would sit in the middle there. So, you had to take those off in another stream.

Well, what do you do with that, because the bitumen is coming out of these clays? It would be easy if you get most of the bitumen at the top, and then the sand can come out of the bottom. So, one of the ways was to take the metal mining industries' performance and use flotation cells. So, we come back right from the beginning of my story, going to Broken Hill and, with the technologies that Rio Tinto developed, be able to recover the zinc by floating and developing flotation cells, which was a breakthrough in mineral technology. Then it went on to be applied in a lot of the mineral applications, and here we are, in the oil sands, going back to this development that was initially used at Broken Hill. And, we're going to now use it in the oil sands, but we needed big, big materials: big vessels to do that. But, if you do that in a staged way, where you are able to recover bitumen from these clay particles, and then that would go on to this new froth treatment process, produce a very clean bitumen that we were able to ship down to Scotford, but had a front end to it. We did all the capital costs on that and we weren't talking about thirteen billion dollars anymore. We were talking around five billion dollars, in today's costs.

BB: Wow!

FIRMIN: And that really drove the project, which was called the Athabasca Oil Sands Project. And, that's what Shell was looking for, and that's how we started to get involved in producing the commercial project.

BB: So, you were involved, throughout the process, of moving from pilot and testing into the commercial. Was your role, primarily, as an advisory?

FIRMIN: Was it advisory? Yes. I sort of got the notion at the front end, but passed it on to the folks who were chemical engineers and knew more about the hydro processing. I was just a "dumb" mining engineer. [Laughs]

BB: Mining was a very important part of it, obviously.

FIRMIN: Yeah, but it's almost like I had learned about the various aspects. And, one of the interesting things in the Alsands project, I was the mining advisor to this group of people that were putting the application in front of the government. When we put the application for the Muskeg River Mine project, I became the extraction-processing expert. So, I sat on the panel as the

extraction-processing expert. So, I changed roles from being the mining expert, because now we had people from BHP who were the mining people. And, I became the extraction advisor, and an expert on this thing. I sort of changed roles a bit.

BB: Different hat.

FIRMIN: Different hat, right. So, we'd gone through the various stages, doing the pre-feasibility study that I was looking after, and then we were into a full feasibility study. And, we brought in the people from BHP. They led the front end and Shell led the back end, which was the upgrading. And, I got involved with the full feasibility study, and that was carried out. And then we started to construct the Muskeg River project. And, Neil and I had a bit of a chat, and I said, "Look, I still want to get involved in this. Is there a role for me?" So, he gave it some thought, and he said, "Look, Keith, we need somebody to manage the contractors, and buy all this stuff that we need. And, we think you'd be an ideal candidate, because you know the front end and you know what needs to be done." And, I had to think about this. I'd never done contracting or procurement of equipment. So, after thinking about it I said, "Boy, this seems to be a good challenge for me, and I could get really involved in the construction of the commercial project." And, he put me right in the middle, because we had to take the design, which was being done by an engineering company. Then, we had to buy the equipment, and then we had to deliver it to the construction on time. And, at a cost, that was acceptable. So, that was something that was a real interest to me, and I became the manager of the procurement, and buying all the equipment, and also managing some of the companies that were constructing the project. So, that took me right through. Initially, I was put in to the engineering offices, and once they started building the thing, something happened. I don't know what. So, they said, "Keith, we need you up at the site. It'll only be for six months, so don't worry about it."

So, off I went up to the site. They had me working up there for 11 days straight, and then coming home for three days, and then another 11 days on. They said, "We only need you for six months." Well, it turned out I was up there for two years. And, when we finished construction, between myself and the project manager, we were the last ones to leave. So, that was a great highlight in my career: taking the project from research point of view, developing a commercial process, then putting it into a commercial project, and then helping to build that commercial project.

BB: What did you do at Shell after that?

FIRMIN: What was the challenge afterwards? Here, I've got all this experience, and what could I do with it? What did Shell want to do with me? There was a chap down in Calgary who had the responsibility to get approval from the various government agencies. And he said, "Keith, I'd really like you to come down and head that up. To get these applications put together, and seek the government approval." Another thing I'd never done before. But, I had been involved with meeting government agencies, because we got them at the front end of the Muskeg River Project and explained to them the various aspects of it. And, one thing I forgot to mention was, one of the requirements for the project, of course is, we need a lot of water. Where was this water going to come from? The Athabasca River. And, one of the challenges, of course, is you've got fish in the Athabasca River and you don't want to harm the fish environment.

So, how could we get the water in? And, so we started to look at ways to do that, and we did some research into developing new types of water intake. And, we did some research in Edmonton. We

actually built a model of the Athabasca River. And, we looked at various designs for a water intake that wouldn't impact the fish, and we were able to do that. So, that was new, if you like. It was a known technology, but not applied to the oil sands and to the water intake. So, we were able to take that research that we'd done in Edmonton and put in this new design for water intake. And, that turned out to be very successful too. So, I had a little bit of a hand in that side of things.

So, I got myself involved from taking water out of the Athabasca River to designing and producing new technologies, and then going on to build the thing. So, after that, the chaps in Calgary said, "Keith, we'd like you take over this regulatory process. Given your knowledge, you know all aspects of the process, we'd like you to do that." I thought, "Wow, this is going to be a cushy job." Because, they'd just got the Muskeg River project going, well, what are we going to do next? Well, as soon as I got down there they wanted to expand the Muskeg River project. So, we needed to make an application to expand the project. So, the next challenge was to put together the applications. And, of course, at that time, there was a lot more interest in what are the impacts of these huge projects on the environment? And so, we turned from most of our applications being to convince the government that we could produce oil and get recoveries from the resource to one of what is the impact on the environment? So, most of the effort was on environmental impact analysis. So, that became a huge a part of putting together these applications, and providing the information to the government so they could feel comfortable that these big oil sands projects were manageable and would limit the impact on the environment. So, there was a challenge to do that. And then, we had the mining of the process scheme already in place. So, that we were looking at ways to just tweak that a bit, so we put that in. But the main challenge was to put together what the impact would be of these big projects on the environment.

BB: So, when you were putting together a proposal to make the project as green as possible, were you looking at just the way the province deals with these matters, or were you dealing with the feds as well?

FIRMIN: We were dealing with the feds. And, it really came through the Fisheries Act. Of course, if you're going to put something in the Athabasca to pour water out, what is the impact on the fish? So, then you become involved with the federal agencies, the Department of Fisheries and Oceans. And, in the first project, the Muskeg River project, the impact was mainly on the Athabasca River and how we designed this intake. And, we were able to demonstrate to the people in the DFO that we designed something that was going to have minimal impact on the fish. We also had put in some design in the way you take the water from the river and you store it in a vessel, and then you pump it down to the facility. We had to put some things in there, design some things so that if there were fish in there, we could recover them and put them back in the river.

So, yes, the involvement of federal government in the Muskeg River project was quite limited. It was limited to that water intake, the impact on the fisheries. And we'd made a decision at that time that we weren't going to impact the Muskeg River, which was a tributary to the Athabasca River. Our mining for the Muskeg River project was not going to interfere with the Muskeg River. So, that was not an impact. The only impact that we potentially could, we had to put a bridge across, because our storage tanks were on side of the Muskeg River and our process was on the other. But, we had meetings with the government and demonstrated to them that this bridge was not going to be impacting at all on the Muskeg River.

On the second stage, however, when we went to expand the project, we were now getting into areas where we would have to modify streams, impact the fisheries, and therefore we brought in other government agencies. Mainly the DFO, which has a very strong and very comprehensive legal point of view to not only manage fish but also manage fish habitat and what goes in to enabling the fish to survive. So, that became a very strong effort on our part, to work with the federal government in ways that we would minimize that impact. Not only minimize it but also compensate for any losses that might happen.

BB: What was it like dealing with the government agencies? Did you feel that it was in a spirit of collaboration and cooperation, or were they throwing roadblocks at you?

FIRMIN: No, I think it was very much in a collaborative point of view. We were not experts in this, and we had environmental consultants on board who had the expertise. But, we very much worked with the federal government, with the Department of Fisheries and Oceans, to ensure that we minimized the impact. But where we did have an impact, we would compensate for that, and the compensation was quite interesting. I got involved in some of that aspect of looking at, how do we compensate for the loss in fisheries? And, one way you can do that is by building a lake. And, building a lake and putting more fish habitat back, I said, "Well, where are you going to put this lake?" Well, there isn't much place you can put a lake because everything's got oil sands there. So, we had to find a place that we could put this compensation lake in. And, so along comes Keith again with his knowledge of the resource, and where are we going to put this thing?

So, I found an area that was just to the north of Lease 13, but it was part of the Syncrude leases. But, it wasn't the part that was going to be developed; it was on the other side of the Muskeg River and it didn't have a lot of oil sand resource. It hadn't been drilled out very much and so we had to go in there and do some more drilling. And, of course, when you do more drilling up there you find more oil sand. But, we felt that there was sufficient area that was not economic for recovery, and we could put this compensation lake in. We went back to the ERCB and they said, "Can you really do this?" And, I said, "Oh, you want more drilling?" And, so, it took us a long time to convince the board that we could put in a compensation lake that didn't sterilize the resource. We could put it in a shape, so we had to make the shape right.

So, that was the way that we compensated for any fish losses. We had to minimize the impact to start with and, as we expanded the project and as we brought in the next project – it was called the Jackpine Mine project – we were going to interface with some of the streams and the fish habitat that was up there.

BB: So, once you got the lake there, you stocked it with fish?

FIRMIN: Stocked it with fish. And, that lake has only been completed maybe two years ago. So, you stock it with fish, and you create a habitat where you can let these fish survive for a period of time. Well, this had never done before. So, we don't know how it's going to work out. We think it's going to be very successful. But, we have to monitor this lake over time. This is going to be a lengthy challenge to ensure that we can provide a habitat in which the fish can survive. And, when you're doing this, and you're discussing it with the DFO, you have to recognize that the compensation can't be on a one-on-one basis. Because, there is some challenge and some unknowns around this, you have to compensate for twice as much.

BB: Oh?

FIRMIN: So, you have to provide twice as much compensation as you would on your impact to the fishery.

How are we doing, is this of interest?

BB: Oh, this is great! Yeah, this is terrific.

FIRMIN: So, as we're going along, not only were we looking at getting approval to expand the Muskeg River, we were also getting approval for a new project which was called the Jackpine Mine project. Which is Lease 13; it's a huge area and we were only developing the western part of it. It was part of Muskeg River, but we had all this resource on the eastern part and that was going to be the Jackpine Mine project. But, we had to get permission not only to expand Muskeg River, but we also had to get permission for this new project: "Keith, we need you." So, my role was to manage putting together the application for the Jackpine Mine, and that involved modification to streams and taking streams out.

So, there was a lot of interface with the Department of Fisheries and Oceans. But, we had to put in some other areas, and we had to get involved with Transport Canada as well. So, here we are, we were involved in that. And, at the same time, our friends in Fort MacKay, the First Nations people, and Neil had developed a very good relationship with them. They had got a lease to the north of us through negotiations and they wanted to develop it. And, we'd got into discussion with them, could we develop that lease in combination with our own leases? Those discussions went on for quite a while but we never did get to resolution on how we could we fit all this together. So, as we developed the Jackpine Mine, we had to be very conscious of the lease that the First Nations had, and we would impact that lease and their ability to develop it, sometime in the future or to incorporate it with developments that Shell was taking place.

BB: So, were there conversations with the First Nations people in terms of what kind of fish you were going to put into the compensation lake?

FIRMIN: There was a discussion around that. They were, of course, the people who took advantage of any fisheries up there. But, the management of those fisheries was with the provincial government. So we had the discussion with the First Nations and we said, "Well, we can afford this compensation lake. What fish would you like to see in it?" So, they'd come up with some species that we just couldn't manage in that area, and the government was saying, "Well why, are you doing that?" So, we had some conversations between the First Nations, the government, and ourselves as to how we were going to stock this, and how we were going to manage it. And, of course, since it was a provincially managed area, we couldn't just make it for the First Nations, although they would be the major users of it. And, we wanted to involve them in, how do we compensate for the loss of fisheries? Because they were the people that took advantage of the existing fisheries there. So, we had that joint discussions with themselves, and with the Alberta government as well, on this compensation.

BB: So, if they wanted to have steelhead trout?

FIRMIN: Yeah, well, they just don't survive. But, I must give credit to Neil Camarta; he developed a very good relationship with the First Nations people in Fort MacKay. And, I think it was a very

positive relationship. And, as we were going on to construct the Muskeg River project, we tried to get them involved as much as we could in various contracting arrangements. So, they could take part in the construction and the benefit of building this project, and then going on to manage and operate the project.

BB: So, taking the Muskeg River project from an idea to an actual commercial proposition, that was obviously a major event in your life?

FIRMIN: Yeah. And, I think, of that, it was being able to recognize and develop technologies that would make that happen. If I go back, what was my contribution? I think the major contribution I had was keeping hold of this lease that Shell had. But, also developing some technologies that would enable it, with the clever guys down at Scotford, these chemical engineers, to put a front end to it and make this whole thing work. Because, it was not only the mining it was the extraction process; producing clean bitumen that then could be fed into the Scotford Refinery at low cost. So, I think if I look back on the highlights of my career, while there were a lot of them, that was one: to be able to make that contribution, recognize the significance of this new technology, and then bring it forward to a commercial scale and making that happen.

BB: Well, I think that's a very good note on which to end our conversation.

FIRMIN: Good. Thank you for the opportunity.

BB: Thank you, Keith.

[END OF INTERVIEW]

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