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NEIL EDMUNDS

Date and place of birth (if available):

Date and place of interview: March 1st, 2013

Name of interviewer: Peter McKenzie-Brown

Name of videographer: Peter Tombrowski

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

Consent form signed: Yes

Transcript reviewed by subject:

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Initials of Interviewer: PMB

Last name of subject: EDMUNDS

PMB: I'm talking to Neil Edmunds who is a Technical Director I think is your title, or Advisory Director with Laricina Energy. It's March 1st, 2013 and the other person in the room with me is Peter Tombrowski. So, Neil I wonder whether you would begin by just telling us about your career? When did you get involved in the oil industry and just briefly, how had it developed?

EDMUNDS: My father was a geologist in the industry with Shell when I was school age. And, so I started in the oil industry in the summers prior to graduation from university.

PMB: What year was that?

EDMUNDS: I graduated in 1978 in mechanical engineering.

PMB: From where?

EDMUNDS: University of Alberta. I got introduced the oil sands in my last summer in university. I was working for Gulf Oil. And that was, at that time, there was a flurry of interest in the in-situ oil sands. My name was still getting...

PMB: What year was that?

EDMUNDS: 1978. So, in the 70s there were a number of pilots basically following Esso's efforts in Cold Lake. So, there were a number of similar technology tests in Athabasca; cyclic steam stimulation for vertical wells which failed spectacularly in most cases in the McMurray reservoir. But anyway, in the third year Gulf was recruiting and they impressed on me the size of the resource. I

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don't think I'd ever quite appreciated that before. I had heard of oil sands before, because my grandfather was Professor Harry Edmunds who was a founder of the School of Geology at the University of Saskatchewan. He died when I was very young. But, one of the few memories I have of him is he gave me a little vile of oil sands from the precursor to Suncor or what was it called then?

PMB: Great Canadian Oil Sands.

EDMUNDS: Great Canadian Oil Sands, yeah. I also like the smell of tar too. But anyway, long story short, I went to Gulf and worked for Gulf for the one summer. And, when I graduated the next year I joined them and I worked on what was the very early precursor of the UTF project, it was called the Surmount project then. And, it was to be on what is known as the Surmount lease. But, we were looking at tunneling and horizontal wells and all kinds of crack-pot ideas like that. And, I was on the facility side then. At Gulf, I had a wonderful mentor named Fred Robinson who was an engineer's engineer. Not a crusty old guy, but a 'near retirement' age fellow who was very much a technical person a disdain for political stuff. So, he was teaching the new grads coming out of engineering. Anyways, after a couple of years they were looking for somebody to go to Pittsburgh and train in numerical simulation.

PMB: What kind of simulation?

EDMUNDS: Numerical; computer modeling in other words. And, that was something I had sort of an interest in. I worked for Shell Oil for one summer, working in their seismic computers in the Standard Life building. And, taught myself how to program in Fortran which I could do -- we had quite a few idle hours when machines were down, other machines were down. And, I had access to an old accessory machine that I could basically run my own little programs on. I'm getting side-tracked here. So, I went to Pittsburgh and Pittsburgh of course then was the head office of Gulf Corporation, when it still existed. I was working for Gulf Canada. And, Gulf Corp had a big R&D facility in a suburb called Harbourville. And, to give you an idea they had about 2500 people working there and I believe something like 600 of them were PhDs. And, I went to work with a couple of guys named Will Kalum and Reid Crooksten and Wen Chan; who are more noted on the -- I think they would have all wound up at Chevron in California after a few years. But, they were pretty notable people in the steam flood business at that time. And, they had written one of the early thermal simulators, thermal reservoir simulators. So, I don't know if you're familiar with reservoir simulation.

PMB: I am, yes. I spoke to Tony Settari about that.

EDMUNDS: So, thermal simulation is just bigger if you like, when you've got the energy equation. What I was doing down there was history matching physical model results. And, also to become knowledgeable in the use of other things, so I could bring the technology back to Canada. And, I have to say at that time there was quite a disconnect between the researchers; this is a common problem probably not just in the oil industry, but especially in the oil industry. And, researchers

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doing kind of academic things and then you have people working at the dirty end in the field. And, often there is quite a bit reality gap between those two. And, that was kind of the case in the oil sands at that time. A lot of the intellectual leadership was taking place in these big major company labs in the US. And, in a lot of cases they didn't grasp just basic aspects of the sands. So, when we start doing simulations for example, you could see right away that there was no way you could eject steam into this formation without fracturing the rock, without physically breaking it. And, either lifting it or pushing it aside. And, that turned out to be quite a bit of a paradigm shift because that wasn't what happened in places like California or Venezuela. In those places, the sand was much more compressible. And, not to mention, the oil was much warmer. So, from all those factors they didn't have those kinds of failures in the...

PMB: California fields.

EDMUNDS. Yeah, the places that were familiar to engineers at that time.

PMB: When did this happen and when did the industry make this discovery that you needed fracturing?

EDMUNDS: Well, that was about 1980 and I don't know who actually made the discovery. Obviously, Esso was doing it by then. I'm pretty sure Esso would have been looking at their pressures and realizing, yeah, we were causing a failure here of some kind. But, it might have been some time before someone actually looked at the data and could put that knowledge together. So, I came back from Pittsburgh. I smuggled a computer tape of the program in the backseat of my Volkswagen Jetta, across the border into Estevan. Basically, I just thought that was the wisest choice rather than try and mention it to them. There were various opinions at that time whether software had any value beyond the value of the tape or not. So, I thought even if it turned up, I probably wasn't going to be in any kind of big trouble. If I tried to describe what was on it, it might lead to complications. So, we just brought it across. As it turned out, at Gulf we didn't use too much of that program because just before I got back, the first commercial code had been released by the computer modelling group here in Calgary. And, that included a number people and Tony Setarri was one of those.

PMB: I think he was one of them, yeah.

EDMUNDS: And, there was Kaz Vinsome was another notable chap who I still with to this day. Kaz made a profound contribution to the simulation technology that we use in terms of the....

PMB: Is he still around?

EDMUNDS: He's in the phone book under Dyad Engineering.

PMB: Great. Because, we might want to interview him as that's an important part of this story that we're just learning about.

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EDMUNDS: So, he's been peripheral guy, but he's worked with a lot of the projects and the people.

PMB: Now, moving on to your work with Gulf. By the way, I was at Gulf at the same time you were.

EDMUNDS: Oh, really?

PMB: Yeah, I worked with Brock Hammond. Do you remember Brock in public affairs? But, I knew a lot of the people. I don't think you and I ever met in those days. Just moving forward, as I go through this resume I find that since then you were a reservoir engineer at the UTF. You then worked for CS Resources. And, later on you worked for Encana and eventually moved here. And, there we number of leaps in between. So, I've probably got the chronology screwed up on that. Would you clarify it for me?

EDMUNDS: Well, do you just want me to chronology?

PMB: Well, finish your story.

EDMUNDS: So, anyway I worked for Gulf for a couple more years until when I was in Pittsburgh and the NEP came in.

PMB: Oh right, it would have been 1980.

EDMUNDS: So, about a couple of years later, Gulf decided to pour all of their money into to the Beaufort Sea and basically ended the oil sands effort. So, as you noted I jumped around a lot. And, somebody asked me after I changed jobs at one point, where my career path was heading. And, I said, "Well, I've always been on the same path. If I see a vehicle going by that's going faster than the one I'm on, I tend to go jump on that one instead."

PMB: The connection between the National Energy Program and your move is quite an interesting one, because all of a sudden the federal government, with that program, were encouraging everybody to put their money into the Arctic; onto federal lands.

EDMUNDS: And so, that's when I joined AOSTRA for the first time. And, this was as a staff member and I spent a couple of not too memorable years there being an engineering rep for AOSTRA. So, AOSTRA didn't operate anything. And, there were four of us engineers and we all sat on the technical committees of, in total, about the 12 or so pilots that AOSTRA was funding at that time. So, it was good in terms of experience. And, it was also good in terms of being able to go through the extensive files of AOSTRA. At some point in there, I left AOSTRA for a couple of years and joined a company called Vikor Resources. And, they were doing one of the few CO_2 miscible floods in Alberta at Joffre. And, that was never really a big economic play as we used to say, it was $30.00 oil back when oil was $20.00 a barrel. After a couple of years of that, I got recruited by Jack Haston who was the manager of the UTF project; a very important guy who you should interview if he hasn't been on your list. Jack was the manager of the UTF project in addition to

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being the previous manager of the Syncrude pilot project that developed the extraction process just before commercial construction. And, the situation when I joined the UTF -- I wasn't actually employed at that time as I was doing some consulting work. So, I had left Vikor and was doing a little consulting here and there. And, needed some money and needed some work. And, the UTF came along.

PMB: You were appointed the process development coordinator at the Underground Test Facility?

EDMUNDS: They let me make that up myself.

PMB: You got to choose your own title. Good. You should've chosen vice-president or something.

EDMUNDS: I was lead reservoir and completions engineer and that would be the summary. So, when I started that was 18 months before the start of steam.

PMB: I'd like to come back to that in a little a while. Just finish up your career, please.

EDMUNDS: Okay, sorry. UTF, I was there until 1993. And, I was not really full-time at the end of that. I was doing consulting as well. In 1993, I joined CS Resources with Dennis Sharpe who would be a very good interview as well.

PMB: Well, I was going to ask you that question. I've been trying to find out how to get in touch with him, if you have his phone number?

EDMUNDS: I think I do have his contact, yeah.

PMB: I'll ask you for it later.

EDMUNDS: I was at CS until 1997 and then I did a little consulting stint again for a couple of years and joined Alberta Energy in 2000 with Harbir Chhina.

PMB: Sorry, you joined?

EDMUNDS: Alberta Energy.

PMB: Oh, Alberta Energy in 2000?

EDMUNDS: 2000. So, CS was taken over by Pan-Canadian, but I had the executive package and I had no intention of working for Pan-Canadian.

PMB: But then, you did end up at Encana.

EDMUNDS: Well, I ended up at AEC.

PMB: Alberta Energy Company.

EDMUNDS: Alberta Energy Company, which to my horror later merged with Pan-Canadian to become EnCana. Well, it turned out okay in the end in the sense that most of the Pan-Canadian types -- we were able to fend them off from the AEC culture. And, especially in the oil sands group which was pretty much Harbir's private fiefdom at that time.

PMB: I interviewed Harbir by the way, a long time ago.

EDMUNDS: He's one of my favourite acquaintances in the oil patch.

PMB: And the, from there?

EDMUNDS: So, Foster Creek I lasted until 2005 and again, a couple of years not consulting; very much part-time. And, that's basically and then in 2005 I ran into Glen Schmidt, who is the president and founder of Laricina and I've been here ever since then. This is the longest I have been in a regular employment in my life.

PMB: And, that's how many years now?

EDMUNDS: Seven and a half.

PMB: Seven years. Wow, you just can't hold a job?

EDMUNDS: Well, that's part of the ADHD, actually.'

PMB: Okay. Well, that's a good and long summary. I would like to find out. There are specifically some things that you've done/been involved in that I have not spoken to anybody else that was really involved. And, I would like you to talk about your main project. I'd like you to talk about the Saleski, extremely important. Those are a couple of the main ones. But, the Surmount project at Gulf and also, of course, your impressions of the UTF, of what you accomplished there. So, let's start with Surmount. I remember going there when Gulf was working on it around 1980 or 1981 or something. So, I do vaguely remember it. But, could you tell us a little bit about what you tried to do there?

EDMUNDS: Well, I'm pretty vague too. And, remember I was an engineer in training and a facilities guy. So, for a year I did stuff like sizing nozzles on tanks and spec-ing pumps and stuff like that. And then, basically by default I was the only one foolish enough to volunteer for basically a suicide position of reservoir engineering and oil sands. And so, they were starting to think about horizontal wells and the first thing they thought about was how can we inject steam evenly along the length of the well? And so, the one thing I remembered doing a lot of work on was -- there is a way of doing that by drilling very small holes. And, so you might have a quarter inch hole every hundred metres. And the, the holes restrict the flow and allow you to put a high pressure inside the pipe. And, that high pressure makes the flow go evenly through each hole to a certain extent even though one hole may be fracturing before the other and so on.

PMB: But, just move up to the present. You don't do that anymore, do you? Don't you have magnetic devices that will just make sure that the two horizontal wells are close to each other?

EDMUNDS: Yes; although, if you cut to Saleski today we are back to the cyclic process with a horizontal well. And, the Primrose play which is CNRL and a lot of the blue sky stuff in the Peace River area; in both those areas they do extensive operations with single, horizontal wells and cycle steaming. So, you have to have the right properties in the reservoir. And, that also appears to be the best way to at least start the Saleski recovery.

PMB: So, you're saying that SAGD really is only useful in some reservoirs and mostly some parts of the Athabasca?

EDMUNDS: On the contrary. I would say on the contrary, that if you are recovering bitumen from a reservoir you are using gravity drainage. So, Esso cannot recover more than about 10% of the oil in place; which is less than half of what they recover without relying on gravity. That's what simulators taught us for those who were willing to ask the questions of simulators; is if you look in a simulator and what's causing the bitumen to move, its gravity. If you turn off gravity, you will recover almost no bitumen whatsoever.

PMB: Help me understand what you're saying, because this is a really interesting idea. Now, SAGD: heat goes in one and the heating chamber forms in there and then you have another well that basically, collects the oil from underneath and then you pump it to the surface. But, cyclic steam stimulation doesn't really use gravity, does it?

EDMUNDS: It must, it must. Certainly, on the first few cycles when you are failing the reservoir and forcing steam into cracks and fluffing out the sand, a process called dilation. When you flow back from the cycle, yes, there's a lot of complicated stuff going on. There is thermal expansion of the oil, is actually fairly significant. And, there is compaction of the rock after you've lifted it up. And, those things will produce oil. But, once you have removed somewhere like 5% or 10% of the oil in the rock, you must have voidage. But, in a reservoir sense voidage in particular means that you have to have something to replace the oil with that you've taken out. It might be steam, it might be gas and it might be water. So, my observation was that it doesn't really matter; any one of those fluids is holy and unable to cause oil to flow back to the reservoir. So, in cycle steam, sure you pump the pressure up to a high value, but the critical detail is that the pressure in the well is never ever very far below the pressure in the reservoir. And, the pressure gradient in the reservoir, the amount of changes over distance is very, very small. It's very small, because it's full of water and gas or steam and by definition it's very high permeability sand. That's the only kind of sand that has ever been found economic to produce heavy oil by thermal means from. And, the reason for that is not what most people think. The reason is that in high permeability sand there is what allows gas and oil to trade places. So, the conventional paradigm is pushing the oil; displacement. And, you start injecting steam here and you pump here and you hope you can pump as long as possible before the steam breaks through. And, actually in the old days it used to be all about what we can do before breakthrough, because after breakthrough nothing much is going to happen.

PMB: Breakthrough refers to what?

EDMUNDS: When steam hits the production well. But, it actually turned out in California and other places, that no, the oil did not stop coming after breakthrough. They had to hold the steam back a little and maybe stop injecting steam quite so fast. But, the oil kept coming out and coming out. And, in fact they get to 50% or 60% recovery in places like Baker's Field or Elk Hills or McKittrick or any one of those oil fields that emits more carbon dioxide than we do. Baker's Filed, Elk Hills and McKittrick are all big oil fields in California, thermal oil fields. Sorry, where was I?

PMB: You were talking about how in California, even after breakthrough the oil would still flow through. But, in Canada it does not.

EDMUNDS: Well, in Canada you couldn't even image. Well, people did try and do such a process (ie. injecting here and producing here). But, the fact of the matter is our oil is 10,000 times more viscous than those fields in California.

PMB: Is it really?

EDMUNDS: 10,000 times. We always plot viscosity on a log chart, but the flow through the reservoir is not logarithmic, it's proportional.

PMB: So, it's not only more viscous, but it's in a colder environment.

EDMUNDS: Yeah, exactly. It's not really that heavier. Lots of oil is heavy and it's ours in both California and Venezuela. It's the temperature of the reservoir.

PMB: So, you mean it's the temperatures which it makes it so much more viscous.

EDMUNDS: Yes, yes. So, the last 20 degrees makes quite a difference. So, one of the early things I did when I worked for AOSTRA, was I analyzed -- if you blew steam through at willy-nilly, so to speak, how much oil would that drag along beside it. And, the answer is not very much. You need a lot of steam. But, something I should mention is in 1978, my very first year at Gulf they sent me to a conference at that Peter Pond Hotel in Fort McMurray. And, needless to say the only speaker I remember was a guy named Roger Butler. And, that was his first presentation of his SAGD theory.

PMB: He gave the presentation in 1978?

EDMUNDS: He published in the Canadian Society Engineering in that year too. So, 1978 and he was a refinery engineer from Sarnia. And so, what Roger understood was bitumen was not a fluid, bitumen is a solid and bitumen has to be melted before you can do anything with it. And, that's the whole concept of SAGD and I think that's pretty much how he came up with the concept. And so, I mentioned he was a refinery engineer because his strength was that he didn't know that oil was supposed to be a fluid. What he knew was as a refinery guy, is that when you have residual and it is cold, it's pretty much a solid, but you can melt it. And, that was his concept.

PMB: That is really interesting.

EDMUNDS: Everybody else had to break and push it and diffuse into it. And, Roger says, “Well, no, just create a melt cap and collect what arrives at the bottom.” So, by the time I saw that paper in Gulf we were involved with horizontal fracturing. So, that idea was you could drill two horizontal wells and you could create a magic planer fracture between the two. And, when you put that on the computer it works great guns, because when you have the steam under the oil they try to trade places very rapidly and isn’t very efficient and aggressive.

PMB: Help me understand? What year was that?

EDMUNDS: The Surmount? Well, this is back in 1978-1980.

PMB: Really? By my understanding, it was Imperial that first did that and not Gulf

EDMUNDS: We were just thinking about it and we were just simulating. It was in fact Esso who drilled the first horizontal well.

PMB: Yeah and I think it was around 1978 or thereabouts.

EDMUNDS: 1978 or 1980. So, not invented here was the reaction to Roger’s talk. Most people thought he was a crackpot. I thought it was pretty reasonable physics. But, when I went through the numbers, I didn’t get anything as good as what we were getting from our 2-D simulations. So, this is a common fallacy of simulation that if you describe a problem that is perfectly symmetrical in one direction that you can model that problematically without resolving that dimension. But, in fact, just because the physics and all the parameters are homogeneous, that doesn’t mean that the solution will be homogeneous. Viscous fingers and water flooding is a classic example; you cannot make a system that is homogeneous enough that it won’t result in viscous fingers even at very small mobility ratios the slightly viscous oil.

PMB: I’m having a pretty good basic education in engineering here, that’s great.

EDMUNDS: Anyway, the horizontal fracturing went away (a) because the fractures aren’t really horizontal, they tend to go straight up and (b) there was a test by Texaco in the early 80s where they tried to propagate said horizontal fracture between two horizontal wells. Their first attempt, they actually found the other well and they promptly eroded a hole about the size of a grapefruit from the steam and the sand rushing in to the well. And, on the second attempt they breached the surface and created quite an impressive crater and chunks of earth flying through the air.

PMB: When did that happen?

EDMUNDS: About 1982, plus or minus.

PMB: Who did that?

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EDMUNDS: Texaco.

PMB: Because, that's been a problem a few times hasn't it.

EDMUNDS: The only other time was the Joslyn breach.

PMB: Well, Joslyn but Imperial. Do you remember the T-Pad.

EDMUNDS: That's true too.

PMB: So, there have been at least three of those. Primrose, were you involved in Primrose at all?

EDMUNDS: No.

PMB: Because, you mentioned that earlier on. Now, what I would like you to do please is talk about Laricina's Foster Creek project. You talk about having SAGD, but also using a Vapex.

EDMUNDS: Foster Creek is Cenovus. Husky and Germain are our two projects.

PMB: According to this bio, when you were at EnCana from 2000-2005, you provided reservoir and operations direction for Foster Creek's Vapex and SAGD pilots? And, I'm wondering whether you could tell me a little bit about that?

EDMUNDS: Yeah. So, when I started in 2000 and Harbir and some of my AOSTRA cohorts who had stayed on at Pan-Canadian -- no, sorry I am mixing that up now.

PMB: So, you were not part of EnCana?

EDMUNDS: I joined AEC in 2000 and Foster Creek was already in progress as a pilot. So, I started helping with the pilot operations. And, at that time they had started the construction of the first commercial phase at Foster Creek too, which was 20,000 barrels a day. So, that was the biggest SAGD project by far to that time. It was the first commercial bitumen project that used SAGD.

PMB: That went on production when?

EDMUNDS: In 2000 or 2001. We had four patterns in the pilot that we continued to operate and do experimentation on as the commercial was running as well.

PMB: So, that was basic SAGD?

EDMUNDS: Yeah.

PMB: Now, the "apex" part of it and that would be "va" for vapour and what does the "pex" stand for?

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EDMUNDS: Well, that was another Roger Butler invention that had just meant vapour extraction, I think.

PMB: How did that work?

EDMUNDS: If you think of SAGD instead of using water boiled to steam, it uses propane boiled to propane vapour. And, instead of the steam mobilizing the oil with heat, the idea of the propane is that it diffuses into the oil and dilutes it to the point where it is mobile. And, then the same gravity mechanism will pull it down to the production well at the bottom.

PMB: So, then you pump it out. Are you able to recover the liquids that you put in there? Or, does that just help it make it flow-able through a pipeline?

EDMUNDS: Well, there hasn't actually been a successful demonstration of vapex in the field. It's fairly well understood technically, but it's a very slow process at the initial temperature of McMurray reservoirs. So, we did one test at Foster Creek and there was another test at the old UTF site conducted by Suncor and a few others. And, that's almost confidential. So, I don't know what happened there. But, they didn't have any success in vapex either.

PMB: So, it was a good idea and it hasn't worked so far?

EDMUNDS: No. But, it's half of the newest technology we're working on called, ESEIEH *(pronounced: easy)*; which stands for Enhanced Solvent Extraction Incorporating Electro-Magnetic Heating.

PMB: Wow, okay.

EDMUNDS: The guy who came up with that is the guy we just toasted off his retirement today at lunch, which was Mauro Cimolai. Ask me to check that.

PMB: I'll check that later. Would be a good guy to interview?

EDMUNDS: Absolutely. Mauro has only been in the oil sands maybe 15 or 20 years. But, he's a very social guy.

PMB: Good. That technology now is being tested. I know that Imperial has a $100 million test at their Cold Lake project that they just got a $10 million grant for or something like that, I think, to essentially test the use of solvents to recover the oil in Cold Lake; anything similar?

EDMUNDS: Yeah. Well, we've done a lot of work on solvent additives with steam. There will be a lot of work on that for a long time. It's the easy project is halfway between that and vapex. So, the theory behind ESEIEH is that vapex has been shown to work in reservoirs that have a lower initial viscosity, like Saskatchewan heavy oil. So, a thousand times lower, in fact. So, the idea behind the easy is that if we heat the reservoir to say 50C, that's enough to soften the oil to make it amenable to

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vapex type technology. And, that's only a quarter of the minimum temperature that steam will raise the temperature too. So, steam is a very powerful way of putting heat in the ground. But, you can't control the temperature that you get with steam even if you ran the reservoir at the atmospheric pressure, you'd still have 100C in the ground and we only need 50C. So, we only need half that much heat. And, that's where the electro-magnetic comes in. It's a way of supplying heat in a less intense fashion.

PMB: How long have you been doing that?

EDMUNDS: The ESEIEH process?

PMB: Yes, the ESEIEH process?

EDMUNDS: Well, Laricina's been working on it for about three years now. It's a consortium between us and Nexen and Suncor and Harris Corporation, which is the US radio frequency experts and Alberta Innovation has kicked in some money too or CCMC, rather, has supported that.

PMB: What is called?

EDMUNDS: Climate Change... The Alberta Carbon...

PMB: Yeah. Okay, CCEMC, it's called.

EDMUNDS: That's about all I can tell you, because it's a pretty tight-hole kind of project.

PMB: It's confidential; but, in general terms, successful or not successful, high potential?

EDMUNDS: We did a simple field test of the antenna and the electro-magnetic modelling. So, if we put an antenna in a chunk of oil sand, then we trucked in and measured the temperature rise when we turned the power on and that...

PMB: And, you saw results?

EDMUNDS: ...it was nominal, so.

PMB: What did you say?

EDMUNDS: It was nominal.

PMB: I thought you said it was phenomenal. I thought I had a story.

EDMUNDS: We didn't try to recover any oil. It's kind of like the first reactor test they did in Chicago. But, our field test in progress. It's been pretty much designed and I'm not sure what the exact status of it is.

PMB: When do you expect the test to be done, this summer?

EDMUNDS: I think it's a -- I'm actually not quite sure. It's sometime within the next year. But, I don't think it's this summer. Marla can tell you that.

PMB: Now, I'd like you tell me a little bit, please about Laricina; interesting company, because of course, it's privately held. And yet, its assets are fairly large. I spoke to one of the fellows who is a -- I did a story. One of the founders of the company, his name is escaping me but he also has a company in Germany. He's basically acquired all of their resources, all of the mineral rights in Germany including Gulf Shore.

EDMUNDS: Peter Putnam, maybe?

PMB: Yeah. Peter Putnam, yeah. And, I believe that he was one of the founders here or one of the original investors?

EDMUNDS: I think he was an original investor.

PMB: How does the business model here work? It's quite unusual to have a company which is privately held, which has such a lot of assets. Or, are you the right person to ask?

EDMUNDS: Well, no I'm one of the people to ask. You should talk to Glen for sure. Before, Glen was an oil sands force he was a force in the conventional industry. So, he's been a serial entrepreneur starting companies. I met Glen because in 2005, things were really starting to heat up again then. And, there was money flowing in the streets and the eastern money guys had finally heard about the oil sands. And, so one day I gave a completely technical paper and was approached by somebody from Connecticut who said, "We've got $30 million. Do you want to start a company?" And, I was like, "Well, okay. But, who are we going to get to run the company?" Because, at least by that time, I had that much sense and that wasn't something that I wanted to do as the front man, but I'm certainly interested as the technical guy. And, I went on a search of the people that I knew who could fill that role, with no success. And, the last guy I tried to entice was a guy named Mark Montemurro. And, his dad was Monty Montemurro from Pan-Canadian. He was a VP at Pan-Canadian. Anyways, Mark was working at Deer Creek Resources at the time, which was running the Joslyn project. And, Mark says, "No, he had some personal things to tend to for the next few years. But, my boss down the hall is Glen Schmidt." And, this was exactly a week after he sold Deer Creek to Total for $1.7 billion. So, Glen was both feeling flush and looking for the next big thing to do. And, he had decided to team up with Dave Terryho to found Laricina and I happened to just walk in the door while they were looking for a reservoir guy.

PMB: So, you brought in another $30 million into the bargain?

EDMUNDS: We told that guy to go away. And, we went around with Glen for a couple of weeks and raised $70 million just as a blind pool, I guess is the term. But, such was Glen's reputation. And, Dave and I were both had some technical reputation anon. We were really well known among the money guys. Glen had been a rain maker several times.

PMB: Let me ask you a stupid question here. It used to be in let's say 20 years ago, that $1 million would start an oil company or gas company for you with no problem. And, especially lately you kind of need a $100 million to get started. Or, am I dead wrong on that?

EDMUNDS: There's never been a time where you could do a serious oil sands pilot for less than $20 million.

PMB: But, to actually get into...

EDMUNDS: When we started this company, to go commercial the number was about $500 million. So, Laricina after seven years, we've raised $1.4 billion I think it is now.

PMB: So, I guess my point was that -- you're saying it's even higher than...

EDMUNDS: Yeah, it's...

PMB: I would be lucky. So, $1 million 20 years ago and now, you're talking about in the order of $500 million, billion?

EDMUNDS: Here's the scale of the oil sands business: one well pair today costs $5 million dollars to drill one well pair. So, the injector, producer and some plumbing and you're going to attach probably $10 million worth of facilities and infrastructure to that one well paid. And, then you're going to put $10-$20 million worth of steam into the injector over the life of it. That's one well pair. And, a minimum project size, commercial project size is 20 or 30 well pairs.

PMB: Thank you. That explains it very nicely. So, my numbers were way, way off.

EDMUNDS: People have tried to launch a $100 million companies. I think Connacher would be an example of that.

PMB: And, they kind of went under.

EDMUNDS: They didn't have critical mass. And, it's not like this is a mature technology with a lot of experienced people available. So, you have to be willing to overcome some problems and you may have cash-flow a few years later than you hoped for. In Laricina's case, none of us intended to be here, I don't think building a producing company after seven years. Our intention was to build it to 50 or so people, maybe get a pilot started to production and sell to a large interest who was looking for a platform to enter the oil sands. And so, our timing would have been about 2009 to do that.

PMB: I want to move over to this project...

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EDMUNDS: That's why we're still private, in a nutshell. We never imagined we'd be at this scale and not be public.

PMB: How many employees do you have now?

EDMUNDS: About 200 in Calgary and maybe 50 or so operators contract in the field.

PMB: Bitumen carbonate. Now, just as a reminder, I'm sure you don't need to reminded. Underneath the oil sands are carbonate rocks in many places and they are saturated with bitumen. And, there might be more bitumen in the carbonates than there is in the sands, according to some theories anyhow. So, the question is: how do you get it out? And, you have actually done some experimentation in that.

EDMUNDS: Well, we have a producing pilot at Saleski now. Saleski is just about due north of Edmonton and therefore, west of Fort McMurray. I wish I brought a core sample, actually. But, if you've ever seen limestone that has what are called: vugs; which are like miniature caverns basically. In fact, caverns are just large vugs, it's all the same thing. So, this rock is very old rock. It's been tortured, we like to say. And, it has all kinds of porosity. It has porosity in the finest grains, such as a lot of light oil that carbonate reservoirs would have. He has these vugular porosities and then it has fractures. So, this was actually pat of the testing frenzy back in the 70s if you like. And, UNOCAL had some pilots in the Saleski area. The operated this pilot for almost ten years and they had some interesting results, but nothing happened there after 1986.

When we were starting Laricina, we needed some assets and most of the stuff in the McMurray that people weren't comfortable with was pretty much all taken (at least anything we wanted to deal with). So, it was actually Peter Putnam who suggested we take a look at the Grosmont? And, I had been on that committee in AOSTRA back in 1982/1983 and heard about the strange goings-on in this reservoir. So, when we looked it in Laricina time after the SAGD experience of the last 15 years had come between. And, we started to think about, "Well, how does gravity apply to this strange reservoir," because almost nothing else applied. You can inject into it willy-nilly at very low pressures. You can make water and steam come out from maybe one of ten wells if you surround the well you're injecting in and maybe hit one of those. But, you won't push any oil with it either. But, if you think about this rock, it's like rock that has too much permeability.

PMB: The vugs.

EDMUNDS: It's got these big cracks in it. It's got these big vugs. And, how are you ever going to push the oil out of this tiny little matrix they call it, the finer grained rock in between the fractures and the vugs. And, the answer is gravity; because in gravity you're not trying to push everything at the same rate. You're just holding it all up in the air so to speak, this steam and letting stuff run out of it. It runs out of the fractures fast, yeah. But, that doesn't make it stop running out of the finer stuff at a slower but useful rate. And, so we recognized that as it's about half the reserves of our company is that one play. And, we chose to pilot it first; because that was the play we weren't getting any value for from the investors. And so, Germain was our other play which is nearby but it's a sand

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play, so it's fairly well-known and it is Cenovus piloting it and Black Rock is piloting the Grand Rapids as well. But, if we demonstrate commerciality in Saleski then we can more or less double the value of our company... all this oil we weren't getting any value for.

PMB: Let me see whether I understand what you do at Saleski. Basically, you drill into the rock?

EDMUNDS: We drill the standard SAGD pattern at Saleski.

PMB: So, it's just the SAGD pattern, but it's into rock; into this carbonate rock. And, basically you just produce it like that.

EDMUNDS: Like, I said, we're doing horizontal stimulation. So, we wouldn't drill typical SAGD patterns again here. The main reason for that is that it's not necessary. So, the whole twin well technology where you drill them five metres apart and the magnetic ranging and all that. The purpose of that is that is close enough to allow you to melt all the oil between the wells. And, melt it or heat it up hot enough so that it will fall out by itself. So, that allows you to make the whole length of the well active, which is actually a pretty good trick when you think about it. It's 800 metres long and it is 7 inches in diameter and we got another one of those hypodermic needles 15 feet above it. And, we're going to all of that start draining and it's all surrounded by pavement, basically. And, it is just a trick of the physics is that 5 metres is close enough that if you circulate steam in the well is that the oil between will melt in a practical time: 3 months.

PMB: Who else is operating in the carbonates now? You were the first, weren't you?

EDMUNDS: We're the only one with continuous operations. Sunshine Oil has done a few cycles of steam stimulation with vertical wells just for test purposes. And, Athabasca Oil Sands are in Leduc, which you've probably heard a lot about, the southern end. And, I think those are the only two others I can think of, but we're by far the leaders in commercialization of it. And, our pilot has achieved essentially commercial results, which means a steam/oil ratio under four.

PMB: Under four. How many well pair do you have now?

EDMUNDS: We have a total of five now.

PMB: Your production is how much?

EDMUNDS: That's confidential.

PMB: Is it commercial in the sense you can extract the oil, sell it and make a profit even at today's prices?

EDMUNDS: We don't have a big enough scale to be commercial in that remote place. But, we're building a 20,000 barrel a day project.

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PMB: Nearby?

EDMUNDS: Well, on the same lease.

PMB: On the same lease?

EDMUNDS: In the meantime, we're building Germain; an intermediate sized project at Germain. So, we've been a busy crew.

PMB: I'm just looking at these notes here that you've...

EDMUNDS: It's hard work spending $600 million.

PMB: Based on your comments a while ago, it shouldn't be that hard. What I see here is that you have -- maybe I don't understand this. But, has your company worked on 49 commercial oil sands projects?

EDMUNDS: No. We have staff who have worked...

PMB: Collectively, you have that kind of experience?

EDMUNDS: Yeah.

PMB: I think I read that you have five project development areas. Saleski would be one of them and what are the others?

EDMUNDS: Germain. I shouldn't be doing this. So, Saleski and Germain; our number three project would be Burnt Lakes and that is on the northern trend of the Grosmont carbonate. So, it's the same reservoir as Saleski, but about 100 some kilometres to the north. So, to give you some idea: there is Saleski, there is Germain, Burnt Lakes is here and this is Shales (Shell) Big Anchorage in Grosmont. So, the Grosmont reservoir is about that big and that is 6 miles. Fort McMurray is here and Edmonton would be over here.

PMB: That is a really big formation.

EDMUNDS: It is all one reservoir and it's about the size of Ghawar, which is the largest in Saudi Arabia.

PMB: Now, the Germain project, anything you want to say about that?

EDMUNDS: That's another pioneering project in the sense that the Grand Rapids reservoir in that part of the province has not had commercial production yet. Gulf was actually piloting there back in the 70s. But, it's a slightly smaller play. But, it's still pretty good quality sand and quite comparable to the McMurray we believe.

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PMB: So, it's not a carbonate?

EDMUNDS: No.

PMB: You have a pilot there?

EDMUNDS: We're building what we're calling a commercial demonstration, which is about 6,000 barrels a day I think.

PMB: That will go on-stream when?

EDMUNDS: In June 30th is…

PMB: Of this year?

EDMUNDS: Of this year.

PMB: Well, that's exciting.

EDMUNDS: That's our internal targets and I probably shouldn't have mentioned that. But, by the time this comes out…

PMB: This will not be donated to the Glenbow probably before late summer.

EDMUNDS: We delivered our last module last week.

PMB: Congratulations.

EDMUNDS: So, it's just a matter of bolting it up.

PMB: You've covered most of the things that we need. It's a really interesting discussion for me, because it helps me understand. I've heard about you, read about you and I think I might've have written about you a number of years ago. But, it's nice to get a little more knowledge about this. Do you any environmental comments that you want to make? Environment is all the rage. What is your thinking about a lot of the environmental concerns about the oil sands? I'm just going to leave that wide open. You can answer in any way you like.

EDMUNDS: Well, I could talk for two hours just on that. When I first heard about global warming in 4th year engineering; so, I'd already spent a summer working in oil sands. And, was pretty sure that's what I was going to do. And so, when I heard this global warming thing, I thought "Oh yeah, I wondered when that was going to come up." I thought about it and I thought, "Well, people had already done the math before that on basically the simple calculation on what should be the effect of any amount of CO_2 in the atmosphere." And so, you can do that from our 3rd year university heat transfer text that's got a picture of the absorption spectrum of CO_2. And, what it shows it that you can't really create a lot more heating by adding CO2 to the atmosphere, because it's already unsaturated. A good analogy would be that once there is so much smoke in the air that it's dark, you can't make it any darker. Or, once you and I can't see each other it doesn't really matter how much you add to it, it doesn't have any greater or further affect.

So, it turns out that what has gone on with global warming is computer modeling. As it so happens, computer modeling is my primary technical skill. I would even say I like computer modeling more than I like oil sands, because you can model a lot more things than oil sands with compares. For example, you can model climate. So, what I would invite the layman to consider is weather forecasting. Weather forecasting has been around using computers for about 30 years now, I think. How much better has it gotten from two days to four days, maybe they're up to a week in Calgary now. And, that is during a time when the power of computers has multiplied by about a million times I think, an unbelievable figure. Why is that?

The answer to that is well known. It is because climate on earth is a chaotic system. And, chaotic system has a very particular meaning in computer modelling, it means that if you have a model of a complex dynamic system and you can reproduce that computer run absolutely perfectly, any number of times; because, a computer always does exactly the same thing with the same digits each time. But, the nature of the problem is that if you change, say the input to that problem is a million numbers with 18 digits of precision each, if you change the 18th digit of one of those numbers, just one of those numbers, truly a rounding error and re-run the problem after some time where two solutions will diverge completely. They'll be doing the same thing and will have the same patterns. But, one will be having a heat wave while the other is having an ice age.

So, I scratch my head at these guys who say they're going to model climate 100 years into the future, because it's the same system as weather. We can't model weather a week into the future. The only way you can imagine it being possible to model climate 100 years into the future is if you are utterly ignorant of the nature of the mathematical system you're working on, which is non-linear. And, non-linear means: that just because you average over it a long time or the whole world, does not mean you get the right answer or even a meaningful answer. That being said, I'd be the last guy to say you couldn't do a lot of climate science with computers, but you cannot predict the future with computers. There is a great Dilbert cartoon about that; some squirrels with a super computer had predicted the future of the world and I forget the punch line. It would be worth looking that up.

PMB: Dilbert my favourite comic. Well, it wasn't so much interested in that part of the argument, although that is a very interesting commentary. There are other aspects of the environmental implications of the oil sands. One is the carbon emissions and your comment that the environment is saturated is a good one. Of course, the other argument that CH4 would be more likely to contribute to global warming if such a thing exists. But, I'm thinking of the other parts of it. You've got water, you've got air, you've got land pollution and then you've got the....

EDMUNDS: Do you? Where?

PMB: Some places, there is land pollution. Didn't you see that report on the news...

EDMUNDS: Go get the paper, Peter. Get the original paper and read the paper. This guy and Schindler are masters and having their master students produce reports that say... well, Schindler's report said, "Well, we sampled some snow from near where the mines are and we found levels of oil sand components in the snow that were elevated." They were not so elevated that things like mercury exceeded the drinking water standards. So, first of all, the oil sands, a river runs through it literally. The banks of the Athabasca River for 100 kilometres and all of the tributaries for 100 kilometres are 50 metres high of oil sand. The oil sand is 25% bitumen by volume. The tailings ponds consist of water and oil sands, with most of the bitumen removed of course. So, if you ask me how you get heavy metals in snow, I'm thinking, "Well, probably it is wind blowing snow up the river valley during blizzards in the winter." I don't know if anyone is burning coke up there. Suncor used to burn coke. That would certainly put some metals in the air. But, none of those actual scientific reports document anything that remotely justifies the use of the adjective massive, as in David Suzuki's Massive Pollution that is complete and utter bullshit.

And then, we have James Hanson scientist of NASA. And, scientist James Hanson is quoted and on record and has blogs about the oil sands being the largest carbon bomb on earth. And, so the largest carbon bomb on earth. So, it's 10% of total oil reserves in the world. Which makes it about 1% of global coal reserves and our current emissions; the emissions at the time he made this statement were less than each of the coal fired power plant emissions of 26 of the United States. And then, everyone runs around, "Why don't you defend yourself?" So, how do you defend yourself against somebody running down the street saying you're a murder and you've killed 30 people? And, in fact we have been accused of murder. We've been accused of killing people in the Fort Chipewyan Band. And, that was all a crock too. The investigations certainly have been done and it was done and there was nothing to it.

PMB: The lady in question was 94 years old, literally. I guess I heard Ernie Wheat, do you know him?

EDMUNDS: No.

PMB: He's with the Alberta Environmental -- I can't remember the name of his organization. He's the top environmental scientist with the Province of Alberta. And, he's the guy who regulates the oil sands. I heard him give a presentation. Really, it was only a few days ago. In which he basically said the same thing that you're saying. And, he's about as credible as anyone can suggest. He said here's what we do in terms of environmental regulation. And, it was actually quite astonishing to hear the things that he had to say. We're hoping to interview him for this project, our colleague up in Edmonton.

EDMUNDS: If I lived in Ramsay where I almost bought a house; Ramsay, the district in Calgary. I would rather be living next to an in-situ oil sands plant than the chicken processing facility.

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PMB: Well, part of the argument of course, is that when you create a mine or tailings pond or something, you have to reclaim it. You must reclaim it. And, of course, Calgary is never going to be reclaimed; Edmonton, Toronto and so on and so on.

EDMUNDS: Glen Mills will just be refurbished; it will be too expensive to abandon a wind mill and the power lines.

PMB: So, social and environmental protection. Anything else you want to add to that?

EDMUNDS: Just that life is about choices. So, it's not about: Does the oil sands create an unacceptable impact? It's about: "Are we really going to go without cars?" And, the answer to that is, "No". Society had a resounding "No" to that. They never had any support for Ontario Carbon Tax on gas. So, the real alternative, what are the real alternatives? And, if you want to talk about wind mills and solar cells, first of all that is far more expensive in terms of backing out carbon, than what a carbon tax would be. But, none of us have ever objected to a carbon tax; society wants to shoot itself in its economic foot. That's where we have to follow the trend. But, we do think there should be a tax on carbon and not on oil sands, because our carbon is the same as everyone else's carbon. And, everyone else's carbon if they're using our fuel is five times what we're producing in the field. And, not much more than what frackers are doing when they flare gas or even what L&G plants use to compress the gas and cool the gas to liquefy it; all those things take a lot of energy.

You can be against Gates Pipelines, but then are you for rails and trucks? And, that's madness. You can be living in Northern BC and say, "Our environment is too pristine to risk." But then, you're going to keep on driving cars. You're going to keep on lighting your heat in your house. And, you're going to keep on flying to Mexico for holidays in the summer. So, if you're going to keep on being in the hydro-carbon age, why are you so special that you're coastline should not be at risk, but everyone else's should be at risk to supply you with hydro-carbons.

PMB: Last question for you is this: the argument is that in order to have a social licence to operate, there are certain things you have to do as a company, because, obviously the resource is owned by the people of Alberta and so on. So, would you like to talk a little bit about the social licence to operate?

EDMUNDS: That actually was a special topic for us, because we're the leaders of the Grosmont play, which could be very large, as large as the McMurray play, but is on the other side of the river of McMurray. So, Wabiskaw is a very small community, smaller than Fort McMurray was in 1920. And, two or three bands of aboriginal and metis in the area. And, of course, as we were getting started things were not looking so good on the social side of Fort McMurray. So, Glen our founder has a pretty enlightened approach to this. And, we emphasized that community relationship right from the beginning with the Big Stone Cree Nation in particular; they are the principal band in the Wabiskaw area. So, as a practical matter we have put as much business through those guys as we can, which is quite a bit of business with all the roads and stuff we're building. A lot of the companies have joined together supporting efforts to train the aboriginals. So, try to keep them in school in the first place, but also point out to them if you can get a steam ticket, which is a fairly demanding academic accomplishment. But, with that ticket you can live where you were born, you can earn $100,000 to $200,000 a year (is what top operators make these days). So, that is something we would take a lot of pride in seeing that being achieved and that kind of thing.

PMB: One of the problems in the oil sands as you know is that it's in a fairly remote part of Alberta and there isn't a lot of labour. And, of course, these local aboriginal groups in particular technically, could be quite an important source of labour for you.

EDMUNDS: Exactly, yes. And, local is the best, because those are the guys who are going to stay there for a while. Lots of people making a lot of money in the oil sands and they'll spend six months at one company and nine months at another company and go whenever they can get a raise in the next company. It's kind of the gold rush situation. So, it's really hard to see how that situation is ever going to end. It's the same way in Calgary with the technical people. The industry has expanded faster than we've been able to train people. And, in the darkest origins of the industry in the 80s, there were only two or three active projects. So, that would make five or six reservoir engineers, for example who had any experience at that length. And, most of them have had the sense to retire by now.

PMB: There's an economic problem as you know, which is that you have the oil sands are the highest lifting costs on the planet for oil.

EDMUNDS: That is not even remotely true.

PMB: Is that not true?

EDMUNDS: No.

PMB: What's more expensive to develop?

EDMUNDS: Well, there are lots of EOR (Enhanced Oil Recovery) projects that will cost more than that. Cenovus' cash costs are under $20.00 a barrel. I don't think there are a lot of off-shore operators who are doing less than $20.00 a barrel.

PMB: That's interesting. But, of course, I just checked Cenovus' site yesterday. The price they were giving, the posted price for bitumen is $51.00. So, then you've got a $30.00 return.

EDMUNDS: If you're not making a huge positive cash flow, then you have no hope of paying for your huge capital investment. So, oil sands was always not a high lifting cost business, because you just can't... steam costs at an SOR (steam/oil ratio) of two, they burn 1,000 cubic feet. So, if your steam/oil ratio is two that means: you have to boil two barrels of water to recover one barrel of oil. And, it takes about one gigajoule of gas to boil two barrels of water. So, if one gigajoule of gas costs $25.00, they can recover $51.00 worth of oil. That's their number one operating cost. Is that a high-lift, high cost lifting operation? I don't know.

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PMB: I needed to have this discussion. Last question...

EDMUNDS: This why all people were so surprised. The miners were all, "It's a high costs... as soon as the price goes down to $80.00 we'll all be out of business." The price could go down $40.00 and Cenovus would still be doing very well, thank you; because, a lot of the other costs would go down because there aren't a hundred other companies trying to build projects world-wide.

PMB: Pipelines are full. Enbridge commented the other day that pipelines are full. How is that affecting the industry? And, the reason I mention this by the way, you're likely to be quoted in an article that I have to finish this weekend.

EDMUNDS: Well, I'm not the expert on this by any means. But, obviously...

PMB: Your thoughts are pretty solid.

EDMUNDS: ... $10.00 or $15.00 a barrel has a pretty big effect on an industry when you're margin is $10.00 or $15.00 a barrel. So, Cenovus is making $15.00 instead of $30.00, then at the other end of the spectrum a Connacher or a Long Lake is making $1.00 instead of $15.00. And, that's not sustainable with the capital that they have.

PMB: So, there are some companies that are simply a sustainable situation.

EDMUNDS: If it persists, it will cause it a shake-out. But, on the front-end of the business, of course, it will reduce the enthusiasm for companies like us. So, it will slow down the rate at which we can develop and that's not good for start-ups.

PMB: And then, of course, there are the problems with Keystone and all of that stuff, getting them approved. Your notion of Keystone, you going to go ahead or not; what's your thinking?

EDMUNDS: I think Keystone will go ahead and I think that people who really don't want Keystone to proceed are pretty small and already in the United States.

PMB: Is there anything else you want to say? You've done a great job.

EDMUNDS: That's enough for now, thanks.

PMB: Well, thank you very much. It's been a tremendous interview.

[END OF RECORDING]