ALASKA STATE LEGISLATURE
SENATE RESOURCES STANDING COMMITTEE
January 18, 2012
3:35 p.m.

MEMBERS PRESENT

Senator Joe Paskvan, Co-Chair
Senator Thomas Wagoner, Co-Chair
Senator Bill Wielechowski, Vice Chair
Senator Lesil McGuire
Senator Hollis French
Senator Gary Stevens

MEMBERS ABSENT

Senator Bert Stedman

OTHER LEGISLATORS PRESENT

Senator Cathy Giessel
Senator Joe Thomas
Senator John Coghill
Senator Charlie Huggins

Representative Lance Pruitt
Representative Alan Austerman

COMMITTEE CALENDAR

PRESENATION: Heavy Oil Solutions; Stephen Yarbro, SNT Ventures, of Los Alamos, New Mexico

- HEARD

PREVIOUS COMMITTEE ACTION

No previous action to record

WITNESS REGISTER

STEPHEN YARBRO, SNT Ventures
Los Alamos Laboratory
Los Alamos, New Mexico
POSITION STATEMENT: Gave presentation on SNT Ventures' new heavy oil technology.

ACTION NARRATIVE

3:35:12 PM
CO-CHAIR JOE PASKVAN called the Senate Resources Standing Committee meeting to order at 3:35 p.m. Present at the call to order were Senators Wielechowski, French, McGuire, Paskvan and Wagoner.

Presenation: Stephen Yarbro, Los Alamos National Laboratory and owner of SNT Ventures LLC; Heavy Oil Solutions

3:36:26 PM
CO-CHAIR PASKVAN announced a presentation about new heavy oil technology, an area that has opened up a lot of resources in North America including the shale gas revolution in 2006 that has led to increased throughput from individual wells using fewer drill rigs. He invited Dr. Yarbro to present his thoughts to the committee.

STEPHEN YARBRO, Los Alamos National Laboratory (LANL), New Mexico, said he is also an owner of SNT Ventures, LLC. He said he would describe a new technology that he thinks will be beneficial for the State of Alaska, but before that he wanted to review his credentials. He first started working in natural gas processing with Phillips Petroleum and then went to work for Rockwell International's Hanford Atomics Products Operations at their plutonium facility. From there he went to Los Alamos National Laboratory (plutonium facility) and has been there for the past 28 years. Explaining the series of events which lead to the current technology, he said 10-15 years ago the laboratory was working on recovering radioactive waste from underground tanks on the Hanford site and he was part of a multi-disciplinary team that was developing a "super critical water oxidization process" to remove the organics from the waste, so that the waste could be sent for vitrification.

After several years that project was completed and he moved from the plutonium facility to a part of the laboratory where he used his experience to analyze foreign countries' nuclear weapons programs. As such, he is part of an organization that has the nuclear emergency search team that looks at various issues worldwide. As part of that charge, they developed very high energy radiography. During the British Petroleum (BP) 2010 Gulf of Mexico oil spill, LANL was asked to deploy that radiography to look at the underwater well casing, so if they had to develop explosive closure devices they would know where to place them. He looked at lot of the real-time feeds from under water and

began to consider how the high pressures (5,000 psi) depth could be used to process the oil. He reflected upon his early experience with super critical water; the two came together and now he has developed this "super critical water treatment" which takes heavy oil with the consistency of peanut butter and makes it the consistency of water. This process could have application to Alaska's vast heavy oil deposits which is difficult to pump into the TAPS because of its high viscosity.

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He recounted how conventional oil production is going down and that drilling to find more is expensive. Huge amounts of heavy oil are available globally, but it has been hard to exploit. It's hard to transport because of its high viscosity; it's typically $10 to $20 a barrel less than conventional oil and only about one in four US refineries can process it.

MR. YARBRO said Alaska is very fortunate in that it has somewhere between 24 to 33 billion barrels of heavy oil deposits split between the Schrader Bluff, West Sak and Ugnu Fields. Heavy oil is fairly shallow so overcoming the viscosity issue would make it relatively easy to get and it doesn't require very expensive offshore drilling.

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The issue around development of heavy oil is its viscosity. So, more wells must be drilled to recover heavy oil than for conventional light oil and some type of thermal technique has to be used, such as steam recovery, to get the oil out of the ground. In California that is not a problem, but it is in Alaska with its permafrost. Also he said that heavy oil is somewhat depleted in hydrogen compared to light oil, so fewer products can be derived from it. It also sells at a lower price than conventional oil. Typically the economics is what have held back heavy oil development.

3:43:31 PM
Alaskan oil is somewhat unique in that between the West Sak and Ugnu Fields there is a "grading viscosity" everywhere from syrupy oil in the West Sak all the way up to honey and almost-like-peanut butter in the Ugnu Fields. However, BP, for example, is beginning to successfully develop and produce heavy oil at its Milne Point S Pad using the CHOPS (Cold Heavy Oil Production with Sand) process.

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He said his solution to the problem is to use "supercritical water extraction and refining" (SCWER) that uses the unique properties of water at very high pressures and temperatures beyond its critical point to dissolve the heavy oil. He explained that oil dissolves completely when water passes its critical point (applying high temperatures and pressures to thermally crack the oil). This process takes long chains of complex oil molecules (c12, c50, c 60 and higher) and thermally cracks them down to smaller c-chains (like c5s and c6s), the higher-value components of conventional oil. The high energy of the water essentially just tears it apart. Water at those temperatures also provides some of the hydrogen needed in order to get the hydrogen value up. It's very unique in that respect.

CO-CHAIR PASKVAN asked if he used the SCWER to remove the hydrocarbons from the source when he worked with plutonium. How did that process relate to this one?

MR. YARBRO answered that super critical water oxidation can completely destroy organics. It can take a fairly complex organic to carbon dioxide, so you get almost complete conversion. You just don't run the conversion all the way to complete. You use it to break up the molecules just enough to get the ones you want (the c5s and c6s) and then stop. Or if needed, you can go all the way to the end and produce carbon dioxide. In fact it's so complete the military has licensed a variant of this type of process for chemical weapons disposal. He said they have carefully looked at the conditions to get to the point of getting just enough thermal degradation to get the products of value.

SENATOR WIELECHOWSKI asked if heavy oil is 5,000 ft. down in the ground, do you inject water into the ground or bringing the oil up first.

MR. YARBRO replied that they intend to integrate with the current BP process, CHOPS, that uses large progressive cavity pumps down-hole to pump the material out with the sand. The advantage to that is that it has been thoroughly tested in Canada's oil sands. The disadvantage is that you don't get all of the oil; a lot is left in place. Going the next step of using the thermal recovery technique (like California has developed) of injecting steam into the reservoir that melts the oil and then pumping it out provides for much higher recovery. His process can use either the steam that is pumped down-hole as it comes out or the waste heat that is generated in the production process to inject down-hole to help recovery.

3:48:14 PM
SENATOR WIELECHOWSKI asked if they can pump up all the heavy oil they can get and then pump in steam to separate the remaining oil and water and to make the oil less viscous.

MR. YARBRO responded that when the oil comes off the well head is when it gets mixed with the steam and that is when it becomes less viscous. It enables transport to and through the pipeline. If they want to inject steam down-hole, they could integrate with that process or with CHOPS that doesn't use that process. They are flexible, but the plan is to integrate with CHOPS and inject the steam at the well head as it comes up.

3:49:05 PM
SENATOR FRENCH said it's a fascinating idea and asked what becomes of the injected water.

MR. YARBRO replied that this is the unique part of this process. The oil and water becomes a single phase because when dropped below the critical point, water behaves like water and the two separate very cleanly. Then all you do is use a gravity settler to skim the oil off.

SENATOR FRENCH asked if the water would stay combined with the oil through its shipment down TAPS.

MR. YARBRO answered that they intend to recycle the water at the well head to keep water usage low. That way the low viscosity oil can be transported without the water; whatever trace amounts are left can easily be removed at the refinery or later on.

3:50:37 PM
SENATOR WIELECHOWSKI asked how much water is used per barrel and assuming they are heating the water with natural gas, how much of that would be used.

MR. YARBRO answered that it depends on the oil feed. It will be somewhere between two to three barrels of water per barrel of oil; but the water gets recycled, so the overall water usage is low. They intend to use electric heaters to heat the water up to get the reaction going and then the reaction itself gives off a fair amount of heat. So, again the overall energy use is relatively low. Comparing this to energy use in a typical refinery, this is probably in the middle to low end of energy use per barrel produced.

SENATOR WIELECHOWSKI asked how many megawatts of power would be needed.

3:52:12 PM
MR. YARBRO replied for 25-barrels per day, the heaters would be 225 kilowatts to get the temperature up; but once the reaction is started it generates about 220 kilowatts of power.

3:52:39 PM
SENATOR FRENCH asked if oil stays light as long as the water is still in it.

MR. YARBRO replied that once the water has been added, the oil has been upgraded to conventional oil. It starts off like peanut butter and ends up with "light phase" floating on top of the water. Once the two are separated, the oil is essentially like water.

3:53:24 PM
SENATOR FRENCH said the reaction upgrades the oil at the well head; so the water is almost a waste product.

MR. YARBRO replied yes; it's a re-agent that they recycle and use to react the oil from the consistency of sticky creamy peanut butter to oil-like water.

3:55:09 PM
CO-CHAIR WAGONER asked what happens to the oil chemically that makes it lighter and still allows it to continue being oil.

MR. YARBRO replied that the large heavy oil molecules sometimes have up to 100 carbon molecules in chains and rings. Water at high temperatures and pressures is a very aggressive environment and it literally "just tears these things apart." As it tears them a part and fractures them, one can think of a glass breaking into fragments that can keep being broken down to the sizes wanted. So, you break it down to the distribution found in conventional oil. As the chains and rings are broken, ends are exposed and they combine with the available hydrogen that is produced in the heated water. This process produces a product that looks like conventional lighter oil.

CO-CHAIR WAGONER asked if that uses up the hydrogen in the water.

MR. YARBRO answered yes; so, they bleed off a small make-up stream. The water can continue to be purged of sulphur or metallic impurities and used.

3:57:46 PM
CO-CHAIR PASKVAN asked him to expand on the extraction of sulphur as part of this process.

MR. YARBRO explained that it's very dependent on the type of oil. The complex structure of the oil molecule has sulphur compounds bound up in it. Those bonds tend to be weaker than the carbon-hydrogen or carbon-carbon bonds and can actually be broken quicker than the other bonds; then it reacts with the water to make a variety of different compounds that are soluble in the water phase and not in the oil phase. So, when you separate them, you get this nice clean water and oil phase and the sulphur compounds are in the water. You can bleed a small amount off and take that to waste treatment and disposal and then bleed a small amount in.

He said that because the molecules are very complex, they don't completely understand all the reactions, but they know that as long as they run the process within the right conditions they get pretty good sulphur removal (50 to 60 percent).

MR. YARBRO said a dramatic reduction in viscosity is what you want, because BP is now doing a great job of producing heaving oil at the Milne Point S Pad, but they have to use conventional oil to essentially dissolve the heavy oil to get the viscosity where it needs to go. And this technology will take them directly to that at the well head without having to do blending which leads to more volume in the pipeline. He added that this process right now doesn't use exotic equipment and they don't need proprietary catalysts.

4:00:09 PM
SENATOR STEVENS joined the committee.

MR. YARBRO said the processing equipment fits in an 8X8X20 ft. common transfer container (25 barrel a day base industrial size that they intend to put in the field). It has typical valves and high pressure pumps and things that are very familiar to the petrochemical industry.

Their proposed pilot project from the bench scale to being industrially ready uses two standard 8X8X20 ft. transfer

containers, one to house the individuals that would be working with the equipment and the other for the equipment itself.

MR. YARBRO said they intend to develop collaborations with the University of Alaska (UAA), tapping into its petroleum development laboratory, and use the facilities at the UAF Pipeline Training Center.

CO-CHAIR PASKVAN asked if he had contacted the University and the Pipeline Training Center yet.

MR. YARBRO replied yes. He has had an ongoing dialogue with Dr. Patel and his associates, and his associate, Jerry Myers, is meeting with the individuals running the pipeline school to get a plot plan to finally place the five-barrel per day unit on the facility so they can begin work there.

4:02:45 PM
He said their path forward and the collaborations that are important for the project's success are clearly to develop collaborations with UAA and UAF Pipeline School because of their enormous experience and knowledge about how to integrate this process with the production process and about how it would interface with the actual oil field operations. They would like to build and test a five-barrel per day unit, which would give them a lot of the industrial skill experience. Then they would like to go to a 25-barrel per day unit, which they think is the smallest industrial block that could effectively be fit together depending on the production assets in the field. Because those blocks could be built in the Fairbanks area, a lot of jobs would be associated with their fabrication and deployment. They can build any size needed, but it is a standardized process.

4:04:36 PM
CO-CHAIR WAGONER asked what temperature the oil is after the water is separated out.

MR. YARBRO replied about 350 to 400 F. Waste heat might need to be removed or it may need to be blended at those temperatures. When you reduce the viscosity and remove the sulphur, metallic impurities and neutralize the naphthenic acids, it reduces corrosion in the pipeline and increases the value of the oil. Originally they thought about developing this for the California heavy oil fields that already have extensive infrastructure. California has steam-assisted gravity drainage and a special high-speed heated train to transport. If they can increase the value of a barrel of oil by $15 or $20 and keep the processing

costs within that delta, that would be a real boon to the California market because they could make more per barrel of oil for the same infrastructure cost. They also discovered that as the molecules are broken up, the volume is increased by about 9 percent.

SENATOR WIELECHOWSKI asked if he had financial models of the estimated cost per barrel for extraction.

MR. YARBRO replied yes, but it depends on the production process that is used; but a fully developed infrastructure that is already injecting steam down-hole would run around $10 per barrel up to $14 per barrel without that.

SENATOR WIELECHOWSKI asked if that cost would be added on to what it costs already.

MR. YARBRO replied yes.

SENATOR WIELECHOWSKI asked if he knew the cost for heavy oil extraction in Canada using conventional methods and how his price compared to that.

MR. YARBRO replied that he didn't have a very good cost for that, but he knew they invested about $10 billion recently in a new facility for a retorting process that dissolves material out; and they are still economically effective at that price. He envisions a smaller more distributed processing that allows more tailoring to the field and the production process rather than these massive billion dollar facilities that are in one place and the oil needs to be transported to keep the facility viable.

4:09:56 PM
MR. YARBRO said they believe there is a real positive impact for the state with successful development of this technology. They believe they can maintain and perhaps increase revenue from the TAPS along with the associated benefits of the jobs and oil field development.

He said Jerry Meyers, Heavy Oil Solutions, has been a partner in helping understand the Alaska part of this and Michelle Huft, also with Heavy Oil Solutions, has been helping with some of the business development along with the UAA Petroleum Development Laboratory and the UAF Pipeline Training Facility.

4:11:30 PM

In conclusion, he said they believe this technology, if properly developed and successful, could provide more oil for the TAPS. They know they can reduce the viscosity of oil from honey to water; and now they want to take it to the next step of higher throughput. This would leverage the investment in conventional pipeline trucks and refineries allowing them to last much longer. The design itself is based on industrial proven technologies; it uses standard petrochemical equipment and standard commodity chemicals and they think the development will be relatively straightforward from the bench scale.

CO-CHAIR PASKVAN asked what he would like the legislature to consider about this new technology.

4:12:54 PM
MR. YARBRO answered that he would like the legislature to consider a capital investment in the development of the process. It would be good for the state because rather than going directly to an oil company that would own the technology or believe they owned it, that investment from the state at this point would allow a diverse licensing structure and a diversity of applications for the state and therefore be a good return.

CO-CHAIR WAGONER asked his estimate for building the demonstration unit in Fairbanks.

MR. YARBRO replied that they are working on getting precise numbers within the week.

CO-CHAIR WAGONER asked if the state became involved with the licensing and use of technology, did he plan to retain ownership of the process.

MR. YARBRO replied that the current plan is to form an Alaskan company and then to essentially pass the license to it to exercise on behalf of the company.

CO-CHAIR PASKVAN thanked Mr. Yarbro for the presentation.

4:16:09 PM
Finding no further business to come before the committee, Co-Chair Paskvan adjourned the Senate Resources Standing Committee meeting at 4:16 p.m.