ALASKA STATE LEGISLATURE
SENATE RESOURCES STANDING COMMITTEE
February 23, 2011
3:33 p.m.

MEMBERS PRESENT

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

MEMBERS ABSENT

All members present

OTHER LEGISLATORS PRESENT

Senator Cathy Giessel

COMMITTEE CALENDAR

SENATE BILL NO. 42
"An Act relating to the procurement of supplies, services, professional services, and construction for the Alaska Energy Authority; establishing the Alaska Railbelt energy fund and relating to the fund; relating to and repealing the Railbelt energy fund; relating to the quorum of the board of the Alaska Energy Authority; relating to the powers of the Alaska Energy Authority regarding employees and the transfer of certain employees of the Alaska Industrial Development Export Authority to the Alaska Energy Authority; relating to acquiring or constructing certain projects by the Alaska Energy Authority; relating to the definition of 'feasibility study' in the Alaska Energy Authority Act; and providing for an effective date."

- HEARD AND HELD

PRESENTATION: Focus On New Oil and Gas Development Opportunities

- HEARD

PREVIOUS COMMITTEE ACTION

BILL: SB 42
SHORT TITLE: POWER PROJECT; ALASKA ENERGY AUTHORITY
SPONSOR(s): RULES BY REQUEST OF THE GOVERNOR

01/19/11	(S)	READ THE FIRST TIME - REFERRALS
01/19/11	(S)	RES, FIN
02/09/11	(S)	RES AT 3:30 PM BUTROVICH 205
02/09/11	(S)	Heard & Held
02/09/11	(S)	MINUTE(RES)
02/11/11	(S)	RES AT 3:30 PM BUTROVICH 205
02/11/11	(S)	Heard & Held
02/11/11	(S)	MINUTE(RES)
02/16/11	(S)	RES AT 3:30 PM BUTROVICH 205
02/16/11	(S)	Heard & Held
02/16/11	(S)	MINUTE(RES)
02/21/11	(S)	RES AT 3:30 PM BUTROVICH 205
02/21/11	(S)	Heard & Held
02/21/11	(S)	MINUTE(RES)
02/23/11	(S)	RES AT 3:30 PM BUTROVICH 205

WITNESS REGISTER

JEFF STEPP
Staff to Senator Paskvan
Alaska State Legislature
Juneau, AK
POSITION STATEMENT: Reviewed CSSB 42(RES), version D.

DAN SULLIVAN, Commissioner
Department of Natural Resources (DNR)
Juneau, AK
POSITION STATEMENT: Commented on the state's oil and gas development activities.

KEVIN BANKS, Director
Division of Oil and Gas
Department of Natural Resources (DNR)
Juneau, AK
POSITION STATEMENT: Commented on the status of the state's current oil reserves.

BOB SWENSON, State Geologist and Director
Division Geologic and Geophysical Surveys
Department of Natural Resources (DNR)
Juneau, AK

POSITION STATEMENT: Explained USGS surveys and other data gathering techniques used to assess the state's oil and gas resources.

PAUL DECKER, Petroleum Geologist and Manager
Resource Evaluation Section
Division of Oil and Gas
Department of Natural Resources (DNR)
Juneau, AK
POSITION STATEMENT: Commented on the state's unconventional oil resources.

ACTION NARRATIVE

3:33:43 PM
CO-CHAIR JOE PASKVAN called the Senate Resources Standing Committee meeting to order at 3:33 p.m. Present at the call to order were Senators Stedman, Wielechowski, French, Stevens, Wagoner, and Paskvan.

3:34:57 PM
SB 42-POWER PROJECT; ALASKA ENERGY AUTHORITY

CO-CHAIR PASKVAN announced SB 42 to be up for consideration.

CO-CHAIR WAGONER moved to adopt CSSB 42(RES), 27-GS1822\D.

CO-CHAIR PASKVAN objected for discussion purposes. He asked his staff to explain the proposed committee substitute (CS).

JEFF STEPP, staff to Senator Paskvan, said the Department of Law suggestions from the February 21 meeting were forwarded to the drafter who prepared a CS deleting the procurement code language.

3:37:44 PM
At ease from 3:37 to 3:44 - technical difficulties.

SENATOR MCGUIRE joined the committee.

3:44:50 PM
MR. STEPP said the CS makes changes relating to the Alaska Railbelt Energy Fund essentially preserving the legislature's authority to appropriate. Fourth, and most significantly, the CS makes changes relating to the creation of subsidiaries and adds a section entitled "Approval of Subsidiaries" so that they are specific to the Watana Hydroelectric Power Project on the

Susitna River. Finally, he said, the fiscal notes for SB 42 are not impacted by any of these changes and will remain the same for version D. He explained that the original language in SB 42 allows AEA to have employees and that remains unchanged in the CS, and that is the source of the fiscal notes.

CO-CHAIR PASKVAN, finding no further questions, removed his objection and CSSB 42(RES), version D, was before the committee. He announced that he would hold it for another meeting.

3:48:11 PM

PRESENTATION: Focus On New Oil And Gas Development Opportunities:

CHAIR PASKVAN announced the presentation on Alaska's oil and gas development activities. He welcomed Commissioner Dan Sullivan to the committee.

DAN SULLIVAN, Commissioner, Department of Natural Resources (DNR), said he would provide a brief overview of the department's view on North Slope hydrocarbons. Kevin Banks, Director of the Division of Oil and Gas, would focus on what they know about the amounts of discovered resources near existing infrastructure. Next, Bob Swenson, Director of the Division of Geological and Geophysical Survey, would focus on undiscovered and probable resources and how those estimates are made. Paul Decker, a star petroleum geologist, would then provide details on their assessment of one of the promising unconventional categories, the shale oil potential on the North Slope.

COMMISSIONER SULLIVAN said an important threshold question when looking at resource development policy is what is left in Alaska, and by any measure Alaska still has a world class hydrocarbon basin on the North Slope. The department believes it is in the state's and the country's best interest to more fully develop them.

The biggest challenge is the throughput decline he said. His graph showed 1 million barrels a day in 2003 that was down to about 640,000 barrels a day last year. Another major challenge, Commissioner Sullivan said, is a federal government that has moved from a focus on environmental protection to a posture of pro-actively shutting down resource development in Alaska. The high costs of doing work in the state, a tough environment to explore and develop in and infrastructure issues are other challenges.

He said to address these challenges it's important to look at all the policy tools available, some of which the state controls and others which the federal government control. Encouraging all players of all sizes is important to finding additional oil as well as commercializing North Slope gas, and from the department's perspective there is no silver bullet.

3:53:27 PM
KEVIN BANKS, Director, Division of Oil and Gas, Department of Natural Resources (DNR), said he would speak about the reserve estimates in the existing and nearby oil fields that have been penetrated by exploration wells at one time or another, and about which they have a degree of certainty about oil and gas amounts.

He indicated that all pieces need to be in place to make a development project successful. At one level data is intrinsically important for the geologist to understand the resource potential. Once some definition is created around that, either through exploration and other activities - but even just access to information that has been collected over the years or a company might need access to land to assemble a position that sufficiently surrounds the resource that they hope to develop - capital is needed from both within a company and from outside capital markets. A favorable regulatory scheme and favorable permitting is also needed so a project can have a predictable set of outcomes. Work plans need to be developed that are sufficiently robust to be approved so the project can move forward.

He said exploration is the physical data gathering effort that most companies have to go through in this process. You can't start popping wells in after reviewing just the data.

Finally, production is required, and here he was talking about the whole suite of development requirements: the infrastructure, the transportation links, and the access to markets to make sure whatever is developed is going to succeed. Mr. Banks said he indicated these as a chain because any element, if it's weak, could defeat a project.

3:57:34 PM
MR. BANKS said he would be speaking about the reserves and the discovered resources around the North Slope units. Basically, they have a fairly good understanding of the remaining oil and gas that can be produced in existing units. About 5.1 billion

barrels of oil and about 35 tcf of gas are in these units. His slide also indicated some resources specifically in northeast NPRA. Liberty was also on that slide, because it is about to go into production as soon BP is ready.

Going to a less certain number of resources not necessarily in production, Mr. Banks said, are estimates of ranges that come from shared non-confidential information about discovered resources without much delineation or development. It included estimates of FEX NPRA discoveries in the central NPRA over the last few years and Kuvlum in the Beaufort Sea near the Sivulliq project, Shell's target for Beaufort Sea drilling that they had to postpone this year. Gubik is Anadarko's gas field and will depend on how they will someday pursue development there.

Finally, a more uncertain number, but related to oil that has been penetrated by wells, the Ugnu heavy oil reservoir just below the perma-frost holds up to 20 billion barrels of oil. BP has indicated it may potentially be able to recover only about 10 percent or 2 billion barrels of oil. Ugnu is challenged technically because of the nature of the reservoir and so the issue will be solving those problems as well as bringing the costs down for developing in general.

Burger in the Chukchi Sea was drilled by Shell in the early 90s and they are interested in pursuing it if they are ever given permission to do so. There is a range of 31 million to 1.7 billion barrels of condensate in place. More delineation is required there as it is for the estimated 8-27 tcf of natural gas.

SENATOR WIELECHOWSKI asked if the Beaufort projects are on state land.

MR. BANKS answered no; they are all on Outer Continental Shelf (OCS) federal lands.

SENATOR WIELECHOWSKI asked which ones are on state lands.

MR. BANKS replied Umiat, Gubik, North Tarn, and the FEX. He added that the state gets a share of royalties that come from the NPRA.

SENATOR WIELECHOWSKI asked why Umiat is not being developed and who has the lease.

MR. BANKS replied that most of those leases are on federal land, but some are on state land on this side of the river. Umiat is not being developed largely because of the whole suite of issues he has talked about: the lack of infrastructure and remoteness; it's an oil play that needs a road and a pipeline, which could be expensive.

SENATOR WIELECHOWSKI asked what information he has about why they are not being developed. Do we need to build a road there or is it the financials that don't work? What information did he have?

MR. BANKS said he didn't have economic information on Umiat. They would have to ask the developer, Renaissance. Gubik is remote as well.

SENATOR WIELECHOWSKI said he wanted to know what lever needed to be pulled for the projects on state land to go forward. If $20 million for a road is needed, they needed to talk about that or royalty relief. Did he know what is needed to get these areas developed?

MR. BANKS replied that several things need to happen. Umiat, to the extent it's on federal land, may not have an option for royalty relief, for example. It's also a shallow reservoir and accessing it from the Umiat staging area could be complicated.

4:05:47 PM
BOB SWENSON, State Geologist and Director, Division Geologic and Geophysical Surveys, Department of Natural Resources (DNR), said he came from the Montana region and has been in Alaska since 1991. He graduated from the University of Wyoming. He joined Arco Alaska in 1991 and worked there through 2002 as exploration lead in the Cook Inlet and non-producing basins around the state. For the last five years he has been working with the state first as a research director and now as the state geologist.

MR. SWENSON said his pictures tell a lot of stories. The first picture was an oblique view of the North Slope with the Chukchi and Beaufort shelves, the main point being about the exploration history and maturity of the North Slope. A number of wells have been drilled on the North Slope but in comparing it to other areas the distance between Burger and Prudhoe Bay is the same as the lateral distance across the state of Wyoming. So, they are talking about a very large area. For perspective, within the 150,000 square miles on the North Slope fewer than 500

exploration wells have been drilled. The entire state of Wyoming is about 100,000 square miles - about 75,000 square miles related to petroleum - and over 19,000 exploration wells have been drilled there. The next slide showed that Alaska has greater than 20 billion barrels of oil, information from 2000-2006 U.S. GEOLOGICAL SURVEY (USGS) studies on global conventional oil reserves, making it a world class basin.

SENATOR STEVENS said he saw another 20 billion barrels in the Aleutians. Is that the OCS?

MR. SWENSON answered yes, and that is the assessment done in 2000 of the Bering Sea basins.

SENATOR STEDMAN said he didn't think all those oil basins were equal in terms of industry's ability to enter or exist and asked what percent of those oil basins are actually tied up by sovereigns that don't allow free flow of capitalism. And of the ones that do, what percentage of what's left is from the Alberta oil sands? He thought they would find that it's only 10 percent.

MR. SWENSON said that was an excellent point and elaborated that this assessment was specifically on the technically recoverable resource estimates and does not include the unconventionals such as shale oil or heavy oil in Canada. A number of different factors across the globe will curtail whether or not a company has the ability to enter and try to access those resources. The USGS will be coming out with a new global assessment, but he didn't know if they would use an "economic and/or political filter" on the access issue.

Slide 3 was a map of the North Pole. He explained that the USGS had recently done a technically recoverable resource assessment of the whole Arctic region. The important point of the map is that the only area they actually think is greater than the 10 billion barrel hurdle is the Arctic Alaska (AA) that has an estimated 30 billion barrels.

4:11:56 PM
Slide 4 looks directly down on the North Pole for undiscovered natural gas. Arctic Alaska is in the greater than 100 tcf of gas resource assessment.

MR. SWENSON said it's important to know what goes into these assessments and understanding the geology is a major portion of their validity. So, he wanted to try to convince the committee of the knowledge that went into this work. The first slide shows

the North Slope regional geology at the surface. It shows the tremendous amount of understanding they have from a regional sense. But the regional look is not what goes into the direct assessment of these resources.

The next slide was a generalized cross section from the Beaufort Sea in the north to the Beaufort Sea to the south in the Brooks Range. It shows what is in the subsurface at depth. It also shows the location of the Prudhoe Bay oil complex, an important part of their understanding of the petroleum systems within this basin. He explained if the same cross section was done in the North Sea, a very hydrocarbon prolific basin in England and Norway, it would show a very similar geologic setting - a rifted margin. To the south of Prudhoe Bay is very similar in geologic style to the Foreland Basin of Alberta. He said both USGS and the Division of Oil and Gas have been doing "surfacial mapping" at a one-inch to a mile scale.

SENATOR STEDMAN said the state spends a lot of money on good subsurface mapping and asked him to explain how they interpret that without sending guys out to do seismic.

MR. SWENSON explained that geologic mapping is a process using all the tools available to them - seismic or airborne geophysical data, and most importantly, surface outcrops. They will study a specific outcrop and put that in the context of all the other outcrops in an area. Measurements of porosity and permeability, of the depositional environment, and a number of different types of analyses on the surface expression are made.

4:17:58 PM
The rocks that are exposed at the surface in the Brooks Range to the south are in the subsurface to the north, because of the thrust belt (mountain building) that happened in the Brooks Range. So, studying them in the Brooks Range gives them an understanding of what is in the subsurface to the north where they expect to see accumulations of hydrocarbons. This point was elaborated in the next three slides (8-10).

Slide 8: Some of the additional studies that are undertaken during the geologic mapping effort are porosity and permeability measurements of different sand bodies as well as the provenance studies (the type of reservoir rock they would expect to see in a given age rock). Electrical measurements of the rock outcrop themselves have been taken so they can be compared to well logs that were drilled in the subsurface to the north.

MR. SWENSON said one of the more important aspects of this entire effort is their understanding of the entire stratographic package - the entire package of rocks that are drilled and explored for in the exploration efforts. The work that has been done along the Brooks Range has dramatically changed their understanding of the stratographic column.

CO-CHAIR PASKVAN asked him to elaborate on the significant change. What was the basic premise and what is the current premise?

MR. SWENSON answered that the initial premise is understanding where a reservoir is located within a given package of rocks and how they were deposited. Understanding where the sand bodies are located within any given package of rocks and how they are distributed from a paleo-environment from where they were deposited is incredibly important in how they understand what type of plays might be available as well as where those plays might be, he said. So, the more detail on the distributions of those reservoir faces of where the sand stone bodies are helps them understand what type of prospect might be in the subsurface for an undiscovered resource assessment.

4:21:21 PM
The next slide, a cross section done by Paul Decker from the Umiat area up to Prudhoe Bay using well logs from wells along that route, illustrated those questions. It also shows how they apply the detailed knowledge that has been gained from all the geologic mapping to the subsurface models. Once all these data sets are put together and finalized, then they go into the available subsurface and the seismic data and apply all this knowledge and model an interpretation of the seismic data so they can look at the distribution of sand bodies, where the reservoirs might be, the quality of those reservoirs, what the porosity and permeability might be, as well as the hydrocarbons that would have been generated and migrated into potential traps.

CO-CHAIR PASKVAN said Mr. Banks in his testimony used terms like the North Tarn, and Mr. Swenson's slide had a Tarn Bermuda Interval and an Ugnu Sands and an Ugnu deposit. Are those intended to correlate to the finds and names that were earlier identified?

MR. SWENSON answered yes; the different formations described in different areas of the North Slope have hydrocarbons present within them. The Ugnu Sands, for example, are a specific oil

reservoir within the Ugnu formation. They study the Ugnu formation and everywhere it's exposed on the North Slope so they can have a better understanding of what the recoverable factor of oil or gas might be out of that formation. They use other analogues to do that as well.

CO-CHAIR PASKVAN pointed out that the Ugnu Sands are closer to the ocean and the Tarn is maybe halfway between.

MR. SWENSON said that was correct and that the section he is talking about focuses on the south of the Brooks Range where one can see faulting and repeated stacks of formations along the ANWR border; it doesn't make it all the way to the Prudhoe Bay area. He said all of this information that he just described is used in the models. The USGS then takes that information and puts it into an industry standard probabilistic model for determining resource size.

He described this statistical method as a flow diagram with different geologic parameters that are necessary for an accumulation to occur in one corner including: closure area, closure of the trap size, the reservoir thickness, porosity, water saturation, et cetera. Each one has been taken into a "probabilistic Monte Carlo analysis" and a series of probably occurrences in graphs are generated from each one of those different parameters. This analysis, then, is generated into an accumulation size. Then each one of those plays are "risked for their occurrence" and results in what they use as "technically recoverable resource assessments."

The next slide showed the distribution of field sizes - how large the fields are expected to be in a given play type on state lands, NPRA and ANWR from the results of one of the Monte Carlo runs. This distribution can be compared to other mature basins that the department has a huge analogue data base on to make sure the analysis is on the "right page."

MR. SWENSON said a series of resource assessments is generated from all of this effort and slide 15 shows the USGS assessments for technically recoverable reserves for the areas of Chukchi-south, NPRA, Central North Slope, Beaufort Shelf and ANWR.

He said three numbers are particularly important and explained that for any given area there will be a single number - 8.2 in the Beaufort Shelf, for example - and then (.4 up to 23.2), the range of potential sizes of the resource in this area. The 8.2 is the mean of the statistical distribution. The issue is to

understand how much they know about a given area; that determines the size of that range of numbers. So, in the Beaufort area where they have relatively little information, the range is very large. But in the Central North Slope the mean is 4 billion barrels and the range is 2.6 up to 5.9, relatively narrow because of the amount of information they have. It's important to look at that range for any resource assessment, he emphasized, for accuracy.

4:27:42 PM
MR. SWENSON said all of these assessments he has been talking about are conventional resource plays in the Arctic Alaska and do not include the unconventionals they have been hearing so much about in the Lower 48. Those include gas hydrates (occurring only in Alaska in the USA) and over-pressured gas or basin shut in gas (shale gas) which they are in the process of assessing. Those numbers will be very large, though. Coal bed gas is another resource that is really large, but that also has not been assessed.

SENATOR STEDMAN asked if his slides show there are 4 billion barrels of oil remaining on Central North Slope.

MR. SWENSON replied using 2.6 to 5.9 as the range of potential estimates (P95 and P5 numbers), that means there is a 95 percent chance that there is more than 2.6 billion barrels of oil and a 5 percent chance that there is more than 5.9 billion barrels of oil in this area - with a mean of that distribution of 4 billion barrels.

SENATOR STEDMAN asked if the mean in the ANWR area is 10.4 billion barrels.

MR. SWENSON replied yes; the mean is 10.4 billion barrels with a range of 5.7 to 16.

SENATOR STEDMAN asked him to explain a red line.

MR. SWENSON explained USGS did a recent assessment of NPRA and reduced the mean from 10 billion barrels down to 680 million barrels.

SENATOR STEDMAN asked for some background. Did they adjust the numbers up a few years ago because of the exuberance over Alpine?

MR. SWENSON replied that resource assessments get fine-tuned with additional information. The USGS did a reassessment of the NPRA work following some of the exploration work that was done there. Their original number - 6.7 to 15 with a mean of 10.7 - was based on their model at the current time associated with just post-Alpine. They felt there were most likely additional accumulations off to the west similar to Alpine, which would be in the Jurassic section. The results of the post-Alpine drilling caused them to reduce the model down significantly. The state's position on that move is that USGS is being much too pessimistic based on drilling from FEX and other data they share.

4:32:57 PM
SENATOR WIELECHOWSKI asked if this information is public. Are they getting it from lease holders? Are they doing their own seismic tests?

MR. SWENSON answered this is all public information.

4:33:36 PM
PAUL DECKER, Petroleum Geologist and Manager, Resource Evaluation Section, Division of Oil and Gas, Department of Natural Resources (DNR), said he moved to Alaska in 1988 and took a position in Arco Alaska in development and exploration on the North Slope. He worked there for about 16 years before coming to work for the Alaska DNR in 2004. Today he said he wanted to share fewer numbers but more concepts about what they hope will be an emerging play concept, a type of unconventional oil resource that they refer to as "source reservoir oil resource."

He explained that unconventional resources can be distinguished from conventional resources simply by the fact that conventional resources are found in discrete accumulations. They are driven by buoyancy like a bubble up through the water-saturated rock; hydrocarbons accumulate at the high point on the structure to form a discrete bubble. Unconventional resources on the other hand have much lower geologic risk - that is, the risk of actually failing to find them is much lower. That is because they are most certainly present throughout the play fairway where they occur. The reason for that is that they are still stuck in the source rocks where the hydrocarbons were actually created. The engineering risk is higher because they are not sure the resource is going to be recoverable from those rocks because they have low permeability that resists fluid flow. So, massive engineering stimulations are required of virtually any kind of unconventional resource. Shale oil is no exception.

Many terms are in the news, but they all refer to "unconventionals" but some are more specific. Source rock is the reservoir rock and it is also the trap simply because of the low permeability, so the oil or gas is still down three where it was formed.

4:36:24 PM
The next map was an overview of the North Slope region that showed three area-wide sales offered every year by the Division of Oil and Gas. The main green blobs in the middle of the map showed the large oil fields of Prudhoe Bay, Kuparuk, West Sak and the Ugnu Sands. A yellow box indicated where Great Bear Petroleum precipitated all the interest in shale resource plays on the North Slope by leasing 500,000 acres. That is really why they are here discussing this today.

SENATOR STEDMAN asked if the newer leases have performance terms attached or are they open ended like the original leases.

MR. BANKS answered these leases are offered with similar terms to what has been offered for several years - the lowest royalty he can offer at 12.5 percent. Most of them lie within an area where the lease terms are 7-10 years. At this particular lease sale the minimum bid was $10/acre. They paid a bit more for that but not a lot more.

SENATOR STEDMAN stated that they have 7-10 years to prove up and move forward.

MR. DECKER responded yes. The only other thing he wanted to point out was the seismic transect or the slice through the earth concept that Mr. Swenson showed, the blue line going east to west across the Central North Slope state lands. He said this was a diagram of the stratographic column for the North Slope borrowed from the USGS. Under the "age" column were a variety of geologic names which refer to periods of geologic time, the oldest and deepest at the bottom of the graph and the youngest and shallowest at the top.

He called their attention to the three prolific source rock intervals on the North Slope starting with the Shublik at the bottom, Kingak Shale above that and then shallower and separated by geologic time is the GRZ and Hue shale system. He said he will talk about all of them as they are all oil and gas prone sources that are of interest to this discussion. A couple thousand feet down the seismic line is where they would have to

be concerned about the base of permafrost and having drinkable quality water. The source rocks here are at a depth of 8,000 to 13,000 feet.

4:40:47 PM
MR. DECKER explained that a number of key geologic factors control the potential productivity of the shale resource plays:

- the total organic carbon content that is a measure of the richness of the source
- the hydrogen index, which is a measure of the hydrogen content, which relates directly to whether that source rock is going to create oil or gas or no hydrocarbon at all
- the oil properties like viscosity and API gravity or the runniness of the oil, very important when talking about low permeability rocks.

MR. DECKER explained that thermal and tectonic history is an absolutely key concept to shale resources. Source rocks that have not been buried deep enough are still "immature," meaning they have not yet generated oil or gas from their hydrogen and carbon precursors. So, one wants to get into a deep enough part of the basin called the "oil window." Deeper will get one into the "gas window" or beyond. Also, natural fracturing occurs in thermal and tectonic history and that can be really important in terms of recovering oil or gas from these very permeable rocks. It is also important when planning frac jobs to understand the stress orientations and magnitudes.

Petrophysics refers to how the fluids interact with the rocks. So, porosity is simply the void space where the oil or gas resides in that rock. Permeability refers to how connected those pore spaces are, a key ingredient. Finally, he explained that geomechanics has to do with how "fracable" or brittle a rock is and how it will sustain fractures either naturally or artificially.

The next slides were from western North Dakota in the Williston Basin where the Bakken source rock is being developed. It showed a stretch of road with gravel pads on either side, each about five acres in size. A well from each pad goes down about 8,000 to 9,000 ft. and then turns horizontal and goes laterally for up to two miles. The slide also indicated a schematic of the "fracture wings" that are being created by artificially fracing isolated sections of the wellbore. The rows of wells set up a very efficient drainage pattern. The concept is close well spacing and a very pattern-driven approach.

4:44:40 PM
He stated that well spacing varies from shale play to shale play. In the Bakken Formation about one well is put in per every 640 acres. In the Eagle Ford Shale in Texas and perhaps on the North Slope they would expect to look at much tighter spacing.

CHAIR PASKVAN asked what the 120-060 acres/well meant on the North Slope.

MR. DECKER explained that was a mistake that was corrected to read 120-160 acres/well. He continued that the idea of a frac well is to inject fluid into an isolated section of the wellbore under increasing pressure until it reaches sufficient fluid pressure to actually exceed the strength of the rock. The sand is "parked" in those fractures that are a few millimeters to a couple of centimeters in width and extend out hundreds of feet on either side of the wellbore. The sand "props" the fractures open and allows a permeable conduit for the hydrocarbons to flow into the wellbore.

Fracing uses a LOT of water, he said. Jobs in the Lower 48 commonly use 1 million to 5.5 million gallons of water per well depending on how large they want to make the frac wings and how many stages of fracturing they want to do in the wellbore.

MR. DECKER said everyone has heard of environmental risks - that it's possible that shallow aquifers will be contaminated if great care isn't taken to ensure that those fractures don't extend up into the fresh water aquifer. But this is something that is clearly avoidable with good engineering and geologic practice and responsible operators, particularly on the North Slope where the aquifer is about a mile above their fracing zones of interest. Slide 11 showed 34 frac trucks on location that could drain about 400 ft. on either side of the well.

The next graph showed a single well's flow rate over time for Whiting Petroleum in the Bakken Formation. Their wells are now coming on stream initially at about 1,000 barrels/day or better. Then within about five years they drop off sharply to about one-tenth of the initial rate. Then the decline is shallow for another 10 years or so, he explained.

SENATOR STEDMAN asked for help with the tables.

MR. DECKER said those were rate of return (IRR) figures from Whiting's annual report and simply shows that at different oil prices the return on investment can be handsome.

SENATOR STEDMAN commented that he hoped the State of Alaska would negotiate better deals than this.

MR. BANKS commented that exploration drilling in Alaska is three to eight times as expensive as a $5 million shale well in the Bakken Formation.

SENATOR STEDMAN said he knows the Bakken tax structure is quite different than Alaska's tax structure and ownership.

MR. DECKER said the intention of this slide is strictly technical and to show how the flow rate declines quickly at first but then levels out for some time.

CO-CHAIR PASKVAN asked if he intended to compare the North Slope shale oil play to the Eagle Ford and Bakken plays.

MR. DECKER answered yes. He said the Eagle Ford Shale is brittle and this makes it a pretty good analogue for one of Alaska's source rocks, the Shublik. That's because it contains a lot of calcite, the mineral that makes up limestone. Some of the other numbers indicate that it's thick and organically rich, it's widespread and therefore it's a very attractive place to try and produce oil.

Turning to the potential analogue in North Dakota, he showed that the Williston Basin in the west that contains the Bakken Formation that is "thermally mature" meaning it has already generated oil or gas. The various circles indicated the initial 2-3 month oil production rates. Over 150 rigs were active last month in this basin alone, so it's really a "boom time" there.

SENATOR STEDMAN asked how immature and mature come about and how they are identified.

MR. DECKER replied that immature rocks are those rocks that haven't been buried deep enough to be warm enough (temperature increases with depth) to generate oil or gas. The western part of North Dakota where Bakken is located is the deeper part of the Williston Basin.

4:54:20 PM
SENATOR STEDMAN asked if he could identify this clearly and how many more years it would take for a rock formation to go from immature to mature.

MR. DECKER answered an immature area won't become mature during our lifetime or our children's lifetimes; geologic time is required.

CO-CHAIR PASKVAN suggested that they could go back a couple of slides and evaluate what one might expect from that well in the next 10-20 years.

4:55:42 PM
MR. DECKER said that the good geologic characteristics of Alaska source rock that make it a good play for shale resources is that it's brittle and therefore fracable, and that's because of silica and pyrite cements and some dolomites in the middle part of it. The thickness is good, the richness is good, the kerogen-type (hydrocarbon precursors) are all there to make this a good oil and gas source rock very much like the Eagle Ford in some respects.

Their counterparts in the North Dakota Industrial Commission, Department of Mineral Resources, have indicated that the average two-mile lateral horizontal producing well in the Williston Basin now costs about $6 million and creates about 47 jobs. He didn't know the precise amounts the first few wells would cost to develop in our North Alaska shale plays, but it would be the same type of well. He ventured an estimate of two to four times that. The operating cost is low in North Dakota, less than $7,000/month/well with about one full-time employee. The royalty rate there is about the same as the Alaska's highest rates. Some of Great Bear's leases will be paying this much and others would be paying 12.50 percent. Initial average production rates for the Bakken wells are just under 1,000 barrels of oil per day (BOPD). Out of about 750 wells that have been drilled in the last few years [in Alaska], all the wells on the left side of the bar would be better than average and the ones they are most interested in are the ones that produce even better than that - 3,000-5,000 BOPD - all of which are being drilled by just three companies.

SENATOR STEVENS asked if Alaska's shale oil potential is about the same as North Dakota's or is it greater.

MR. DECKER said the USGS is conducting a shale resource assessment of Arctic Alaska which should be available within the next year, but he didn't feel enough was known right now to say.

4:59:40 PM

MR. DECKER said the Bakken has been very successful. About 83 percent of the wells fall in the better-than-break-even category. That is because of the rates they can achieve early on in the lifespan of the well and the total production over the life of the well.

He showed them examples of the characteristics of the North Slope source rocks starting with the oldest, Shublik. It presented a lot of layering variability. The next slide was a cross section showing the same zones being highly traceable across many miles of the North Slope. This was good because it allows them to predict what zones will be fracable once they get the data.

The Lower Kingak Formation is immediately above the Shublik and has a lot of the same thermal characteristics. The Hue Shale/GRZ is several layers that coalesce to the east in the cross section. His calculations show that it compares favorably with any of the shale plays anywhere in the world. Finally, the Shublik and Kingak are together so they have the same thermal maturity zone, a wide swath across the North Slope indicating that Great Bear is well positioned.

CO-CHAIR PASKVAN asked if the location of the TAPS is significant to those sites.

MR. DECKER answered yes and that is another good reason for Great Bear picking up the acreage that they did. The most commercial development early on will occur in close proximity to the TAPS and the Dalton Highway.

5:03:36 PM
A comparison chart of source rock characteristics showed the Shublik and the Eagle Ford being about as closely matched as they can get. The department expects to look at Eagle Ford to answer questions they don't yet know from direct evidence about the Shublik source rock.

5:04:07 PM
To summarize, he reinforced the point that there are many different geologic and engineering variables that impact the productivity of source rock reservoired oil and gas geologic and technology practice. A successful development of the North Slope's shale oil is likely going to depend on a series of events kind of like the resource chain the Mr. Banks alluded to earlier. It will start with a successful pilot exploration drilling project. Then a way to lower the cost of drilling the

wells will have to be found partly through learning and partly by just getting the equipment up there. All-season roads will likely be needed for year-round surface access to get this done in a reasonable amount of time. More equipment and crews will be needed as well as establishing the presence of sufficient water for the fracs. People will also need to have this frac-based dialogue on practices to replace some of the emotion around those issues.

SENATOR STEVENS asked who he expected would be exploring and developing the shale oil plays. Will it be the big three or the smaller companies like Great Bear?

MR. DECKER answered that Great Bear is a newly formed company with key technical people who have long experience in Alaska. They have seen how prolific these shale plays have been and formed a company specifically devoted to this venture. "They are the first on this wagon here," and he thought other companies of different sizes should follow.

SENATOR WIELECHOWSKI commented that five years ago people hadn't heard of shale gas in the Lower 48. Would this potentially happen on the North Slope with shale oil?

MR. DECKER replied that is potentially in our future if companies have sufficient access to capital. Great Bear has very aggressive plans.

CO-CHAIR PASKVAN thanked the committee for going past 5:00, the Commissioner and the three members on the panel, and adjourned the meeting at 5:08 p.m.