STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

ORIGINAL

APPLICATION OF WILLIAMS PRODUCTION COMPANY, LLC, FOR AN EXCEPTION TO THE SPECIAL RULES AND REGULATIONS FOR THE BLANCO-MESAVERDE GAS POOL FOR INCREASED WELL DENSITY IN THE ROSA UNIT, SAN JUAN AND RIO ARRIBA COUNTIES, NEW MEXICO

CASE NO. 14586

REPORTER'S TRANSCRIPT OF PROCEEDINGS

EXAMINER HEARING

BEFORE: DAVID K. BROOKS, Legal Examiner
WILLIAM V. JONES, Technical Examiner

January 6, 2011

Santa Fe, New Mexico

This matter came on for hearing before the New Mexico Oil Conservation Division, DAVID K. BROOKS, Legal Examiner, and WILLIAM V. JONES, Technical Examiner, on Thursday, January 6, 2011, at the New Mexico Energy, Minerals and Natural Resources Department, 1220 South St. Francis Drive, Room 102, Santa Fe, New Mexico.

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EXAMINER BROOKS: At this time we'll call Case Number 14585, application of McElvain Oil & Gas Properties, Inc., for compuslory pooling, San Juan County, New Mexico.

Call for appearances.

MS. MUNDS-DRY: Mr. Examiner, you may recall that we asked to continue that case to February 3rd.

EXAMINER BROOKS: Okay. That's right. That one has been continued. I'm sorry.

Then we'll call at this time Case Number 14586, application of Williams Production Company, LLC, for an exception to the special rules and regulations for the Blanco-Mesaverde Gas Pool for increased well density in the Rosa Unit, San Juan and Rio Arriba Counties, New Mexico.

MS. MUNDS-DRY: Good morning, Mr. Examiner. Ocean Munds-Dry with law firm Holland & Hart, LLP, Santa Fe office. I'm here representing Williams Production Company, LLC, this morning, and I have four witnesses.

EXAMINER BROOKS: Other appearances?

MR. KELLAHIN: Mr. Examiner, I'm Tom Kellahin of the Santa Fe law firm of Kellahin & Kellahin, appearing on behalf of ConocoPhillips Company.

EXAMINER BROOKS: Do you have any witnesses?

MR. KELLAHIN: No, sir, not this morning.

EXAMINER BROOKS: Do you oppose the granting of the application?

MR. KELLAHIN: We have not taken a position for or against the parties. My client and Ocean's clients have entered into a stipulation about the buffer zone.

MS. MUNDS-DRY: And, Mr. Examiner, if we could address that before we call the witnesses. I do have a copy of it here. I thought I had it right on top.

As Mr. Kellahin mentions, we, being Williams and ConocoPhillips, have entered -- if I may approach?

EXAMINER BROOKS: Yes.

MS. MUNDS-DRY: -- have entered into a stipulation where Williams has agreed to a half-mile setback in certain areas of their unit. And you'll see there in the stipulation, the acreage that has been identified, it's not only listed in the stipulation, but there's also a map, which is Exhibit A, on the back there so you can easily reference where Williams has agreed to that setback.

You'll be able to see in the stipulation that Williams is not necessarily agreeing that this is the appropriate setback for drainage issues. We're simply allowing Conoco more time to review our application and proposal, and it also allows Williams to go forward so we can hopefully start a drilling program if this application is approved in a timely manner.

So for the time being, this is what we agreed to. And we would ask that the Division take this stipulation under consideration when it's drafting its order.

EXAMINER BROOKS: Do you want to have this -- would you like --

MS. MUNDS-DRY: We can mark it as an exhibit, if you'd like.

EXAMINER BROOKS: I'll let you do the marking, because you know what exhibits you're going to offer.

MS. MUNDS-DRY: If you'd like, I can submit it at the end. I'll figure out what the number should be, if that's all right.

EXAMINER BROOKS: Okay. Very good. Before we get started on four witnesses, I think we should take a 10 minute recess.

MS. MUNDS-DRY: That would be great.

(A recess was taken.)

EXAMINER BROOKS: We're back on the record then in Case Number 14586, application of Williams Production Company, LLC, for exception to the special rules and regulations for the Blanco-Mesaverde Gas Pool for increased density in the Rosa Unit, San Juan and Rio Arriba Counties, New Mexico.

We've taken the appearances. We now need to swear in the witnesses. Would the witnesses please stand, identify yourselves and then be sworn? Let's start with you.

MR. McQUEEN: Ken McQueen.

MS. WRAY: Laura Wray.

MR. HANSEN: Vern Hansen.

MS. BRUEGGENJOHANN: Marcia Brueggenjohann.

EXAMINER BROOKS: Would the court reporter please swear in the witnesses?

(Four witnesses were sworn.)

EXAMINER BROOKS: You may proceed.

MS. MUNDS-DRY: Thank you, Mr. Examiner. With that, we call Vern Hansen.

Mr. Examiner, may we take a short break? I apologize.

EXAMINER BROOKS: Okay.

(A recess was taken.)

EXAMINER BROOKS: Are we ready?

MS. MUNDS-DRY: I think we are ready. Thank you for indulging us.

EXAMINER BROOKS: You may proceed.

MORGAN VERN HANSEN

Having been first duly sworn, testified as follows:

DIRECT EXAMINATION

BY MS. MUNDS-DRY:

Q. Please state your full name for the record.

A. Morgan Vern Hansen.

Q. Where do you reside, Mr. Hansen?

A. Tulsa, Oklahoma.

Q. By whom are you employed?

A. Williams Production Company, LLC.

Q. What do you do for Williams?

A. I'm a senior staff landman.

Q. Have you previously testified before the Division and were your credentials accepted and made a matter of record?

A. Yes.

Q. Are you familiar with the application that Williams has filed in this case?

A. Yes, I am.

Q. Are you familiar with the status of the lands in the subject area?

A. Yes, I am.

MS. MUNDS-DRY: Mr. Examiner, we would tender Mr. Hansen as an expert in petroleum land matters.

EXAMINER BROOKS: So qualified. I assume you have no objection?

MR. KELLAHIN: No objection.

Q. (By Ms. Munds-Dry) Mr. Hansen, before we turn to your exhibits, would you briefly summarize for the Examiners what Williams seeks with this application?

A. Williams seeks an exception to the special pool rules and regulations for the Blanco-Mesaverde Gas Pool to increase the well density to 8 Mesaverde wells per 320-acre spacing unit from the current four. This is based on data from Williams' pilot project. This data is in support of our request and will be reviewed by other witnesses.

Q. Thank you. Mr. Hansen, if you would turn to what's been marked as Williams Exhibit 1 and review this document for the Examiners.

A. This is a map of the Rosa Unit showing the full boundaries of the unit. And in the red hatched area, that shows the extent of the Mesaverde participation that exists today.

Q. And it also shows -- although it's not necessarily pertinent to this application -- shows, I believe, the nature of the ownership in the Rosa Unit?

A. Yes. Most of the unit is federal, and although it's not showing up very well on this map, what would be in gray would be the federal acreage, what is in brown is the state acreage, and what's shown in white would be the fee acreage within the unit.

Q. Thank you. If you could review for the Examiners, just so we're all on the same page, what rules govern the development of the Blanco-Mesaverde Pool?

A. The current order is R-10871 -- or rule. It provides for 320-acre spacing, up to four wells per spacing unit, and that the wells be drilled no closer than 660 feet to the outer unit boundary, nor 660 feet to any uncommitted acreage. It provides for -- I'm sorry -- outer boundary of the spacing unit or uncommitted lands, and that no well be closer than 10 feet to the interior quarter line of the subdivision inner boundary.

Q. Now, those rules now stated, is Williams pre-approved, though, to have non-standard locations within the Rosa Unit?

A. Yes, it is.

Q. Do you know the order number that approved non-standard locations for -- I believe it was all producing pools in the Rosa Unit, if I recall correctly.

A. Yes. It's Case Number 14335, Order Number R-13200(A). Williams was granted the pre-approval of the non-standard locations.

Q. And if you'll now turn, please, Mr. Hansen, to Williams Exhibit Number 2. This is the order approving the pilot project that precipitated this case; is that correct?

A. Yes.

Q. What's the order number here?

A. R-13123, dated May 11, 2009.

Q. And if you could summarize for the Examiners, what did this order approve Williams to do?

A. The Oil Conservation Division originally approved a two-year pilot project that studied the feasibility of increased density for the Mesaverde wells within the Rosa Unit. The order allowed for one additional well per 320-acre spacing unit in those portions of Townships 31 North and 32 North, 6 West. The order required that within six months of the completion of the pilot project, that Williams provides its overall findings and well density recommendations to the Division.

Q. And, Mr. Hansen, is that, in fact, what we're doing here today?

A. Yes, it is.

Q. If you could turn to what's been marked as Williams Exhibit Number 3. What is this display showing us?

A. The map shows the -- in yellow, the area approved for the pilot project. The wells are indicated in green. And on the map is also indicated the Bureau of Land Management and U.S. Forest Service boundary within the unit.

Q. Great. Thank you. And is Exhibit Number 4 the notice packet?

A. Yes, it is.

Q. It includes the letter that was sent to all interest owners in the unit and offset operators from the unit?

A. Yes, it does.

Q. Were the State Land Office and the BLM also notified of this application?

A. Yes, they were.

Q. In fact, has Williams met with the BLM and the Forest Service about this application?

A. Yes. We met with the BLM and the Oil Conservation Division Aztec Office and the Forest Service on October 13th.

Q. And did the BLM or the Forest Service express any concern or objection?

A. No, they did not.

Q. Did the OCD Aztec Office express any concern or objection about this application?

A. No, they did not.

Q. Has Williams received any other objections to this application that you're aware of?

A. No, we have not.

Q. Mr. Hansen, in your opinion, is this application in the best interest of conservation, the prevention of waste and the protection of correlative rights?

A. Yes.

Q. Were Exhibits 1 through 4 either prepared by you or compiled under your direct supervision?

A. Yes, they were.

MS. MUNDS-DRY: Mr. Examiner, we move the admission of Williams Exhibits 1 through 4 into evidence.

EXAMINER BROOKS: I take it no objection?

MR. KELLAHIN: No, sir.

EXAMINER BROOKS: 1 through 4 are admitted.

(Exhibits 1 through 4 were admitted.)

MS. MUNDS-DRY: Thank you. And I have nothing further for Mr. Hansen.

EXAMINER BROOKS: Okay. Any questions, Mr. Kellahin?

MR. KELLAHIN: No, sir.

EXAMINER BROOKS: I don't believe I have any questions either.

EXAMINATION

BY EXAMINER JONES:

Q. I probably should just quickly ask -- you may have already covered this. The proposed -- so it's 40-acre --

A. 40-acre density, yes.

Q. Would they be drilled from a separate new location or --

A. There will be a combination. You know, we're restricted by the surface agencies on where we can locate our wells. But, you know, we have to drill as efficiently as possible with the surface locations available to us.

Q. So that affects your economics in places?

A. It does, yes.

Q. So it's just different depending on where you're at from -- this is more than one county; is that right?

A. Yes. It's San Juan and Rio Arriba. The river -- if you go to Exhibit Number 1, it shows the river cutting through the unit, and that is the boundary. That's actually on the Navajo Reservation right now.

Q. Okay. Did you get -- did you guys have any talks with Steve Hayden?

A. Yes, we did.

Q. Can you --

A. We had a very large meeting with all of the parties and just set forth what we were doing. And also, when we originally submitted the pilot project, we met with the BLM and Steve Hayden before we even submitted it, and they did not have any objections whatsoever to our proceeding.

When we originally submitted it, we didn't know what the correct density was, and that's what we were trying to ascertain. And the testimony that will be provided later will show what we found from our project. This wasn't a typical pilot project. We spread the wells out over the productive area of the Mesaverde so we could try to get a better understanding of a very large area within the unit boundaries.

Q. Are most of these wells downhole commingled?

A. The newer wells, yes. The 20 wells are downhole commingled, I believe all with Mesaverde, Mancos and Dakota.

Q. Okay.

A. Mr. McQueen could better testify to that. I believe they are.

Q. As far as the regulatory filing that you would have to do for that, are you familiar with that?

A. We also have pre-approval for downhole commingling with all the formations.

Q. Throughout the Rosa Unit?

A. Yes.

EXAMINER JONES: I just wanted to make sure you had that. I don't have any more questions.

EXAMINER BROOKS: Okay.

EXAMINATION

BY EXAMINER BROOKS:

Q. The eight wells that will be in the 320-acre spacing unit, what you're proposing here, are you proposing that they can be located anywhere in the spacing unit?

A. Yes.

Q. The current rules for the Blanco-Mesaverde as I recall, it's 80-acre well density and it's no more than two wells per quarter section.

A. This would be four wells per quarter section.

Q. It would be four wells per quarter section. Do you want to have no restrictions on where in the unit the wells can be, though?

A. I believe that that should be a question that should be directed to our reservoir engineers.

EXAMINER BROOKS: Very good. Thank you.

I have no further questions.

MS. MUNDS-DRY: Thank you. I have nothing further of Mr. Hansen.

EXAMINER BROOKS: Okay. You may call your next witness.

MS. MUNDS-DRY: We call Laura Wray, please.

EXAMINER BROOKS: You may proceed.

MS. MUNDS-DRY: Thank you.

LAURA WRAY

Having been first duly sworn, testified as follows:

DIRECT EXAMINATION

BY MS. MUNDS-DRY:

Q. Will you please state your full name for the record?

A. Yes. Laura Louise Wray, W-r-a-y.

Q. Ms. Wray, where do you reside?

A. Denver, Colorado.

Q. By whom are you employed?

A. Williams Production Company.

Q. What do you do for Williams?

A. I'm a senior staff geoscientist.

Q. Have you previously testified before the Division?

A. No, I have not.

Q. Would you please review your -- summarize, if you could, your education and work history pertinent to being a geologist?

A. I have a Bachelor's degree in geology from Wellesley College in Massachusetts, and a Master's degree also in geology from West Virginia University.

My pertinent petroleum experience is 29 years of service, 18 of those with Amoco Production Company in Denver. I've been with Williams Production Company for 6 years. I had 3 years as a petroleum and coalbed methane geologist for the Colorado Geological Survey, and I was a consultant for 2 years for both the Colorado Geological Survey and the Bureau of Land Management, Moab, and Monticello offices.

Q. Are you responsible for -- do your duties include any geologic duties for the San Juan Basin, specifically the Rosa Unit?

A. Yes.

Q. Are you familiar with the application that's been filed in this case?

A. Yes.

Q. Have you made a geological study of the Mesaverde formation in the Rosa Unit?

A. Yes, I have.

MS. MUNDS-DRY: Mr. Examiner, we tender

Ms. Wray as an expert witness in petroleum geology.

EXAMINER BROOKS: Any objection?

MR. KELLAHIN: No objection.

EXAMINER BROOKS: She is so qualified.

MS. MUNDS-DRY: Thank you.

Q. (By Ms. Munds-Dry) Ms. Wray, if we could first review the general characteristics of the Mesaverde formation.

MS. MUNDS-DRY: And some of this, I believe, Mr. Examiner, was previously reviewed by Dr. Lessinger in the pilot project. And before Ms. Wray begins, I would ask you take administrative notice of Case 14291.

EXAMINER BROOKS: There being no objection, we will take administrative notice of the record of Case 14291.

MS. MUNDS-DRY: Thank you.

Q. (By Ms. Munds-Dry) Ms. Wray, I know you have this also published as the PowerPoint for the Examiners. If I could ask you first to turn and discuss what is Exhibit Number 5.

A. Exhibit 5, is a part of a stratigraphic column representative of the San Juan Basin. This would be the upper cretaceous period.

And what I've done is to highlight the

Mesaverde formation with the three members from top to bottom, Cliff House, the Menefee and the Point Lookout. I'll be discussing in a little more detail the sedimentological characteristics which I've listed on the right. But I think they may be easier to understand with some of the subsequent exhibits that I have.

Q. Can you please identify and review Williams Exhibit Number 6?

A. This is a modified block diagram taken from a publication by Ryer and McPhillips in 1983 -- 1963. Excuse me. And the block diagram was constructed for both the Mancos and the Mesaverde above the Mancos in Colorado and Utah. But the depositional environments are absolutely pertinent to the San Juan Basin.

I start here with the depositional environments for the Cliff House sandstone. What I've done is circle with that red oval both the orientation and the depositional environment of the Cliff House for the Rosa Unit.

You can see to the right here the north arrow and the orientation of the shoreline in the Rosa Unit and much of the San Juan Basin is actually northwest/southeast, so I think it is a very good representation of the what the depositional environment would look like, sort of a snapshot in time.

The Cliff House sandstone itself is a transgressive stack sequence of various types of sands, including bar sands here, lower Delta Plain sands, shoreface sands or beach sands, with associated silts and shales.

The word transgressive refers to the fact that the ocean is actually moving to the southwest in the basin. And the reason I bring this up is that you're looking just at a single point in time at the sands and they are variable. But you can understand, as the oceans moved to the southwest and back again to the northeast, that these sands in a lateral -- in a vertical sense would be variable. And that really is important to our particular hearing.

So though the word transgressive suggests that the sea moved in a landward position to the southwest, they're actually sub-movements back and forth of rising and falling sea levels that caused these sands to migrate in two directions. And I think that will be obvious when I show you the cross-section.

Q. If you could turn to your next slide, which is the second page of Exhibit Number 6.

A. I'm using the same block diagram again, this time to show the depositional environment of the Menefee. In this case, again, the oval shows sort of a snapshot in time of what the Ménefee sands an coals would look like.

This particular unit has stack sequences of both of those fluvial sands, and you can see those sands on this diagram coming from the southwest, and that is true of the San Juan Basin. We know the major source area west of the southwest actually in Arizona -- what is now Arizona -- so there are a series of lower Delta plain fluvial channels and also coal swamps.

What makes this particular environment so complex is that those rivers over time shift back and forth, and they cut out coals. So you have varying thickness of coals and stack sequences of coals and sands. Again, I think this will be more obvious when I show some of the cross-sections later on.

Q. Those coals are represented as sort of black splotches on the display?

A. That's right. Those swamps are not continuous. It does depend where the river channels cut through them as to whether you have small lagoonal areas that allow peat swamps to accumulate.

Q. If you could turn to the third page of Exhibit Number 6 and review this for the Examiners?

A. I should have mentioned that I'm going older in the section. So I started at the Cliff House and now -- these are the oldest sands that we're dealing with, the Point Lookout sands.

These are what we call regressive sands. And again, the orientation for the Point Lookout sandstones was northwest/southeast in the San Juan Basin. The source area was to the southwest as this demonstrates.

And the Point Lookout sands are very thick, horse grain stack sequences of sort of barrier bars, maybe some fluvial channels and so on. What makes this a little different is that the source area was the highest at this time, so there was a tremendous shedding of clastics from the southwest to the northeast and into this basin. So we tend to find the Point Lookout sandstones often have better reservoir qualities and tend to be a little thicker than some of the Menefee and Cliff House sands above.

Q. If you'll turn to Williams Exhibit Number 7 and explain to the Examiners what this document is.

A. This is a cross-section that actually is fairly extensive and goes on the left-hand side from New Mexico, all the way up to the Denver Basin, Colorado. But the portion is a little hard to see. The portion of the San Juan Basin is right here. And I think the time is on the y-axis getting younger going to the top.

So if I start again with the same order of the Cliff House sandstones, you can see that over time, and it's a little subtle, these sands are moving landward and getting younger and younger. That was what I showed on the depositional environment, the block diagram.

The Menefee sands are in between, and they're actually a combination because they're sandwiched between the major sands that were prograting or moving to the northeast in the Point Lookout and the Cliff House sands, which were migrating landward to the southwest. So you actually have a combination of both what we call seaward and landward stepping non-marine intervals.

So the Menefee is non-marine coals and sand sandwiched between these marine sands of the upper Cliff House and the lower Point Lookout. And again, to clarify, I put the orientation of the landward to the southwest, seaward to the northeast.

Q. Please turn to what's been marked as Williams Exhibit 8 and review this set of documents for the Examiners.

A. In the previous hearing, there were outcrop photos which were submitted. I made a couple of minor changes. I'll tell you what they were.

Here is an outcrop photo of Cliff House sandstone from Mancos Canyon. And previous testimony indicated that these are very homogeneous in nature, these sandstones, and I agree with that in terms of the sand bodies themselves being continuous over a couple hundred feet.

However, I wanted to make a point that when you move to the subsurface, these may not be as continuous as we think over thousands of feet. We see, you know, some lateral continuity of sands in the outcrop, but not necessarily in the subsurface. I'll show that in a couple more slides.

Q. If you'll go to the next slide, which will be the second page to Exhibit Number 8.

A. Here was another exhibit which had been shown that just shows the Cliff House sandstone here. What I've done is I highlighted the outline of the body of the sandstone. The cliff is going around the corner so it looks like it thins, but that may not be the case.

Again, when we talk about lateral continuous sands, we're talking about the sand bodies themselves. I'm not making any reference to lateral continuity of the reservoir qualities, porosities and permeability within that sand body.

Q. And the next slide?

A. This was an example of Menefee sands. This particular outcrop shot doesn't show any coals very well, if at all. But you can see that there are sands here and there are a couple of discontinuous sands. And I've noted that both these sandstone bodies and the outcrop are discontinuous, and I will show that they're very laterally discontinuous as well as vertically discontinuous when I show you some cross-sections.

Q. Okay. Your next slide, which would be page 4 to Exhibit 8?

A. This is a just a highlight of those sand bodies which I colored or outlined in orange to show that lateral continuity.

Q. The next slide, which is page 5 to Exhibit 8?

A. This is an outcrop of the Point Lookout sandstone. Again, you see there's quite a bit of heterogeneity in the vertical sense. You have thicker sands here, sands, silts and shales here. And as I'll show you, there's very little lateral continuity in the subsurface as well.

Q. Finally, page 6 of Exhibit Number 8?

A. Again, one outcrop photo of the Point Lookout that shows here is a fairly continuous sand body and a discontinuous one below it. Again, I want to make the point that on an outcrop scale when you're looking at hundreds of feet, you may see a sand body that looks continuous, and from the subsurface, we're not seeing that.

Q. Before we turn to your cross-sections, if you could summarize for the Examiners what you can say about these three reservoirs that you reviewed for us today?

A. What I can say is that in each of the three formations, from the top to the bottom, the Cliff House, the Menefee and the Point Lookout, we see lateral variability from the migrating sands, coals, silts and so on from the depositional environment. But in a stack sequence, as those sands and coals were being deposited, we see a lot of vertical heterogeneity.

So I think I'll be able to show you in the cross-section that in terms of gas-filled sands, there are -- almost all of these are gas-fill sands but they're very discontinuous. And it's my contention that in order to effectively drain these reservoirs, you will need increased density. Because many of those sands will not be even penetrated by the existing wells.

Q. Thank you, Ms. Wray. If you would now turn to Williams Exhibit Number 9 and review these documents for the Examiners?

A. I've established a log curve and color scheme for the subsequent cross-sections so they're all the same format. In Track 1 off to the left here, I have a shaded gamma ray curve. The scale is from 0 to 180 API units. What I've done is I've scaled that gamma ray to show the best developed sands or coals -- and we can't just, from the gamma ray necessarily distinguish the difference by the hot colors. And as you get cooler colors or the yellows, those are siltier or shalier intervals.

Also, on Track 1, and it's very difficult to see, but in the left-hand corner is a black curve, which is the caliper curve scaled 6 to 16 inches. That will become important when I talk about the Menefee formation. It's one of the curves I used to identify the coals, distinguishing them from the sands.

Finally, there are some pinkish/reddish bars on the left-hand side. Those denote the perforations in the various wells.

Then in Track 2, I have a deep resistivity curve, which is on a logarithmic scale in ohm meters. I shaded in orange the deep resistivity greater than 18 ohm meters. This is not a hard and fast indication of good permeability, but it's one that we think is fairly conservative and we've used fairly successfully to demonstrate in comparison with the sands what might be permeable, porous sandstones. Also, that's true for the coal.

Then in Track 3 you'll see a blue curve, which is the bulk density curve scaled 2 to 4 grams per cc, and I shaded that curve red using a 7 percent porosity cutoff. That's very conservative, I think. Some people might argue that some of these sands would produce from 6 percent. That may be the case. But I'm looking for some economic production cutoffs, so I used 7 percent.

Finally, in Track 4, I have a mud log total gas curve. These are not necessarily scaled from well to well, because the units are different. But they give you a representative idea of what formations may be producing gas.

Q. Okay. If you'll turn to the next slide, which is the second page of Exhibit 9, and review it for the Examiners.

A. The first cross-section I'm going to show you is a northwest to southeast cross-section. The five wells are included and labeled here. This is a cross-section that would be parallel to the Mesaverde shoreline as I set up with that block diagram.

Q. Okay. Turn to the third slide.

A. Before I show the representative formations about which we're discussing, I want to just mention how I have identified where those formations may be. And as many are familiar, there is a bentonite, which is an ash fall, that represents a single point in time when there was a volcanic ash flow, and it represents equal time. It's labeled here at the top, the Huerfanito Bentonite.

I used this marker and then looked down to make sure that the Mesaverde interval, which is often a little difficult to distinguish between some of the upper silts and sands, to make sure I'm in the right interval. You can see there's a little bit of thickening here. That's to be accounted for by the fact that there are various patterns of stacked sands and silts. Compaction will be a little bit different.

But generally, I'm very confident that I'm in the right interval for the top of the Cliff House, which you see, and the Menefee formation underneath.

Q. Turn to your next slide.

A. This is the same cross-section from northwest to southeast here. Now you can see the top of the Cliff House sandstone that I've established. Again, I've used the Huerfanito Bentonite to make sure that I was in the right interval.

Again, the shaded gamma ray is in the left-hand curve, and you can see a little bit of a depression here right above the Cliff House, which gives me more confidence that this is the top of the Cliff House sands.

Let me just make a mention that if you look above the Cliff House, you can see that there's sands and silts there. It's a very difficult top to pick. I do want to point out that there are some people that think the top of the Cliff House might be up here. In fact, there are perforations in our wells that are up there. It's really not significant. I've looked at the literature, and the top of the Cliff House varies depending on the operator. So I just wanted to be clear with that, that I picked it down here because I find it a very good marker and I can correlate that.

So what I show here in the interval between the Cliff House and Menefee formations here, what stands out the best are these thick sands, again shown in red, and you can see that the deep resistivity in Track 2 is shaded greater than 18 ohm meters, indicating that you've got good sands.

But as you cast your eye across this interval, you see that the thickness of sands changes and even the presence of the sand changes. And this is very typical of this heterogeneity that we see. It's very difficult to track a single sand across an area in west Rosa that would even be the same sands. The sands themselves may somehow go from one well to another, but they thicken and thin.

I have no way of really knowing whether you have a flow unit across that. But certainly this cross-section gives you an indication that there are thin sands and thicker sands. These could be representative very easily of separate sands as you move through time, based on both the lateral and the vertical heterogeneity that we see resulting from the sea level changes of sands moving back and forth.

Q. If you'll please turn to the fifth page in Exhibit Number 9, which is the cross-section of the Menefee.

A. This cross-section is the same one you saw before of the same five wells going from the northwest on the left, to the southeast on the right.

I picked the Menefee top, which you saw on the last cross-section, and I picked that where there is a really big shift in the gamma ray to the right, indicating at the top there a silty or a shaley interval. It's a very easy pick to see in this case.

The top of the Menefee also is where you first see coals. And I've identified the coals here with the black arrows based on several log characters. Coals often wash out here. So the caliper curve, that black curve on the left, will go to the right, indicating whether you're drilling on air or mud. You have sort of blown apart a very soft formation, and you get what we call a rugose hole or elongated hole.

The gamma ray for coal is low, just as they are from sands. That's why I mentioned you can't, just on a gamma ray, necessarily tell the difference between coals and sands. The resistivities are high both for coals and sandstones.

But what's really characteristic if you look at these intervals here, is that you get a big spike in density, very low density. Coals are typically low density, and you get a big spike. And often, but not always, you have a gas show associated with the coals. And the coals are the source of the Cliff House and the Point Lookout sandstones.

So as you cast your eye across this cross-section, just looking at the black arrows you see tremendous heterogeneity in the coals themselves, as well as the sandstones. And again, that's because of the depositional environment. You have variable coal swamp deposition, and then these coals are cut out by meandering sands that change orientation and change spacial arrangements throughout time. So I think this shows, again, that there is tremendous heterogeneity in the Menefee formation.

Q. Please review your next slide, the cross-section for the Point Lookout.

A. Finally, the same cross-section as I've shown before, this time of the Point Lookout formation.

In one case I did find a Point Lookout top where there was coal above that. It's a little tough to often depict the Point Lookout, but I feel fairly confident with this cross-section.

What we see here is a coal-free section. Again, you see somewhat thicker sand bodies. Again, that's because of the depositional environment. You had a tremendous shedding of clastics into the basin at Point Lookout.

But again, if you just pay attention to the thick sands in red here, you see there's tremendous variability. Here you go from a sand. You don't see anything in that same interval. This sand is a little bit lower. Here's one that's higher. And, again, I think that shows the nature of heterogeneity of the Point Lookout formation.

Q. What is your next slide?

A. I wanted to also show a four-well cross-section which would be perpendicular to the shoreline. And, again, the numbers of the wells are shown here.

Q. So this is your base map showing --

A. This is the base map with the location of the that cross-section that we'll look at in just a moment.

Q. Let's look at that cross-section, the last page to Exhibit 9.

A. Again, I didn't include a slide, but I did the same thing as I did with the first cross-section to confirm that the top of the Cliff House had a good relationship with the Huerfanito Bentonite time marker above it.

Now here you can see, from the southwest to the northeast in the Cliff House interval, which is this one up here, there's a little bit of thickening and thinning of the interval itself. Again, I picked the top of the Menefee with that characteristic shift in the gamma ray. I haven't labeled the coals on here, but this is the coal sequence.

This pattern would be expected. Again, this was a sandstone that was migrating to the southwest. So by the time the sands got to the southwest here, this accumulation of sands was much thicker, so I think that fits the pattern very nicely.

The Menefee formation is roughly of equal thickness, and the Point Lookout has sort of a reverse pattern. It's not perfect. But again, those sands were migrating the opposite direction, moving to the northeast in a seaward direction. And you can see between these two wells, you have a thick sand here and then younger in time. That sand may be the same sand. I can't tell you that it is. It has migrated towards the sea direction.

Q. Thank you. Now that you've reviewed this material for the Division, what can you conclude in your opinion about what the density should be for the Mesaverde formation in the Rosa Unit?

A. I can't say what the ultimate density would be. What I can testify to is that it does appear that even with the current spacing unit we have, there is so much heterogeneity that there are likely to be sand bodies in all these three formations, as well as coals, that are not penetrated by the existing wellbores.

Q. Would this then lend credence to Williams' application for the need to increase density to eight wells per 320-acre spacing unit?

A. Yes, I believe it would.

Q. Would you agree that increasing the density would more efficiently drain those reserves because of the heterogeneous nature of the reservoirs?

A. Yes.

Q. Were Exhibits 5 through 9 either prepared by you or compiled under your direct supervision?

A. Yes.

MS. MUNDS-DRY: Mr. Examiner, we move the admissions of Exhibits 5 through 9 into evidence.

MR. KELLAHIN: No objection.

EXAMINER BROOKS: 5 through 9 are

admitted.

(Exhibits 5 through 9 were admitted.)

MS. MUNDS-DRY: That concludes my direct examination of Ms. Wray.

MR. KELLAHIN: Mr. Examiner, a few questions?

EXAMINER BROOKS: Yes.

CROSS-EXAMINATION

BY MR. KELLAHIN:

Q. Ms. Wray, do you have in the exhibit set a copy of Exhibit Number 2? It's the copy of the pilot order. Would you thumb through this pile for me? I think it's the second one after the tab.

A. Yes.

Q. Did you participate on behalf of Williams as a geologic expert in the formulation of the geologic information for the pilot study?

A. No, I did not.

Q. That was not your work?

A. No, it wasn't.

Q. Would you turn with me to page 3 of that order. I'm dealing with an extension of Finding 6, and I'm looking at subsection 6(K). It talks about some of the objectives of the pilot project were to achieve additional geologic information.

A. Yes.
Q. Was it your understanding that the pilot was going to give you more geologic information?
A. Yes.
Q. When I set that aside and go back to your Exhibit 5, which is your stratigraphic locator, I'll call it --
A. Um-hum.
Q. -- prior to the pilot then, did you examine the existing population of Mesaverde wells within the Rosa Unit?
A. Prior to the --
Q. Yeah, prior to the pilot.
A. No, I did not.
Q. Do you know from your knowledge if the wells, prior to the pilot, had penetrated all these members of the Mesaverde?
A. I don't know if all of the ones -- yes, very many of them did.
Q. So the exploration geology within the Rosa Unit historically has been to try to access all three of these intervals of Mesaverde?
A. Yes. And all of the wells that I looked at in the entire Rosa Unit, they've all been penetrated. And I can't say that I know for a fact that all of them have

been completed, but a great majority of those.

Q. But that was the generalized methodology for the unit operator at that time?

A. Um-hum.

Q. If you turn to Exhibit 3 for me. This is the color map that locates the pilot wells. Do you have that?

A. Yes, I do.

Q. Did you play any part in the selection of which of these locations would be the population of pilot wells?

A. No, I did not.

Q. As a geologist, you obtained, I assume, log data from the pilot wells?

A. Yes.

Q. Is there any other type of geologic data that you obtained from the pilot wells?

A. No, not in terms of geologic data. For example, we didn't get any cores or cuttings or anything like that.

Q. What kind of log data was obtained from these?

A. Triple combo, gamma ray, resistivity, density neutron and gas, total gas from mud logs.

Q. Part of that data then forms the basis for your exhibit sets under Exhibit 9. Would you turn to those for me? That starts your analysis of the log curves?

A. Yes.

Q. If you turn past the cover sheet on Exhibit 9 --

A. Okay.

Q. -- if you turn past the summary sheet, there's a line of cross-sections that you've selected?

A. Yes.

Q. In looking at this, it appears that you've selected certain of the pilot wells and a couple of existing wells that were not pilot wells.

A. Correct.

Q. What was your general methodology or strategy for this selection?

A. I tried to get the best sweep of logs that I could for analysis. Many of the older wells didn't have a full sweep of logs through that, and I had a combination of older wells and younger wells. Again, a lot of that was to be able to identify the coals with all those curves.

Q. As part of your geologic study, was any of your data used with the assistance of the reservoir engineer to re-calculate the gas in place for any of these three intervals?

A. You'll have to ask --

Q. Let me ask if a different way. Were you asked by any of the engineering staff to help them total up, sum up the thickness components for the gas in place calculations?

A. No.

Q. That wasn't your work?

A. No.

Q. You now have some new geologic information from the pilot wells. How many pilot wells do you have?

A. I don't remember.

Q. 19 or 20?

A. I think 20. Is that right?

Q. From that general population, what is it that you learned that you did not know before about this project?

A. What I learned is only by hearsay. If you really want, you know, a detail summary of the reservoir components, I didn't necessarily learn anything more, except what I've shown you geologically. I think Mr. McQueen would be able to tell you in terms of pressures and rates and so on what those pilot wells showed.

Q. I was just curious about the -- the outline of the pilot project area indicates to me in this order that one of the objectives was to generate new geologic data.

A. Well, as I mentioned, to get more modern log sweeps.

Q. Are you satisfied that Williams was able to achieve that objective?

A. Yes.

MR. KELLAHIN: Thank you. That's all the questions.

EXAMINER BROOKS: Thank you. I don't think I have any questions. Mr. Jones?

EXAMINATION

BY EXAMINER JONES:

Q. I wrote a bunch of questions down. I guess, basically, as a geologist, couldn't you make almost the same argument all over the San Juan Basin for discontinuity between the -- lateral discontinuity as a justification for increased density drilling?

A. For all the formations?

Q. No. For the Menefee, Cliff House and Point Lookout.

A. You know, I looked pretty extensively in this area, and then I relied on literature from the Menefee, both from outcrops to the east of the basin -- or the west. And there is a lot of lateral variability. And I think it has to do with the depositional environment and the shifting seas. And that's sort of the stacking pattern of the sands.

Q. Okay. This is just for the Rosa Unit. But it seems like those logs are really hard to correlate everywhere you go in the Mesaverde formation.

So these Menefee coals, those washouts, the density still reads -- is still good enough --

A. No. I don't believe you can read a good density curve when you have a spike like that in a washout.

Q. So you just look at your resistivities and your caliper coals.

This Menefee coals, is that -- I saw in the order that was done previously that, given a lot of gas in place for those coals is corresponding to the other members of the Mesaverde. So is that -- are you expecting the Menefee to be the major contributor here?

A. No. I'm not familiar with how the designation of gas in place was divided between sand and coals. What I can say is not all the coals give a gas indication. So I think some probably are source and reservoirs, but they were also -- there may be some that are a little bit silty or something that doesn't give up gas as easily. It's a tough thing to try to figure out.

Q. So you don't have any gas in place numbers for the Menefee coals?

A. I don't have any gas in place numbers. I don't have any desorption data. I don't know whether Mr. McQueen will have access to that, but I don't have any.

Q. But your testimony is it's a lot of discontinuity out here?

A. Um-hum.

Q. So that takes care of the coals.

But the Menefee looks like it's a thick package of sands and coals.

A. Yes.

Q. And when you get down to the Point Lookout, is it fighting upwards? There's a little sand sequence -- little sands -- does it get dirtier as you go up on the gamma ray?

A. That's a really good question. I tried by best to see if I could identify in these coals whether you had fluvial finding upward sequences or marine coarsening upward sequences. It's so complex that I can't separate out what's exactly going on.

Because you have, for example, in the offshore bar, you could have two bars stacked on top of one another, and you would have no way of knowing what that was without some core data.

Now, the problem with core data is you take it in one place. As soon as you move to the next section, the sands have changed. So I really struggle with what I could do to extract additional depositional environments from the these logs, and I can't do anything more, except to know sort of where I am in a depositional environment and to know that it's extremely complex.

Q. Do you guys have all your logs digitized in a database?

A. We do.

Q. I think it was -- Burlington came a couple years ago for a pilot, but it included the Dakota and members of the Dakota and Mesaverde. But you're not looking at that here?

A. No.

Q. Because the major downhole commingling would be between the Mesaverde and Mancos sands and the Mancos?

A. No. As I understand it, it is a three-way completion that includes the Dakota. But my understanding is that both the Mancos and the Dakota, where these increased density wells would be drilled if this is approved, are within the spacing units already established for the Mancos and the Dakota. So we're not seeking increased density for those formations.

Q. Okay. So you, basically -- instead of tackling the whole sequence, you're just coming from the

Mesaverde in this case?

A. Correct.

Q. I know the Piceance Basin was drilled pretty densely now in the last 10 years or so. Does this have any correlation to the Piceance basin here? Are you taking any analogy from that as far as --

A. Not for this formation. You'll recall the cross-section that I showed that went from New Mexico all the way to Colorado, you can see that -- and admittedly it was the eastern part of Colorado. But the Mesaverde section is not as regionally extensive. The Mancos is.

So we do look for comparisons in the Mancos, because the Mancos Sea, as you saw in that block diagram, is very laterally extensive. But when you get up to the Mesaverde -- yes, there are equivalents, but not so that I can correlate exactly what's going on.

The other issue is that the source for these Mesaverde sands in the San Juan Basin comes from the southwest, in now what is Arizona. If they got up to the Piceance Basin, they would probably be silts because of the distance of transport. So I don't think they will be equivalent for what we're looking at.

Q. Your sand bodies here, is the total porosity -- the effective porosity real close to the total porosity? Do you have a lot of fines in these sands? You talked about lateral discontinuity, but you didn't say that this was because of clays inside the sand.

A. If I might, let me tell you what we did. This past year, we drilled four wells in which we collected x-ray defraction data from the cuttings, so that would tell you the percentages of quartz, carbonate, clays and other minerals. Yes, there's a lot of variability between the amount of quartz and the amount of clay, which suggests to me that you probably have variability between total porosity and effective porosity.

Because I don't have any sidewall cores or core data, nor have I looked at any thin sections of cuttings, I wouldn't be able to give you an idea of how those might be distributed. But it's certainly my belief that you have quite a bit of variability in the quality of the sand, the percentage of the quartz in that sand, and then how much of an admixture you would have of silts and clays and other minerals.

Q. Of these source rocks that you say are from Arizona, was that before the laramide?

A. Yes, it's before the laramide. And in that source, there were a lot of volcanic and igneous source materials, particularly in the Point Lookout. So in these sandstones, you have lithic fragments, you have volcanic fragments --

Q. How does that show up on or gamma ray?

A. I don't think you can see it.

Q. It's not potassium, sodium or uranium?

A. The only way we would be able to see it, again, is on our x-ray defraction. We were able to split out potassium feldspars and -- orthoclase and potassium feldspars so we can see it. And I haven't done the full analyses to see whether I could see a pattern, but I'm only looking over a very small area here, two townships, so it would be a little tough to pick up a trend.

But that's what we were trying to do using easily available cuttings data and some new on-site technologies from Weatherford Laboratories.

Q. I guess this question is not totally -- but just for my information, the top of the Mesaverde, what age would that be and what age would be the bottom of the Mesaverde, as far as millions of years ago?

A. Do you want subdivisions, like cenomanian or --

Q. What I mean is, was this all done really rapidly or --

A. I see what you're saying.

Q. -- is it lower cretaceous?

A. It's upper cretaceous. I mean -- no, it's not a -- in the overall sequence, it's relatively fast. I don't know that I even have years, that I could tell you how many tens of millions of years this would represent.

But let me just make a comment that in the southwest, where you start with deposition of the Point Lookout, you have a much longer period of time that that was deposited until those sands got to the northeast. So that time range will vary.

Q. Okay. It looks like you're kind of fighting the prices of natural gas here, and you're kind of, you know, forging ahead with the reservoir management, but your prices are against you here, as far as drilling increased density wells.

When you met with the other people that you noticed -- I'm sure you talked with other geologists working in the other parts of the basin -- was there any management objectives from other companies that you can talk about?

A. No. Really, the only geologist I talked to is the one from ConocoPhillips, but it was not on this particular issue. It was on Dakota sandstones.

Q. Okay. Hopefully the prices will move and you'll have a rising tide here, so to speak.

A. I think you'll hear from Mr. McQueen's testimony, price is a big driver for our economics, and that's certainly taken into consideration. But it's not something that I deal with.

Q. Are you going to gather any more information than you did with the pilot? In other words, is this going to be a cookie cutter approach here as far as drilling? Do you have more mud loggers? Are you going to have --

A. My understanding is we'll have mud loggers. This program will be directed by our Tulsa asset team. I'm in the exploration department in Denver. And we've already had a discussion about what sort of data. It's not reasonable to collect core data.

However, I'm considering making a recommendation that we do this on-site Weatherford portable x-ray defraction data. We also get source rock data. They give us a RockEval source rock, amount of total organic carbon, what the T-max is. We have some very interesting results in another area of Rosa, and I'm thinking about making a recommendation that we have a unit -- it's very easy to use the same cuttings that a mud logger does and it's not a problem operationally at all.

I think that would fill out some of our understanding of the distribution of sands and maybe some of these volcanic rock fragments, as well as give us an indication of whether maturity is different. We could look at maturity of the coals and see from the bottom to the top of the Menefee if some of the coals might be more gas bearing. It's an interesting technology and it might be one we would apply.

Q. Are you going to drill the whole unit, or are you going to focus on one side of it? Do you know yet?

A. I think the areas to the northwest of the unit -- I don't have specific knowledge of the locations, but I will know -- you know, if this hearing is approved, I will certainly know where those locations are.

MS. MUNDS-DRY: Mr. Jones, we also have -- this is a federal unit. We have Mesaverde participating areas. There are other considerations in terms of where we drill.

EXAMINER JONES: Thank you very much.

EXAMINER BROOKS: Anything further?

MS. MUNDS-DRY: Nothing further for Ms. Wray.

EXAMINER BROOKS: You may call your next witness.

MS. MUNDS-DRY: Thank you. We call Marcia Brueggenjohann.

EXAMINER BROOKS: Would you spell your name for me, please?

MS. BRUEGGENJOHANN: Seriously?
B-r-u-e-g-g-e-n-j-o-h-a-n-n.
EXAMINER BROOKS: Thank you.
MARCIA BRUEGGENJOHANN
Having been first duly sworn, testified as follows:
DIRECT EXAMINATION
BY MS. MUNDS-DRY:
Q. Would you please state your full name for the record?
A. Marcia Lynn Brueggenjohann.
Q. And where do you reside?
A. In Tulsa, Oklahoma.
Q. By whom are you employed?
A. Williams Production Company, LLC.
Q. What is your position with Williams?
A. I am the reservoir engineering manager for the San Juan and Green River Basins.
Q. Have you previously testified before the Oil Conservation Division?
A. No, I have not.
Q. Would you please review for the Examiners your education and work history relevant to being a reservoir engineer?
A. I received a degree in petroleum engineering from the University of Texas at Austin. My pertinent

work history is eleven and a half years working as a petroleum engineer, three for Chevron, four for Petrolight, and the last four and a half years, I've been working for Williams.

Q. You stated you're the reservoir engineer manager for the San Juan Basin and the Green River Basin; is that correct?

A. That's correct.

Q. Are you familiar with the application that's been filed in this case?

A. Yes.

Q. Are you familiar with the gas reservoirs that are the subject here?

A. I am.

MS. MUNDS-DRY: We would tender Ms. Brueggenjohann as an expert witness in reservoir engineering.

MR. KELLAHIN: No objection.

EXAMINER BROOKS: So qualified.

Q. (By Ms. Munds-Dry) Ms. Brueggenjohann, we have a slide here, and I believe this is also Williams Exhibit Number 10. Before we get into this document, if you could please give the Examiners some background of how this paper came to the attention of Williams.

A. This paper was written by Mr. Luo and

Mr. Kelkar, who are at the University of Tulsa. Williams has had a long history of working closely with the University of Tulsa's petroleum engineering department.

Mr. McQueen, who will testify after me, in addition to his responsibilities at Williams, also serves as an adjunct professor at the University of Tulsa.

Approximately one year ago, while he was at the University of Tulsa, he had a conversation with Dr. Kelkar and found out that one of his graduate students, Mr. Luo, was working on a thesis to assess the infill potential in tight gas sand reservoirs. Mr. Luo was looking for additional field data on which to test his model, and Williams provided our data from the Pinedale field in Wyoming for him to use.

This data was utilized along with field data provided by Devon in the Wamsutter field in Wyoming, in order to prove the theory behind this particular technique. This paper is a modified version of Mr. Luo's Master's thesis, and it was presented at the SPE annual conference in October of 2010.

Subsequent to completing his Master's thesis, Mr. Luo was hired by Williams and worked for me in order to perform an evaluation on the Rosa-Mesaverde formation.

In order to understand how the model works, I'm going to try and explain the theory behind his thesis and walk through an example. Then once I go through the paper, I will present the results that were obtained from the study on the Mesaverde formation at the end.

Again, I would also like to mention that this paper, this version of the paper is a shortened version of the actual paper, was presented on October 13th at our offices in Aztec, New Mexico, when we had the joint presentation with the BLM, the OCD and the U.S. Forest Service.

Q. If I understand correctly, then, Devon submitted information on their Wamsutter field, and then Williams also submitted data from their Pinedale, and then Mr. Luo then used that information to validate his theory?

A. That's correct.

Q. Then Williams submitted additional information when they hired Williams to actually apply the method that he had validated on the Rosa Unit?

A. That's correct.

Q. If you would then please take us through the paper. This has been marked as Williams Exhibit Number 10.

A. The purpose of the infill analysis technique was dual. First, to predict the EUR of potential infill based on production data from existing wells. And second, to predict the components of the infill EUR that could be attributed to incremental reserves or to acceleration.

For the purpose of this paper, incremental reserves are defined as new reserves, and the acceleration component of the EUR are reserves that might have been produced from existing wells. Obviously, the higher percentage of incremental component, the better the infill potential for that particular area.

Two of the parameters that we're going to discuss are IP performance and decline rate. These are important because there are two basic models for reservoirs, homogeneous and heterogeneous, and the infill well performance will differ based on the reservoir type. The IP or initial production rate will indicate access to new reserves. So if the infill well accesses new reserves, the IP will presume to be higher. If the infill well is producing from the depleted reservoir, then the IP rate would be lower.

By evaluating the IP, it's possible to know if you're accessing new reserves or not. The difference in decline rates from surrounding wells can also indicate whether or not that there is communication. After infill wells are drilled, the decline rate of the original well or the parent well can be expected. Normally, the decline will increase if there's communication. And if the reservoir is heterogeneous, the decline rate typically is not affected. This will be more obvious as we walk through the paper.

In this representation of the homogeneous reservoir, the first well drilled is in the center of the reservoir, and the four infill wells are drilled surrounding the well, as pictured on the left. The production rate of those wells is shown on the graph. If there are no infill wells, the production rate of the parent well is going to be like this higher blue-dashed line.

If, after the infill wells are drilled, the decline rate of the parent well increases or becomes steeper, because it's been affected by communication with the infill wells. The difference in the two decline rates -- so between where this would have been had no infill wells been drilled, and where it is after the infill wells are drilled, that difference can be categorized as accelerated production.

I also noticed that because this reservoir is homogeneous, the initial rates or IPs of the infill wells are very similar to that of the parent well at the time the infill wells are drilled.

This is an example of a heterogeneous

reservoir where the parent well, again, is in the center and the infill wells surround it, as pictured on the left. This reservoir is heterogeneous to the extent that there's no communication between the wells as shown in the diagram.

In this case, the production decline rate of the first well or the parent well is not impacted by the infill wells because there is no communication. It's also important to note that the infill wells' IP or initial production rates are similar to the first well, indicating that they are accessing new reserves. These infill wells would be categorized as having all incremental reserves or production.

In a perfect world, this would be the preferred type of reservoir. In reality, most reservoirs behave with some combination of these two cases, so in other words, come contribution of incremental reserves and some component of acceleration. This is why it's really important to be able to evaluate what portion of the infill EUR can be attributed to incremental and what portion can be attributed to acceleration.

Q. The next slide?

A. The objective of this model is to develop a methodology to estimate how much gas from the parent well is taken by the children to estimate the EURs of the incremental wells using existing production data, and finally, to calculate the portion of that EUR that is attributed to the incremental reserves or to acceleration.

The first step of this technique is to determine the appropriate time function to get a linear relationship with cumulative production. Having a linear relationship between production and time is critical. Non-linear relationships which are traditionally used in decline curve analysis can be very difficult to extrapolate, and also, to understand the difference between before and after in infill drilling.

In tight gas reservoirs, frequently linear or bilinear flow is observed, so these equations are going to be used to try and find a linear relationship between cumulative production and time. We'll see that in the next two slides.

This a graphical representation of bilinear flow in a fracture. The linear flow can be observed in both the fracture direction and perpendicular to the fracture. For bilinear flow the flow rate equation is represented by Q. When Q is integrated with respect to time, the equation becomes what is shown in the red box and now represents pseudocumulative production, GCP, with respect to time. In this equation, K2 is a constant shown below, so the pseudocumulative production with bilinear flow is linearly related to time to the .75 power.

This is a graphical representation of linear flow in a fracture, and below is an equation for linear flow which, again, is represented by Q. Once again, Q is integrated with respect to time in order to achieve pseudocumulative production, and the resulting equation is in the red box. Again, in this case, K3 is the constant shown below, and the result is an equation with pseudocumulative linear flow that is linearly related to time to the one-half power.

Now that it's been established that a linear relationship between cumulative production and time is possible, the next step is to group the wells. The wells in the evaluation area are sorted chronologically by production start date and then grouped into three to four groups. This is done in order to be able to predict average behavior. The grouping really depends on the range of start dates. With more wells in an evaluation area the groups will be larger and the results naturally will be more robust. The next slides will show the example.

This slide shows some of the producing wells on the Pinedale anacline in Green River, Wyoming, that were provided by Williams for use in this paper. The current spacing is predominantly 10-acre spacing. For evaluation purposes, the well locations were provided to Mr. Luo in lat-longs, and he then converted them to x/y coordinates. So what you see in this graphical representation are the actual x/y coordinates of the bottom hole locations of these wells.

Due to the high density in Pinedale, it was possible to use the congressional sections in the evaluation. In other fields that were evaluated, it was necessary to make a grid that differed from the congressional sections in order to have a large enough well sampling to make a robust sample.

For this example, we're going to use Section 5, shown in the red box. There are 57 producing wells in Section 5. On this slide they are sorted into chronological order by delivery date and then divided into three groups. And most evaluation areas were divided into either three or four and occasionally five groups.

The wells in each group were then treated as if they were drilled together and evaluated for any impact that the subsequent group of wells might have had on the prior group. I think this will be more clear as we walk through.

The next step is to plot the cumulative production for each of the wells individually, using both of the equations that we saw derived earlier in order to determine which equation would provide a linear relationship. Then the linear plots for each of the wells were examined to see if there were any inflections in the line due to the subsequent wells that were drilled. So again, this is an example from the Pinedale field.

After the parent wells were drilled, there were two generations of wells drilled in the field which is defined by the grouping. Each generation of wells typically will result in an inflection point in the production data of the parent well, which is extrapolated to calculate a new EUR. The difference between the original EUR and the new EUR is the amount of gas that were produced by the next set of wells and, therefore, attributed to acceleration.

So what we see here is the production from the first well in Group 1, and it is plotted until the time that the first well in Group 2 was drilled. This line is then extrapolated out to some point in time to get an EUR, and that EUR represents what the EUR of this well would have been if the second set of wells had never been drilled. So in this case, it happens to be 5 bcf.

Next, the production of that well is plotted until the time that the first well in Group 3 is drilled. And again, that line is extrapolated to determine what the EUR of that first well in Group 1 would be if the third group of wells had not been drilled. This delta there then represents acceleration due to the second group of wells.

The process is then repeated for the production that occurred from the beginning of the third group until the end of available production. This line is extrapolated and a third EUR is determined. The final delta then is the acceleration due to the third group of wells.

This is another example from the Pinedale field and, again, you can see the original EUR until the second group of wells is drilled. It's extrapolated, more production until the third group of wells in another delta. So this process was done for every single set of wells within the evaluation area.

So in the previous slide we looked at an extrapolation in order to estimate the EURs from the wells using the integrated flow equations. In order to be convinced that these estimated EURs were reasonable, they were compared to the EURs that were reported by the companies that provided the data. If the results are similar, then it's possible to be more confident in the ultimate results.

So here we see a graph of the EURs that were estimated by extrapolation that are compared to the EURs that were provided by Williams, and the correlation is quite good. There's a confidence factor of greater than 90 percent. This would indicate that the procedure used for extrapolating the cumulative production does indeed provide a reasonable EUR since they are very close to the conventional EURs.

Using the computed EUR for each well, the incremental portion of the EUR can then be determined by subtracting the amount that is attributed to acceleration from the parent well.

So this is how the incremental and acceleration components are calculated per well. You calculate the average EUR for this second group of wells. From the extrapolations that were done on the parent wells in Group 1, the acceleration component has been calculated, and the average is computed by dividing by the number of wells that were in Group 2. This gives the acceleration EUR per well in Group 2.

The difference of the average EUR for Group 2 and the acceleration then is the incremental EUR component. The results here are the results from Section

5 in the Pinedale field. This process is then repeated for Group 2 and Group 3, to assign an incremental acceleration component for each of the groups.

After calculating the total EUR and the components, then percentages of acceleration and incremental EURs are then plotted as a function of the well spacing. This is done in order to observe a tendency towards either incremental acceleration as the well density increases or is extrapolated.

This particular plot is a plot of the acceleration component versus incremental reserves for a section in the Wamsutter field. In this plot, the total EUR is the blue line and it corresponds to the left axis and has units of bcf. The red and green are percentages, and they correspond to the right axis. The number of points that are shown on the graph correspond to the number of groups that this particular evaluation had. There were four different groups.

The green line represents a decreasing amount of incremental reserves as the well density increases, which is what you would expect to see. The red line shows the amount of acceleration increases also with increasing well density. I think it's also important to note in this case that the total EUR per well declines with subsequent generations of wells.

The next step is to extrapolate the data to some desired spacing using curve fitting. In this case, it was extrapolated to 80 acres, and the resulting projected EUR in this case was 1.355 bcf per well at the 80-acre spacing. This is done for each section in the entire study area, and the next step is to compile the results and determine which sections are the best candidates for infill potential.

This happens to be a summary from the Wamsutter field, and in this case, multiple sections were evaluated together, and the blue lines indicate the areas that in this case had the highest infill potential. Based on this work, Devon has drilled seven infill wells in those sections, primarily in Section 14.

Q. Do you know what the density is in the Wamsutter field?

A. Not off the top of my head.

Q. That's okay if you don't know.

A. I don't know. Williams has also used the results of this work in the Pinedale field to determine whether our not to participate in some of the wells that have been proposed by the operator in this field.

So now we're going to move to the results of the west Rosa-Mesaverde evaluation. The size of the circles on this map, which don't show up as blue as they should, are representative of the EURs of the producing wells in the Rosa-Mesaverde.

The coordinates then shown on the graph again are x/y coordinates from the lat-longs of the bottomhole locations. The grid here is not representative of congressional sections, as larger groupings were needed in order to have enough wells to make the results robust. So what you see here is each smaller square in the grid is larger than an actual congressional section.

The work that was demonstrated in this paper was performed across all of these wells. This graph represents the average results of the field-wide evaluation of the Mesaverde. The center blue line represents the total EUR based on the spacing below and correlates to the left axis which, again, is in bcf.

The upper green line is the amount of incremental reserves as the density increases and as a percentage and correlates to the axis on the right. And the lowest red line then represents the acceleration component, and, again, is with the right axis. As you would expect, the overall EUR does decrease with increasing density and the amount of incremental reserves also decreases.

In the next slide here we have extrapolated the existing data to predict the results of the well drilled on 40-acre spacing. The result is an EUR of .73 bcf with 74 percent incremental reserves with 40-acre spacing.

This is the compiled results of all the grids that were shown for the Mesaverde and the Rosa. And I think it's important to note that almost all of the sections indicate that they would have greater than 75 percent incremental reserves with a very low component of acceleration. We believe these results indicate that increased density is required in the Mesaverde.

Q. Thank you, Ms. Brueggenjohann. Hopefully an explanation of some of those mathematical equations -- hopefully they'll ask for clarification, because I certainly had a hard time understanding it.

Was this paper that was submitted by Mr. Luo, was this peer reviewed?

A. It was.

Q. And then was the information and data -- I believe you said, and I just wanted to emphasize -- some of this data was actually submitted by Williams?

A. Yes.

Q. Did Williams rely on this document to make its business decisions, particularly in bringing this application here today?

A. Yes, we did.

Q. Was part of this paper at least compiled under your direct supervision?

A. It was.

MS. MUNDS-DRY: Mr. Examiner, we move the admission of Williams Exhibit Number 10 into evidence.

MR. KELLAHIN: No objection.

EXAMINER BROOKS: Okay. 10 is this entire paper?

MS. MUNDS-DRY: Yes, sir.

EXAMINER BROOKS: 10 is admitted.

Did you get the last witness's exhibits admitted, Ms. Wray's?

(Exhibit 10 was admitted.)

MS. MUNDS-DRY: Yes, sir.

EXAMINER BROOKS: Okay. I didn't remember whether they were admitted or not. I wanted to be sure the record was correct. Go ahead.

MS. MUNDS-DRY: That concludes my direct examination of Ms. Brueggenjohann.

EXAMINER BROOKS: Okay. Mr. Kellahin, go ahead.

CROSS-EXAMINATION

BY MR. KELLAHIN:

Q. I'm looking at the paper here. Would you turn to page 28? I'm having trouble taking page 28 and finding the areas. The areas are 1 through 25. If I look back to the field map on 25, I can't show the areas.

A. And I apologize. We have another exhibit where the areas are actually numbered.

Q. Will that be introduced?

A. It will be introduced.

MS. MUNDS-DRY: Mr. Examiner, with Mr. McQueen's exhibits and testimony, there's actually a map that lists that, if that's helpful to Mr. Kellahin.

A. If I recall correctly, Number 1 is in the upper left corner, so it's 1 through 5 across the top.

Q. Let me ask you this. I think it will be helpful. My degree is in English literature. If I look at page 28, it would be helpful I think for the Examiner to have and for my client to have the population of wells for each of the 25 areas. I think that would be helpful to analyze your work.

A. Certainly. I do have, actually, the full analysis of the west -- of the Rosa-Mesaverde that was done. However it's a fairly substantial document, and I knew you really didn't want to go through the entirety of it. I'm happy to provide any --

Q. I'd appreciate having a copy. I have an engineer that might look at that.

A. Absolutely.

MS. MUNDS-DRY: We can provide that to Mr. Kellahin. And if the Division would like a copy of that, we will be glad to provide it.

EXAMINER BROOKS: I think we probably would like a copy of it. Are you passing the witness?

MR. KELLAHIN: No, sir.

EXAMINER BROOKS: Because of timing sequence, if I may interject, this may be an awkward time, but I would like to take a brief recess, about seven minutes, and be back ready to go at 11:00.

(A recess was taken.)

MR. KELLAHIN: I moved over here because the court reporter said she could not hear the witness when I had her turning her head the other way. It's not my intent to make things more difficult.

EXAMINER BROOKS: I have been doing this type of work for a long time, and I found it's very good to keep court reporters happy.

MR. KELLAHIN: A few more questions, please.

EXAMINER BROOKS: You may proceed.

Q. (By Mr. Kellahin) Ms. Brueggenjohann, we were looking at Exhibit 28, and I think you satisfied my interest in having information about the area to be identified.

A. (Witness nods head.)

Q. In drawing the analogy between the SPE paper and the Rosa Unit, as I understand that, the objective that you think you have achieved is on the basis of the analysis of the SPE paper, then you've applied that methodology to the Rosa Unit, and using certain parameters, believe that you have sufficient new reserves for the increased density wells that justify that project; is that about right?

A. That's correct. I, myself, did not do the work. The work was done by Mr. Luo under Williams' employ and under my supervision when he evaluated the Mesaverde field.

The results that we presented on the previous graph -- I won't be able to get there now -- but on page 27, I believe, show that the field-wide average is .73 bcf. The part that's of most interest to us is that 74 percent of that is incremental, according to this analysis.

Q. What part of this process was assigned to Mr. McQueen?

A. This particular evaluation using this technique in the SPE paper?

Q. Yes, ma'am.

A. He was familiar with the work.

Q. I'm trying to understand what I've learned from you and what I'm about to learn from Mr. McQueen, how this was apportioned.

MS. MUNDS-DRY: I'm not sure I understand the question, Mr. Examiner.

Are you asking for a preview of what Mr. McQueen is going to testify to?

Q. (By Mr. Kellahin) I assume you're his supervisor; are you not?

A. No, I am not.

Q. That answers that question.

When we make the link from Rosa to the SPE paper, is this your work product?

A. No. This is Mr. Luo's work product.

Q. In applying this method to the Rosa Unit, did Mr. Luo generate a pattern for the increased density wells using layouts that we find in the early pages of your presentation?

A. Yes.

Q. For example, using the heterogeneous reservoir depiction that's on page 4.

A. The two equations that were shown to be derived that would give a linear relationship between cumulative production and time, were applied to every producing well in the Mesaverde formation in the Rosa

Unit. One or the other of those equations would give a linear relationship, and then that line was used and these calculations were done.

Q. When I look at the wells in Area 1, for example, am I going to see a depiction, when I plot those, that will conform to some type of layout that shows this relationship?

A. That particular graph is a representation of a heterogeneous reservoir. That was not used during the analysis. That was only used -- that particular graph was used to explain the difference between a homogeneous reservoir and a heterogeneous reservoir within the context of understanding the technique that was used in this paper.

Q. When we get down to the specifics of the Rosa Unit, which engineering calculation is the one that applies to the Rosa Unit?

A. Again, as I stated, the two equations of pseudocumulative flow with respect to time were applied to the production on every single well in the Mesaverde in the Rosa Unit. So this equation in the red box there for bilinear flow and that equation there were applied.

This is a tremendously onerous task. What Mr. Luo did was right a VBA program to take the production data and look at both of these curves and determine which one had a linear relationship.

Q. In taking this information, can my engineers at ConocoPhillips, then, have enough information by which they can check the assumptions and values placed in each of these two calculations?

A. I believe so. These are standard flow equations.

Q. There's nothing unique about these flow equations that they would not understand or have access to?

A. No.

Q. In talking to engineers in prior hearings about flow equations, there is always some range of choice in the values used for each of these -- in the range of numbers used for each of these values. Are any of these values such that they would give you the ability to manipulate the end result?

A. Not to my knowledge.

Q. In a more simple fashion in doing volumetric calculations, if you have a thickness component, it would change the thickness, you can change the results.

A. Absolutely.

Q. In doing that, are there any of these engineering parts of the formula that have that type of sensitivity to the end result?

A. No, there are not. The primary purpose of these equations is to be able to draw a straight line and to be able extrapolate out to some point in time to get an estimated EUR.

Those EURs were then correlated to the EURs that were provided by Williams to make sure that there was a good correlation. That would have been the only place where there might have been room for some interpretation.

However, the correlation was greater than 90 percent confidence, so I don't think that Mr. Luo took any liberties with his interpretation.

Q. You're being very responsive, and I'm trying to understand. When I look at engineering plots and see design curves, you depict various data points. That's --

A. The reason for using the linear line is that it's less open to interpretation than a non-linear curve.

Q. Were you involved in this project from an engineering perspective when the pilot order was issued?

A. I was not.

MR. KELLAHIN: Thank you, Mr. Examiner.

EXAMINER BROOKS: Thank you, Mr. Kellahin. Ms. Brueggenjohann, I don't believe that I can -- that I have any questions. Mr. Jones?

EXAMINER JONES: Okay. I'll probably be

easy compared to Tom.

Okay. I think Mr. Luo is going to have a thriving career as a reservoir engineer or mathematician.

THE WITNESS: He's currently working on his Ph.D. right now.

EXAMINER JONES: That's a good choice.

EXAMINATION

BY EXAMINER JONES:

Q. I like the idea of the straight line, that that factor versus the time, and that -- is that revolutionary, or is this something that the CAD all does, or is this something that's brand new?

A. I don't believe it's brand new. These are pretty standard flow equations.

Q. He basically creates these grids of the sizes in order to handle Pinedale, basically, and the Rosa Unit?

A. (Witness nods head.)

Q. So it's universal, as far as you can apply it to different areas of the country?

A. Tight gas reservoirs, yes.

Q. Oh, tight gas reservoirs. So hyperbolic type declines and stuff would be a better representative for calculation of incremental reserves this way, than would be through time zero -- did you do that sort of thing?

A. This is simply one predictive tool to use in addition to all the other standard reservoir engineering tools. The advantage of this is it doesn't require any pressure data. You're able to use existing production data. And it's a predictive method. It's not something intended to be used solely as the primary method of making an engineering decision, but really to predict what the results will be.
Q. So, basically, it kind of depends on the slope change and how that -- because if you choose a different slope change, you've got a vastly different number.
A. Yes.
Q. And the number of wells that you drilled for pilot on the Rosa Unit, how many was that?
A. 20 wells.
Q. And it was Ms. Wray that said it was all across the unit; is that right?
A. (Witness nods head.)
Q. It was pretty representative?
A. Yes. It was spread across the -- most of the participating area.
Q. And those wells, were they downhole commingled?
A. They are all commingled.
Q. Even the original parent wells were commingled

and the child wells were commingled?

A. Some of the parent wells I believe are stand-alone Mesaverdes and are not commingled. And I believe some of the original wells were not downhole commingled. I would have to look at my records to give you that.

Q. That's okay. But you're confident that the percentage allocated to the Mesaverde was correct as far as this prediction goes?

A. Yes.

Q. Were you the one having to get your management to drill these wells?

A. No. I left that to Mr. McQueen.

Q. Okay. There's always somebody that has to do it. Acceleration is almost sometimes good economics also, isn't it?

A. It is. Depending on the current gas price and the economics of drilling the well, there are times when even though you're getting a component of acceleration, it's still economically viable.

Q. Isn't that even more so if you've got hyperbolic type gas?

A. That can be true.

Q. And the life of these wells as far as -- it seems like it makes a big difference, you know, your

field-wide compression and how much you can pull these wells down. But I guess this comparison is assuming the same end pressure --
A. Yes.
Q. -- in the reservoir?
A. Um-hum.
Q. Does Wyoming require pressure data to be turned in by operators so it's available to other operators, or studies?
A. Our position in Wyoming is non-operated, so I'm not sure I can answer that question definitively.
Q. Because New Mexico got rid of that a few years ago. What about pressure transient analysis? Have you done any of those around in -- does it help you in any way as far as looking for boundaries, looking for reservoir pressures and --
A. We have not done any of that analysis on the Mesaverde.
Q. On the new wells that were drilled in the pilots, were they completed the same way as the older parent wells?
A. I believe so.
Q. Same frac jobs?
A. Mr. McQueen can provide you more details around that.

EXAMINER JONES: Okay. I have no more questions. Thank you very much.

MS. MUNDS-DRY: I have nothing further.

EXAMINER BROOKS: She may step down.

I have a question for you before we -- Ocean, before we go with the next witness. In Case Number 14581, which is two cases down from this, Number 8 on the docket, you entered an appearance. Is that a limited entry of appearance or is that a contested case?

MS. MUNDS-DRY: That is entry of appearance. I'm also here for Nearburg. I believe Mr. Carr has entered that appearance.

EXAMINER BROOKS: I assumed that since Bill had entered an appearance for Nearburg, that you would represent that as well. So in effect, none of the remaining cases on the docket are contested. The only things that are remaining is 14587, 14581 and 14582, and they're all Jim's cases, as far as I can see, and none of them are contested. So if we get through with this case, we will be on the home stretch.

MS. MUNDS-DRY: Good shape.

EXAMINER BROOKS: That's what I was trying to figure out. Can we complete this witness in 30 minutes?

MS. MUNDS-DRY: I imagine he will be done well within 30 minutes.

EXAMINER BROOKS: I put a premium on that, because I want to take a lunch break at 11:45.

MS. MUNDS-DRY: I'm right there with you.

EXAMINER BROOKS: You may proceed.

KEN McQUEEN

Having been first duly sworn, testified as follows:

DIRECT EXAMINATION

BY MS. MUNDS-DRY:

Q. Would you please state your full name for the record?

A. My full name is Ken Haywood McQueen, Jr.

Q. Where do you reside?

A. I reside in Tulsa, Oklahoma.

Q. By whom are you employed?

A. I'm employed by Williams.

Q. What do you do for Williams?

A. I'm the director for the San Juan Regional Asset Team.

Q. Have you previously testified before the Oil Conservation Division, and were your credentials made a matter of record and accepted?

A. I have, and they were.

Q. Are you familiar with the application that's been filed in this case?

A. I am.

Q. Have you made an engineering study of the subject lands in the Rosa Unit?

A. I have.

MS. MUNDS-DRY: Mr. Examiner, we would tender Mr. McQueen as expert in petroleum engineering.

EXAMINER BROOKS: Okay. Do you find that when you introduce yourself as Mr. McQueen, people occasionally start calling you Steve?

THE WITNESS: People of our generation, that's very common, yes. People of my children's generation, not so much.

EXAMINER BROOKS: So qualified.

MS. MUNDS-DRY: Thank you.

Q. (By Ms. Munds-Dry) Mr. McQueen, before we turn to your exhibit, let's first review what Williams studied during the pilot project.

A. On March 19th, 2009, in Case 14291, we requested approval of the infill pilot in the western portion of the Rosa Unit. The subject area covered all 26 sections in Townships 32 North and 6 West and 31 North and 6 West within the Rosa Unit.

Our thesis, very simply, was that increased well density was justified based on observed geologic heterogeneous entities and gas recovery factors that were calculated. If our thesis proved true, ultimate gas recovery could be improved by increased well density.

Our infill pilot proposal requested the drilling of 20 wells within this 26-section area and the collection of data that would confirm or deny our thesis. Today we are meeting our requirements from Case 14291 and under Order 123 to record our conclusions from that data gathering.

You've heard from my colleague, Laura Wray, that the openhole logging data gathered from these 20 infill wells was integrated with our previous data and geologically confirms a highly heterogeneous reservoir, one comprised of many lenticular sand bodies with multiple reservoir compartments.

You've also heard from my colleague, Marcia Brueggenjohann, on how newly-developed peer reviewed technologies from SPE was developed from the University of Tulsa. I'll show you and re-review the results of that technology to identify well interference, rate acceleration and incremental recovery in the Rosa-Mesaverde.

We also attempted to conduct a minimum of four DFIT in each of the 20 infill wells to confirm or deny zonal pressure variations, and I'll show you those results, as well. We have painstakingly re-examined our original assumptions related to gas in place information and have revised and updated those numbers. And finally, we have prepared and inspected our production plots for evidence of interference.

Q. Let's turn to Williams Exhibit Number 11, and if you'll identify and review this set of documents for the Examiners.

A. The first chart of Exhibit 11 graphically demonstrates the end results of the application of SPE 13249. And, basically, the technique is used to quantify what portion of the production can be related to incremental that is recovered by this well and what portion is acceleration that would be gas that would be recovered by other wells had the 100B not been drilled.

And for this particular well, we see that the total EUR is 1 bcf and .85 bcsf can be attributed to incremental reserves, and .15 bcf that is acceleration reserves. The second page of Exhibit 11 is a bubble map of the Rosa-Mesaverde. The size of the bubbles is simply representative of the estimated ultimate recovery.

Q. This is the same map that, I believe, Ms. Brueggenjohann, with the exception that you listed, the numbers, the area numbers on there?

A. That's right. This reservoir for the purpose of this SPE technique has been developed for the last 55

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years, so some of the bubbles are large simply due to the longevity of the well. Other bubbles are large because they are in better parts of the reservoir.

For the purposes of the SPE analysis, the map is laid on an x/y coordinate plain, and those coordinates were calculated from the wells' latitude/longitude coordinates. The Rosa-Mesaverde producers were then divided into 25 like-sized rectangles.

In the Pinedale example, the well density was 10 acres and the wells were grouped into three chronological groups. So there were enough wells in every 640-acre section to make this analysis statistically significant.

In Rosa, with 80-acre well densities and four chronological groups, a larger area must be utilized in order to have enough wells to analyze in four chronological groups. Each of the 25 rectangles was analyzed independently for its unique split between incremental and acceleration production.

The next page shows the analysis that results in quantifying the split between incremental and acceleration, again, as a reminder, the top line annotated with triangles and shown in green is the incremental data, and the bottom line annotated with the squares and shown in red is the acceleration data. And both of those lines are associated with the right access.

The blue line annotated with the diamond in the middle and labeled "sum" is really the average EUR for each chronological grouping and is associated with the left axis. As you would expect, the first chronological group shows zero acceleration and 100 percent incremental.

As more wells are drilled, which creates more chronological groupings, the corresponding EURs decrease and the acceleration component increases. Again, in Rosa, the analysis used four chronological groupings.

To determine the acceleration impact at some predetermined well density, 40 acres in this case, the data is curve fit to produce an equation that can calculate these parameters.

Q. That's shown on the next page titled "Area 1 Extrapolation"?

A. Correct.

Q. The next page shows the curve fit and the equation for each grid so that you can see in Area 1 40-acre well density would result and predicted 16 percent acceleration. So 84 of the production would be gas production that would not be produced with the current well spacing. The identical process is repeated 25 times so that each rectangle is analyzed for its unique results.

If we look at the next page, we see the field-wide averages, and the following pages show the extrapolation back to 40-acre well density, indicating that on a field average, infill drilling the entire field to a 40-acre well density would result in an average 26 percent acceleration component.

In practice, the field-wide average is only useful as a high-level screening tool to determine whether or not the field might be a candidate for increased density. The real value of this methodology is determining geographically within a producing field where the optimal plays with increased density exists.

If you look at the last page of Exhibit 11, we show the results for each of the 25 geographic areas in analyzing Rosa. The table clearly indicates that the best places to consider infill drilling is Areas 2, 6, 7 and 9, all of which have acceleration components less than 15 percent. The worst places to infill drill would be Areas 13 to 24, which have acceleration components in excess of 45 percent.

Q. Let's turn, then, to what's been marked as Williams Exhibit Number 12. Please identify and review this document?

A. This document reflects the DFITs that we did in all 20 of our wells. Diagnostic fracture injection tests, commonly known by the acronym DFIT, is a procedure by which fluid is pumped into the formation. When the parting pressure is reached, fluid injection stops, the pressure response is recorded during the entire process and can be analyzed for certain information.

The DFIT can be thought of as a pre-frac breakdown. The pre-closure pressure history can be used to discern unique fracturing characteristics, such as near well stress, pressure dependent leak-off, fracture height recession, leak-off and fracture complexity.

More importantly, the post-closure pressure history can be analyzed as a fall-off test with traditional pressure transient techniques. This analysis can provide different leak-off types, namely normal, pressure dependent, fracture hyperextension and fracture tip extension. More importantly, can be used to provide closure stress estimate for pressure from which we can derive an average reservoir pressure.

In our case, we shot one hole into the porous interval, conveyed a bridge plug to just above that perforation by wireline with a pressure recording device hung underneath the bridge plug. We started pumping fluid into the formation while monitoring pressure on the surface. When the formation parted, the pumping ceased, the bridge plug was set. And after four days, the bridge plug was recovered with the pressure bomb and the fall-off data was downloaded from the pressure bomb.

Our goal was to conduct four DFITs in each of our 20 infill wells. Because of some bridge plug failures and other mechanical issues, we were not able to collect all four DFITs in all wells. So looking at Exhibit 12, if everything went according to plan, we should have four bars for each well representing the reservoir pressure and each zone tests.

Those wells that have missing bars are those where we experienced mechanical issues. The data gathered was an additional cost component, as it represented 16 days on each well or 320 days to our entire program, where other downhole operations had to be delayed.

Nevertheless, we believe that the data here provides insight into untapped potential in the Mesaverde and supports our case. Incidentally, all of our DFIT data was captured and analyzed independently by Halliburton.

For consistency, the zones included one test in the Cliff House, one in the Menefee and two in the Point Lookout due to its much greater thickness. The shallower test in the Point Lookout is labeled as upper

Point Lookout on Exhibit 12 and corresponds to what many geologists refer to as the massive Point Lookout. This is where most of the Rosa-Mesaverde production originates.

The deeper point Lookout test is labeled -- excuse me -- the lower Point Lookout on Exhibit 12, and corresponds to the more heterogeneous sands found in the lower section of the Point Lookout. These sands have not historically received the degree of stimulation as the upper sands.

The reservoir pressure as determined by Halliburton indicates significant variation from zone to zone and from well to well. This indicates that differential depletion is occurring across the interval due to variations in permeability.

So we can surmise that the reservoir connectivity is highly variable as a result of this reservoir heterogeneity. The data also suggests that there are significant reserves remaining in some of the less connected reservoir components, and additional reserves could be recovered by more wellbores.

Q. In particular, if I understand this correctly, Mr. McQueen, the yellow, the lower Point Lookout, indicates higher pressures --

A. Correct.

Q. -- which would seem to confirm --
A. -- less drainage.
Q. That's an untapped --
A. Untapped resource.
Q. Let's turn to Williams Exhibit Number 12. You have a series of production plots here?
A. Um-hum. The production plot is a collection of 20 rate/time semi log production plots showing the production history for the first well that was drilled and every proration unit where a subsequent 40-acre pilot infill well was drilled. At the bottom of the plot are a number of annotations and some are labeled "FDD." This stands for the first delivery date. For these oldest producers in each proration unit --
EXAMINER BROOKS: Excuse me. You said Exhibit 12. Do you mean Exhibit 13; do you not?
MS. MUNDS-DRY: I'm sorry. 13. I apologize.
A. So we've annotated the first delivery of every subsequent offset with this name and the distance from that well to this initial producer. Based on the previous description from SPE 13249, we expect to see a change of slope in the original well's production history after subsequent wells are drilled if the reservoir was homogeneous.

In 19 out of 20 of these production plots, we see no change in exponential decline, except for the occasional mechanical issues. In reviewing the production plots, we actually see an increase in production trend which resulted from gathering system optimizations.

The only production plot that has fallen from established trend is the Rosa 160. That well was shut in for drilling of the 160D. They share the same surface pay. The Rosa 160 Mesaverde is also commingled with the Pictured Cliffs, and since its extended shut-in, we've been unable to get the water block removed and this well restored to production.

Q. I believe that's the third page to the back of this packet?

A. Correct. So these observations again confirm our thesis of a heterogeneous reservoir, rather than a homogeneous reservoir with minimal interference between wells.

Q. Okay. You said that you also re-examined the gas in place numbers for the Mesaverde. If you could explain what you did and what you estimated for new gas in place numbers?

A. We have spent a fair amount of time examining volumetrics in the Rosa-Mesaverde. Our current estimate of gas in place is 505 bcf. Our current recovery as of today is 132 bcf. That's roughly 27 percent of this gas in place. And our projected ultimate recovery is 262 bcf. That works out to 52 percent of the gas in place. Our hopes with infill drilling would be a recovery of perhaps 50 or 65 percent gas in place or another 4265 bcf of gas production above current projections.

Q. That percentage increase is based on our request for 80 wells per 320, that you think you can get that additional percentage?

A. Correct. We have decreased our estimate of gas in place from what we recorded in our infill pilot hearing. We have analyzed 21 months' of additional production volumes plus log data from these 20 wells. And collectively, we now believe that the cutoff parameters utilized last time were probably too optimistic. Nevertheless, the revised GIP still leaves a significant target for increased density drilling.

Q. Getting sort of to Mr. Jones' point about prices, you're still optimistic, even with these reduced GIP numbers, even with pricing the way it is, to explore increased density in the Mesaverde?

A. We are.

Q. Okay. Mr. McQueen, if you could then -- you've gone through a number of different factors that we looked at in our study. If you could summarize your conclusions in support of our application today?

A. In summary, we believe that we have offered conclusive evidence that our Rosa-Mesaverde is a very heterogeneous reservoir and additional drilling beyond the current 80-acre well density is warranted and will result in gas production that would otherwise be left in the ground.

Our conclusions are confirmed by the data we gathered from the 20 wells previously drilled in our pilot project. We've presented geologic testimony that confirms that our reservoir is a lenticular sand with multiple reservoir compartments of varying size and connectivity.

We have presented engineering testimony using the latest SPE peer review paper to quantify the amount of acceleration versus incremental recovery that could result with additional drilling.

We've conducted multiple DFITs and confirmed zonal pressure variations which suggest that additional drilling could drain additional reserves in these higher pressure intervals.

We have re-examined our original assumptions related to gas in place, and our updated numbers still leave room to achieve a higher recovery factor with additional drilling.

Finally, we have prepared and inspected our production plots for evidence of interference and conclude they support our conclusion of a heterogeneous reservoir that would benefit from additional drilling.

Q. Why is this application important to Williams, Mr. McQueen?

A. The Rosa-Mesaverde is almost fully developed under current 80-acre well density. There are about 30 locations remaining at that spacing. Additionally, we believe that somewhere between 40 and 65 bcf of gas would be left behind in the ground without this additional drilling.

Q. You mentioned there are approximately 30 well spots left in the Rosa Unit for infill drilling under current rules. Of those 30 spots, are all of them suitable for drilling a successful well, in your estimate?

A. We actually believe that some of the 40-acre locations would provide higher EUR recovery than some of the 80-acre locations. Because a lot of the remaining 80-acre locations are located on the east side of the field, and that's where productive Mesaverde tends to shale out.

Q. Will the approval of this application be in the best interest of conservation, the prevention of waste and the protection of correlative rights?

A. Yes, we believe it will.

Q. Were Exhibits 11 through 13 either prepared by you or compiled under your direct supervision?

A. Yes.

MS. MUNDS-DRY: Mr. Examiner, we move the admission of Exhibits 11 through 13 into evidence.

EXAMINER BROOKS: 11 through 13 are admitted.

(Exhibits 11 through 13 were admitted.)

MS. MUNDS-DRY: I have nothing further.

EXAMINER BROOKS: Mr. Kellahin?

MR. KELLAHIN: Thank you.

I have just a few questions for clarification.

CROSS-EXAMINATION

BY MR. KELLAHIN:

Q. Would you go back to a copy of the pilot order, if you have the pilot project order? It's Exhibit 2 in the package of documents. If you'll turn to the bottom of page 2 from the pilot approval hearing, there was adopted in the order some findings concerning the calculation of gas in place.

A. Yes.

Q. I got part of your testimony a while ago about some of the changes in those numbers. Would you give them to me again, and let's do them by Cliff House, Menefee and upper Point Lookout? Can you do that, separate them out by zone?

A. I don't have the zonal splits with me.

Q. Can you provide that to me?

A. Yes.

Q. In re-analyzing the gas in place numbers, what did you find that caused you to change any of the components in the volumetric calculations?

A. The reservoir cutoffs that were used, in particular in the Cliff House last time, calculated more reservoir volume than what we really believe is there. This is a very important aspect to me personally, because I'm the guy in the organization that's on the hook for spending our capital dollars, and certainly I want to be able to apprise management that we have analyzed, as carefully as possible, what we think the remaining gas in place is, because that has a big impact on whether these infill wells will produce economic quantities of gas or not.

Q. I understand that. My question was with the cutoffs, do you use different cutoffs for each of the zones? Is it not your engineering methodology to use a different cutoff when your calculating the gas in place for the Cliff House as opposed to the Menefee?

A. I believe we did use some different cutoff parameters, but I'll be happy to document and supply all of that.

One of the big complications in calculating gas in place numbers for the Mesaverde infill comes with regard to the Menefee was the presence of the coals, and we've spent a fair amount of time debating what that contribution component might be from the Menefee coals.

Q. Did you analyze the geology to come up with values for thickness and porosity in doing the volumetric calculation?

A. An engineer under my direction utilized that. And, basically, our process was to use our inventory of log data and apply a variation of cutoff parameters to that data to come up with these numbers.

And I will say it was not necessarily an application of a specific cutoff, but this has been a very iterative process to look at sensitivities of how the various cutoffs impact our gas in place calculations.

Q. Let me see if I can focus my question on what I'm interested in. You have historical data on your wells and the ability to get net thickness numbers for the volumetrics?

A. Um-hum.

Q. Did any of the new log data appreciably change how you came up with the numbers selected for that value when you're looking at thickness?

A. I don't think the logs changed our view of the thickness, but they added additional data points for analysis, 20 additional data points that we had not previously had.

Q. From the order, one of the things that you were seeking to achieve with the pilot was the zonal specific pressure data. As I understand it, there's a summary on page 12 of your presentation. This is the depiction of that effort; is it not?

A. Yes, sir.

Q. Some of the other things that you're seeking to achieve with the pilot project was to demonstrate wellbore interference. Were you able to achieve any of that?

A. We believe that we demonstrated that by the quantification of acceleration versus incremental through the SPE paper.

Q. That would be how you link that to this issue?

A. Yes.

Q. In the classic sense, though, these pilot wells have not been produced long enough where you could demonstrate interference between wells to the pilot well?

A. Because we are in a heterogeneous reservoir, I do not expect to see a big impact of these 20 40-acre spaced wells to the parent wells, and I base that conclusion on the same 20 production plots that I had provided.

Since we started drilling here in the mid '50s, we have a number of subsequent offsets that have been drilled to the parent well. And as I demonstrated in these plots, we don't see any slope change in the exponential fit of those wells for, basically, any of the infill wells that have been drilled. So that suggests to me that the reservoir is heterogeneous, and you just don't see that pronounced degree of interference from these subsequent wells.

Q. In selecting the 19 or 20 pilot wells, did you have someone or did you attempt to conduct any pressure transient analysis on those wells?

A. On which wells?

Q. The 20 pilot wells.

A. The pressure -- the PTA that we did on the 20 pilot wells revolved around our DFIT data and the analysis of the fall-off trend that we recorded post closure, yes.

Q. Would you finally turn to Exhibit 11, which is your tabulation of multiple pages on the rate acceleration EUR calculation?

A. Yes.

Q. Would you turn to page 2 for me?

A. (Witness complies.)

Q. In looking at the bubble map -- and go to bottom of the map. For example, in section -- I guess Section Number 24, 24 and 23 on the bottom.

A. Yes. If I could --

Q. My point is there's a large drainage bubble, and those bubbles are overlapping by other drainage bubbles from other wells. What explains that?

A. This map does not represent drainage. This map -- the size of the bubbles simply reflect EUR. So you -- it's simply a graphical representation so that you can compare one well adjacent to the next well of what we think the estimated ultimate recovery will be.

Q. Aren't each of those wells competing for the same gas to the extent that you're using the same EUR? I'm having trouble understanding the visualization of a bubble map that overlies bubbles. Explain it to me.

A. The intent of this exhibit is really designed to show how we split the field up into 25 areas for analysis by the SPE paper. The size of the bubbles should not be interpreted as showing interference between wells. It's simply a graphical representation, one well relative to another well, of what the EUR for that well was.

So it basically gives us a quick look of which wells in the field will have a higher EUR and which wells have a lower EUR. But it's basically nothing different than taking these 300 wells and putting them in an Excel spreadsheet and just having the EUR data adjacent to that, and then normalizing that circle size according to some EUR and plotting them on the map.

So you really can't discern interference between wellbores from this map, because that's not the purpose of the map. The purpose of the map is simply to show the relative EUR, one well to another.

Q. So this map, in your opinion, should not be used to show well densities? I would look at this and say you've got your wells too close.

A. The exhibit that should be used to determine whether our well densities are correct, is the last page of this exhibit, the chart.

Q. The one that's done by areas?

A. Yes, sir. So if you look in the areas that have the smaller acceleration components, it would be our view that those are the optimal places to choose infill drilling, because in some places of the field, as I mentioned in my testimony, it's clear that the existing wells there are going to do a pretty adequate job of drilling the field.

And just so I might clarify, our intent here today is not to drill eight additional wells in every proration unit. Our purpose is to have that latitude, but to allow the operator, in our best analysis, to make judgments on where additional wells make economic sense.

Q. My last question, Mr. McQueen, in the pilot order under paragraph finding 6(K), one of the other issues you were exploring was the orientation. Do you have any comments about that topic?

A. I had hoped that this would be a straightforward process. And as we delved into this and consulted with our geologist, we found that it was a much more complex process than what we anticipated.

If you survey the literature, most of the literature suggests that there is a preferred drainage direction that ranges, depending on the author, somewhere between 10 and 30 degrees east of north. But as we look at the particular geologies zone by zone, we found that it was not clear cut that you could assume a uniform direction for these drainage ellipses across the wellbore.

So, in fact, in reality, what we suspect that we have is, in Cliff House, for example, we may have a drainage ellipse oriented in one direction, and the Menefee, because it's a very different geological deposition, might be slightly different, and in the Point Lookout it may be different again.

And if ascertaining the direction of the predominant -- the major axes of the ellipse wasn't tough enough, then there's also this big debate of what the ratios between the major axis and the minor axis of the ellipse are. Obviously, if those are the same, you have a circular drainage area. But I think everyone believes there is a preferential direction present in the reservoir, and I think that is open, really, to a lot of debate.

Q. So after the pilot study, we still can't answer that question about the orientations?

A. I can answer it and I can generate lots of drainage of ellipses. Whether I have confidence that that really represents what is going on to the reservoir, I'm not so sure.

MR. KELLAHIN: Thank you, Mr. McQueen. We'll save that for another day.

Thank you, Mr. Examiner.

MS. MUNDS-DRY: I have nothing further for Mr. McQueen.

EXAMINER BROOKS: Okay. I have no

questions.

EXAMINER JONES: I'd like to thank you guys for showing up here and showing us this.

EXAMINER BROOKS: I do have a question that I addressed to Mr. Hansen and he referred me to another witness. I'm not sure which one. But maybe you, Ocean, are the person who can answer.

What exactly are you asking for in terms of the eight wells per unit? Are you asking for eight wells? I asked this because it's my understanding the present rule governing the Mesaverde is that there can be up to four wells per unit, no two of which can be in any one quarter/quarter section, and no more than two of which can be in any one quarter section. I think I've stated it correctly.

THE WITNESS: That's correct.

EXAMINER BROOKS: Okay. Do you want to get rid of all those rules about the well location and just allow eight wells per 320 unit, or what are you asking that --

MS. MUNDS-DRY: That's not something we would really detail out. I think that's right. I think we want to have the flexibility to put eight wells where it makes most geologic and engineering sense.

Is that fair, Mr. McQueen?

THE WITNESS: Yes.

MS. MUNDS-DRY: I've got my boss right here.

THE WITNESS: Yes, yes.

EXAMINER BROOKS: Okay. Then you are the person to ask the question. Thank you. The hearings will be adjourned until -- first of all, we'll take Case Number --

MS. MUNDS-DRY: Mr. Brooks, we need to admit the stipulation as Williams Exhibit Number 14.

EXAMINER BROOKS: Okay. Williams Exhibit Number 14 is admitted. We will take Case Number 14586 under advisement. The hearings will be adjourned until 1:30.

(Exhibit 14 was admitted.)

* * *

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. ______, heard by me on ____________ ______.

____________________, Examiner
Oil Conservation Division

REPORTER'S CERTIFICATE

I, JACQUELINE R. LUJAN, New Mexico CCR #91, DO HEREBY CERTIFY that on January 6, 2011, proceedings in the above captioned case were taken before me and that I did report in stenographic shorthand the proceedings set forth herein, and the foregoing pages are a true and correct transcription to the best of my ability.

I FURTHER CERTIFY that I am neither employed by nor related to nor contracted with any of the parties or attorneys in this case and that I have no interest whatsoever in the final disposition of this case in any court.

WITNESS MY HAND this 18th day of January, 2011.

Jacqueline R. Lujan, CCR #91
Expires: 12/31/2011