STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT
OIL CONSERVATION DIVISION
STATE LAND OFFICE BLDG.
SANTA FE, NEW MEXICO

11 July 1984

EXAMINER HEARING

IN THE MATTER OF

Application of Shell Western E & P, Inc. for infill findings, unorthodox locations, and directional drilling, Lea County, New Mexico.	CASE 8262 ~~8263~~ 8264

BEFORE: Richard L. Stamets, Examiner

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the Oil Conservation Division:

For the Applicant: Michael Fredette
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I N D E X

MR. STAMETS: We'll call next Case 8262, being an application of Shell Western E&P, Inc. for infill drilling -- infill findings, Lea County, New Mexico.

MR. FREDETTE: Mr. Examiner, we'd like to consolidate for hearing purposes this case and Docket Numbers 8263 and 64.

MR. STAMETS: All right, let me call those other cases and if I hear no objection, they will be consolidated.

8263 is the application of Shell Western E&P, Inc. for unorthodox locations, Lea County, New Mexico.

And the last case, application of Shell Western E&P, Inc. for directional drilling and unorthodox locations, Lea County, New Mexico.

MR. FREDETTE: My name is Mike Fredette and I'm appearing today in association with the Montgomery Law -- Montgomery and Andrews Law Firm here in Santa Fe.

I'm appearing on behalf of Shell Western E&P, Inc. a subsidiary of Shell Oil Company and the applicant in this case.

I'll try to be brief but I'd like to make an introductory statement.

The Oil Conservation Commission

by its Order No. R-6198, dated November 19th, '79 approved statutory unitization of the North Hobbs Grayburg-San Andres Unit Area, consisting of a portion of the Hobbs Grayburg-San Andres Pool, located in Lea County, New Mexico.

By its Order No. R-6199, also dated November, 1979 the Commission authorized the institution of the North Hobbs Grayburg-San Andres Unit Pressure Maintenance Project in the unit area.

Shell Western, as operator, proposes to drill as infill wells 38 unit wells. The infill wells and the proposed locations are described in the application of Shell Western and will be further identified in today's hearing.

Each of the wells will be drilled in an existing proration unit and each will be drilled at an unorthodox location.

Three of the wells will be directionally drilled.

Shell Western requests three forms of relief in this hearing. We request a finding that each of the wells is necessary to effectively and efficiently drain a portion of the pool underlying the existing proration unit to which it will be drilled.

We request approval of the unorthodox locations and permission to directionally drill the wells.

I might add for the sake of

clarity that these 38 wells are part of a 48-well infill program. Five of the 48 wells have been drilled as producers. Five additional injectors will be drilled in the future and their permitting will be attempted administratively, and the 38 wells which are the subject of today's hearing will be drilled as producers.

We will have two witnesses, Mr. Van Akkeren and Mr. Lancaster.

Mr. Van Akkeren will describe the pool and its characteristics, the unit, its performance, and the locations of the proposed infill wells.

Mr. Lancaster will describe the development of the unit, the necessity for infill drilling, and the additional recovery which will result from the program.

Following Mr. Lancaster's testimony, we will recall Mr. Van Akkeren who will then describe the necessity for directionally drilling the three wells and the manner in which these wells will be drilled.

We would like to have our witnesses sworn at this time.

MR. STAMETS: Okay. Lest I forget to suggest at the end, it could be useful if you wish to prepare some draft orders on at least the infill findings. If you'd like to do some draft orders on all three of these things it could be finished up.

MR. FREDETTE: Oh, in that case

I'd be only too happy --

MR. STAMETS: All right, very good.

MR. FREDETTE: -- to try doing that.

MR. STAMETS: Let's have both witnesses stand and be sworn at this time, please.

(Witnesses sworn.)

MR. FREDETTE: I'd like to add that we will introduce approximately six exhibits which are plats of the North Hobbs Unit. You will notice and probably wonder why the exhibits vary in size. There's no particular reason for this other than our drafting department decided not to follow our instructions.

T. J. VAN AKKEREN,

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. FREDETTE:

Q Mr. Van Akkeren, please state your name and business address for the record.

A My name is Tom Van Akkeren. My business address is 200 North Dairy Ashford, Houston, Texas.

Q By whom are you employed and in what capacity?

A I'm employed by Shell Western E&P, Incorporated as a Senior Production Engineer.

Q Have you previously testified before the Oil Conservation Division?

A No.

Q Would you briefly describe, then, your educational background and work experience for the record?

A I attended the University of Wisconsin from 1965 to 1970; graduated with a BS degree in mining and metallurgical engineering; started working with Shell Oil Company the same year; been employed in various positions in engineering and operation surveillance of fields of West Texas, New Mexico, and Michigan.

In April of 1983 I became involved with the Shell operated North Hobbs Grayburg-San Andres Unit and in October of 1983 I was selected as the team leader of a group of engineers that was organized to optimize the development of the North Hobbs Grayburg-San Andres Unit, and I presently serve in that capacity.

MR. FREDETTE: Are Mr. Van Akkeren's qualifications acceptable?

MR. STAMETS: Yes.

MR. FREDETTE: Okay.

Q Have you prepared exhibits for today's testimony?

A Yes, I have.

Q Would you please describe the location of the Hobbs Grayburg-San Andres Pool and in that regard I direct your attention to what's been marked as Shell Western's Exhibit Number One and ask you to identify and briefly describe the exhibit.

A Exhibit Number One is an exhibit to depict the geographical and geological location of the Hobbs Field.

It's located in Lea County in southwest -- southeast New Mexico, and it's on the northern edge of the Central Basin Platform near the San Simon Channel.

Q At this point I'll ask you to describe the characteristics of the pool and in that regard I direct your attention first to what's been marked as Shell Western Exhibit Number Two and ask you to identify the exhibit.

A Okay. Exhibit Number Two is a structure map of the Hobbs Grayburg-San Andres Field contoured on the top of the San Andres interval. The structure is a northwest/southeast trending anticline nearly eight miles long and approximately three and a half miles wide, with nearly 400 feet of closure above the original oil/water contact at -614 feet.

The pool is developed by the Shell Western North Hobbs Unit, the Amoco-operated South Hobbs Grayburg-San Andres Unit, by two Moranco leases to the north and by a Conoco and a Getty lease in the southern portion of the

field.

The North and South Hobbs Units and the Moranco leases are currently undergoing water injection to improve recovery.

Q I now direct your attention to what's been marked for identification as Shell Western's Exhibit Number Three and ask you to identify that exhibit.

A Exhibit Number Three is a type log of the San Andres pay, using a gamma ray sonic log from the Amoco State "G" 5 Well, located in the southeast quarter of the northwest quarter of Section 33, Township 18 South, Range 38 East, Lea County, New Mexico.

This exhibit depicts development of the San Andres pay. I'd like you to notice that the Upper San Andres is erosional, which affected the development of the upper portion of this pay interval.

The lower part of Zone 1 is very permeable and known to be cavernous in places. The Zone 1 interval is connected to an active aquifer and is under strong natural water drive.

Separating Zone 1 from Zone 2 is a thin shaley barrier that is an effective permeability barrier over most of the field.

The Zone 2 porosity is also very well developed, especially in the crest of the field. At the base of the Zone 2 is a 10 to 20 foot interval that the old drillers called Sandy Break, a sandy dolomite that acts as a

very effective permeability barrier between Zones 2 and 3, and Zone 3 is subdivided into an upper and lower zone, is generally characterized by thinner bedding.

Zones 2 and 3 were under solution drive on primary depletion and are currently undergoing water injection for secondary recovery.

Q Mr. Van Akkeren, does the San Andres exhibit good pay continuity?

A It exhibits good continuity in a gross sense but there are some very rapid facies changes in both horizontal and vertical direction that preclude making a definitive correlation between individual stringers between wells.

We do feel that there are localized barriers to flow, as evidenced by production performance in offsetting wells.

Q Does Exhibit Three depict the entire unitized interval?

A No. The unitized interval consists of both the Grayburg and the San Andres zones. This exhibit does not show the Grayburg pay which is better developed along the flanks of the field, but this area has insufficient pay development to warrant infill drilling at this time. The wells in our proposed infill program will be completed in the San Andres pay.

Q I direct your attention now to what's been marked for identification as Shell Western's Exhibit

Number Four and ask you to identify this exhibit.

A Exhibit Number Four is a tabulation of the reservoir properties and fluid characteristics of the Hobbs Grayburg-San Andres Pool.

The exhibit shows the original reservoir pressure, oil gravity and viscosity, the oil formation volume factor at saturation, solution gas/oil ratio, regional solution gas/oil ratio, and it shows the irreducable water saturation to be 22 percent.

The original gas/oil contact was 600 -- 360 feet subsea. The original oil/water contact was 614 feet subsea.

The second tabulation summarizes the average porosity, permeability values for the various San Andres zones, shows the original oil in place in millions of barrels, net feet of pay in the productive area for each of the San Andres zones.

Q Mr. Van Akkeren, would you describe the North Hobbs Grayburg-San Andres Unit and in that regard I direct your attention to what's been marked for identification as Shell Western's Exhibit Number Five?

A Exhibit Number Five is a current plat of the North Hobbs Grayburg-San Andres Unit, showing the section lines and mineral leases along with the existing producing and injection wells.

The unit covers approximately 10,650 acres and is currently developed by 264 wells, 190 producing

wells, 68 injectors, and 5 shut-in or temporarily abandoned wells.

The producing wells are indicated by the solid circles and the injection wells by the solid triangles.

The unit wells are uniquely identified by the number of the section in which they're located and a three digit number that defines the well's location in the section.

The first two numbers in this three digit number defines the proration unit by identifying the row and tier in which the well is located. I direct your attention to Section 27 on the right side of the exhbiit, that shows how we have divided up the section into sixteen blocks that coincide with the proration units. We just use a completely numeric numbering system.

The well numbers are listed with the row numbers first and then the tier number. And the third number in the well number system identifies a priority in which the well was drilled in the proration unit with the -- with the newest well having the highest number.

North Hobbs Grayburg-San Andres Unit Area, or the unitization of North Hobbs Grayburg-San Andres Unit Area and the institution of the North Hobbs Grayburg-San Andres Pressure Maintenance Project were approved by the Oil Conservation Division in October or November, 1979, and the unit became effective in February of 1980.

Q Mr. Van Akkeren, would you describe the performance of the unit? In this regard I direct your attention to what has been marked for identification as Shell Western's Exhibit Number Six and ask you to identify and briefly describe the exhibit.

A Exhibit Number Six depicts the performance of the unit since it became effective in February of 1980.

The oil and produced water and injected water volume are scaled on the left side of the scale in thousands of barrels per day.

The gas/oil ratio is scaled on the right-hand side of this -- our graph in thousands of cubic feet per barrel.

As you can see, the oil production has shown steady increase from initial rate of 6050 barrels of oil a day to a rate of 11,071 barrels of oil a day in May of this year.

Water injection started in September of 1980 and the water production has shown a rapid increase in the last two years. We feel that this is largely due to a very aggressive program to open additional pay and install larger lift to prepare the wells for flood response.

We do not feel that this additional water production is due to significant water breakthrough.

Q Would you describe the proposed locations of the 38 wells which are the subject of today's hearing and

in that regard I direct your attention to what's been marked for identification as Shell Western's Exhibit Number Seven and ask you to identify this exhibit.

A Exhibit Number Seven is a plat of the existing North Hobbs Grayburg-San Andres Unit wells as introduced in Exhibit Five and in addition it shows the surface and bottom hole locations for the proposed infill wells, along with the proration units in which they'd be drilled.

The new wells are identified with the red dots and the proration units are identified with the orange -- the squares outlined in orange.

In addition there will be five injection wells identified with the blue triangles for which we make separate administrative application to drill these wells.

Q Mr. Van Akkeren, were Exhibits One through Seven prepared by you or under your supervision?

A Yes.

MR. FREDETTE: Mr. Examiner, we'll ask at this time that Exhibits One through Seven be admitted into evidence.

MR. STAMETS: Exhibits One through Seven are admitted.

MR. FREDETTE: I have no further questions on direct for Mr. Van Akkeren at this time but he will be recalled after our subsequent witness.

MR. STAMETS: I have none for

him at this time, either, and I presume no one else does. He may be excused at this time.

MR. FREDETTE: Our next witness, Mr. Lancaster, as I explained earlier, will describe the development of the unit, the necessity for the unit drilling program, and the additional recovery which we would expect from the program.

You might be able to follow his discussion of the first three exhibits, Eight, Nine, and Ten, if you were to hold them side by side.

MR. STAMETS: Okay.

W. R. LANCASTER,

being called as a witness and being duly sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. FREDETTE:

Q Mr. Lancaster, would you state your name and business address for the record?

A My name is Bill Lancaster. I am employed by Shell Western E&P with the address at 200 North Dairy Ashford, Houston, Texas.

Q Okay. You are employed by Shell Western in what capacity?

A I am a Staff Reservoir Engineer.

Q And have you previously testified before

the Oil Conservation Division and had your qualifications as a reservoir engineer accepted as a matter of record?

A Yes, I have.

MR. FREDETTE: Is Mr. Lancaster accepted?

MR. STAMETS: He is considered qualified.

Q Have you prepared exhibits for today's hearing?

A Yes, I have.

Q I direct your attention first to what's been marked for identification as Shell Western's Exhibit Number Eight and ask you to identify the exhibit briefly and describe what it shows.

A Exhibit Eight is a plat of the North Hobbs Grayburg-San Andres Unit in which we have highlighted in green the producing wells and the proposed infill area that existed at the time the unit was formed in February of 1980.

The shaded area around each well represents approximately 20 acres of what we feel has been the area that was effectively drained during primary.

The areas that are in white are the areas that are probably less effectively drained, although they've been drained, they have not recovered all of the oil that's been in that area.

The wells that are lighter colored, there

are ten of them, are wells that will subsequently be in 1980 and '81 converted to injectors. The other, the remaining green wells will remain as producers.

One of the reasons for illustrating or showing this exhibit is to illustrate how wells, how the cluster wells, or how the wells were clustered as a result of the competitive drilling where wells were drilled 330 feet from the corner, and in fact that in drilling this way they concentrate their recovery at a very small area, leaving large portions of the field relatively undrained.

Q Just for the sake of clarity, these 20-acre circles do not necessarily represent the drainage --

A No, no. They represent what we think is the area that's well drained.

Q Okay. I direct your attention now to what has been marked for identification as Shell Western's Exhibit Number Nine and ask you to identify that exhibit.

A Exhibit Number Nine depicts the development of the North Hobbs Unit as it exists today, with the exception that there are five infill wells that have been drilled.

Again the green circles are the producing wells and the blue and red circles are the injection wells.

Included on this, the ten wells that were converted are now blue wells. We have added twenty new drilled wells at infill locations and we've added, well, in 1983 we developed a line agreement with the South Hobbs Unit

and there are fifteen wells, fifteen injection wells, along the South Hobbs Unit. Eleven wells were drilled; four wells were converted.

The wells colored in red are operated by South Hobbs Unit. The wells in blue are the North Hobbs Unit.

These wells, the wells that we drilled in the north were located in the -- in the areas that we thought were poorly drained and to kind of confirm this, three of the twenty wells were converted or were produced for short periods of six to nine months to test the infill potential. These three wells are marked in yellow on your chart, and from left to right, the furthermost west well on the left was 24-242. The center well was 30-222, and the well on the right or the easternmost well was 29-132.

No. 24-242 tested primarily all water at approximately 2-to-300 barrels a day.

The Wells 30-222 and 29-132 both flowed initially and produced in excess of 200 barrels a day oil throughout their period of testing, indicating that there was additional pay that had not been effectively drained by existing wells, wells that had been producing since the thirties.

Q The wells offsetting the injection wells which were produced for a period of time, what was their average?

A They averaged --

Q During that period?

A -- during the same time, the wells offsetting the infill wells that were tested averaged probably less than 100 barrels a day.

Q And those offsetting wells had produced for approximately since the 1930's?

A Yes.

Q All right. Again for the sake of clarity and you may have stated it, the wells which are shaded either in green, blue, yellow, or pink, these do not represent all of the wells in the unit at this time, is that correct?

A No, they don't.

Q Simply the wells in the infill area?

A That's right. They represent the wells that are in the area that was studied and is used as the --

Q Okay. At this point I direct your attention, then, to what's been marked for identification as Shell Western's Exhibit Number Ten and ask you to identify the exhibit and briefly describe what it shows.

A Exhibit Ten is a plat of the North Hobbs Grayburg Unit showing the current development and the proposed -- and the infill area as depicted in Exhibit Nine. In addition we have included the 48 infill locations that were selected using the criteria, number one, that they were in the areas of relatively poor drainage, and that they had at least 12 net porous feet of pay in Zones 2 and 3, San

Andres Zones 2 and 3.

The next thickness was kind of a minimum cutoff criteria used for the infill program.

Now five of these dots, as located in black, were completed during late 1983, early 1984, to test the pay development and productivity potential. They did find the pay development as expected and the productivity indicated in their early tests will be something on the order of 100 barrels a day each.

We are currently going through these wells and zone testing them so we don't have the completion date, the completion data at this point.

Okay, there are also five wells indicated with orange dots. These are the five recommended locations for new injectors which will be handled administratively at a later date.

The remaining 38 infill locations are the recommended locations for the wells which are the subject of today's hearing.

Q Mr. Lancaster, is it your opinion as a reservoir engineer that each of the proposed 38 infill wells at its recommended unorthodox location is necessary to effectively and efficiently drain a portion of the North Hobbs Grayburg-San Andres Pool underlying the existing proration unit into which it will be be drilled that would not be drained by another well within that unit?

A Yes. As a result of the competitive

drilling prior to unitization and the current injection pattern, a portion of the existing proration unit into which each of the proposed 38 wells will be drilled is not being effectively drained at this time.

The proposed infill wells will improve pay continuity and sweep efficiency resulting in the recovery of otherwise unrecoverably hydrocarbons. The necessity for improving continuity was evidenced by the better than average performance in two of the three injection wells that were tested during 1980-81.

Q Would you describe then the improved sweep efficiency which will result from the proposed infill program, and in that regard I direct your attention to what has been marked for identification as Shell Western's Exhibit Number Eleven and ask you to identify and briefly describe the exhibit.

A Exhibit Eleven is a typical pattern in the North Hobbs Unit and what it represents, we just extracted the wells that existed in Section 30.

Okay, this illustrates the four modified, what we call 160-acre 5-spot patterns, where you have one injector offset by four producers, the four producers being clustered at the corner of the proration units with the injector at the center of the quarter section.

Now this pattern yields a producer to injection ratio of 4-to-1, which is rather unequal. We'd like to have it be 2-to-1 or 1-to-1.

Okay, the shaded areas shown on this each in between these 160-acre patterns consist of approximately 40 acres and represent the areas that we think will have poorer than average sweep efficiency. The poor sweep efficiency or the lack of sweep is based on the fact that there's no pressure sink in this area, there's no drainage point in order to pull the water through it.

Consequently, to improve sweep efficiency we propose to drill our infill wells in the middle of these shaded areas as shown by the open circles and these lines will be drilled along the quarter section and sections lines, as indicated.

Q Mr. Lancaster, does Shell Western plan any further revisions in the injection pattern in the unit as far as this infill program, and in this regard I direct your attention to what has been marked for identification as Shell Western Exhibit Number Twelve and ask you to identify and briefly describe the exhibit.

A Exhibit Twelve is a plat of the North Hobbs Unit where we have highlighted the location of the five infill wells in blue. These five wells will be drilled as injectors in 1984.

We feel that in order to achieve an optimum sweep efficiency in this North Hobbs Unit, in the San Andres, about half fo the 38 infill wells which are subject to today's hearing will have to be converted to injectors in about 1987, which will create a line drive flood pattern.

With such a pattern it's important that the injectors be lined along rather than across any permeability trends and in order to ascertain if there is a permeability trend and what effect it might have, we plan to install a north/south and east/west pilot line drive in '84.

As illustrated in Exhibit Twelve, the five infill injectors, along with existing injectors, form the center, north/south and east/west, lines of this pilot.

Q Have you determined the incremental oil recovery which will result from the proposed infill drilling program and if so, please describe this incremental recovery and the basis for your opinion. In this regard I direct your attention to what has been marked for identification as Shell Western's Exhibit Number 13 and ask you to identify and briefly describe the exhibit.

A Exhibit Thirteen documents the published infill drilling experience of Amoco and Exxon in various fields and Shell's estimate of additional recovery for 20-acre infill drilling the West Texas Wassam Field Denver Unit.

The two most important factors that contribute to additional recovery by infill drilling are the resulting increase in waterflood sweep efficiencies and improved zone continuity between wells.

Since each reservoir is unique, the volumes of estimated additional recovery are generall made using the data on hand, such as log, core data and per-

formance, and by analogy with similar reservoirs that have already been infill drilled.

For the North Hobbs Unit we have estimated that the unique or additional oil to be recovered by the infill drilling, as indicated in Exhibit Thirteen, will be 4 percent of the oil and gas in place in Zones Two and Three in the 40-acre drainage area immediately around each infill well.

This additional recovery averages 125,000 barrels and 80 MMCF per well, and for the 48 infill wells the total is 6-million barrels of oil and 4-billion cubic feet of gas, or 1.7 percent of the oil in place in Zones Two and Three in the North Hobbs Unit.

Now, as shown on Exhibit Thirteen, Amoco's infill experience has been documented by Vance Driscoll's paper entitled Infill Drilling, Concepts, Analysis, and Field Results. In this paper he lists a range of recoveries from 2 to 8 percent of the oil in place in the 40-acre tracts around infill wells and comes up with an average or typical recovery of 4 percent.

Exxon's experience in infill drilling is documented in their 1982 paper by Barbara George Styles and Thompson entitled Infill Drilling to Increase Reserves, Actual Experience in Nine Fields in Texas, Oklahoma, and Illinois.

In this paper they estimate Exxon's increased recovery as a result of infill drilling will range

from 5 to 8 percent of the oil in place for 40 acres.

Shell, in requesting authority to increase their Wassam Field Denver Unit, estimated the additional recovery would be 5 percent of the oil in place for 40 acres with 3 percent of this coming as a result of improved sweep and 2 percent as a result of improved continuity.

Although we believe the North Hobbs San Andres has a better than average pay quality and is a good candidate for infill drilling, we have discounted the recovery slightly because of the problems associated with a natural influx into Zone 1, some of which has crossflowed into the lower San Andres zones. As a result we have used 4 percent of the oil in place for 40 acres as the estimated additional recovery per well.

Q Mr. Lancaster, you mentioned the Shell operate Denver Unit. Is that -- produces from the San Andres, is that correct?

A That's right.

Q And that's in West Texas?

A Yes.

Q Is the reservoir similar to the Hobbs Grayburg-San Andres Pool?

A Yes, it is.

Q And you also mentioned the opinions expressed in two papers regarding infill drilling. Were those opinions based on studies of similar reservoirs similar to

the Hobbs Grayburg-San Andres Pool?

A In some of the fields it, well, some of the fields were San Andres fields. Many of them, in fact most of them, were carbonates.

Q I direct your attention now to what has been marked for identification as Shell Western's Exhibit Number Fourteen and ask you to identify the exhibit and briefly describe what it shows.

A Fourteen is an example of the average infill well production function that was used in evaluating the infill drilling potential. It represents an initial rate, this is for each well, an initial rate of 70 barrels a day, which at the time of the evaluation was the averge production for a San Andres well in the field. It shows an increase in production over four and a half years to 100 barrels of oil per day as the wells and the field respond to water injection.

It remains roughly flat for six and a half years a sthe water cut increases but the pressure also increases and then declines over a thirteen and a half year period as the water cut.

Q I direct your attention to what has been marked for identification as Shell Western's Exhibit Number Fifteen and ask you to identify the exhibit and briefly describe what it shows.

A Exhibit Fifteen is an example of what the water -- of what the infill drilling will have -- what ef-

fect the infill drilling will have on the overall North Hobbs Grayburg-San Andres Unit production, production function.

The lower line represents the anticipated production function with no infill drilling.

The upper line represents the effect of the -- of adding the infill wells to our production.

The sharp drop observed in 1987 represents the conversion of about half of the 38 wells to injectors, as we create the line drive, line drive flood.

Q And finally, I direct your attention to what has been marked for identification as Shell Western's Exhibit Number Sixteen and ask you to identify and briefly describe this.

A It kind of reiterates and puts into perspective what the 6-million barrels -- what the 6-million barrels represents.

As shown here, the two axes are the millions of barrels and percent of recovery of the oil in place for Zones 2 and 3.

Under the primary production we will recover approximately 89.3-million barrels.

With the waterflood we would have, as it existed, we would have recovered 48.6-million barrels for a total of 137-million barrels, or 40 percent of the oil in place.

The additional 6-million barrels that we

would recover from the infill drilling program will increase this to 143-million barrels or 41.7 percent of the oil in place.

Q Mr. Lancaster, were Shell Western's Exhibits Eight through Sixteen prepared by you or under your supervision?

A Yes, they were.

MR. PREDETTE: Mr. Examiner, we tender at this time Exhibits Eight through Sixteen.

MR. STAMETS: These exhibits will be admitted.

MR. PREDETTE: I have no further questions for Mr. Lancaster.

CROSS EXAMINATION

BY MR. STAMETS:

Q Mr. Lancaster, how many infill wells have been drilled to this point?

A Five. Well, we drilled 20 injectors. They were, the 20 wells we drilled during 1980 and '81 were all injectors. We tested three of them for a short period of time and then converted them when we --

Q So that would leave two other producing wells that were drilled as infill wells, is that correct?

A No, no. Okay, we drilled -- we drilled 20 wells in 1980 and '81. We came back in '83 and '84 and drilled 5 more.

Now, the 5 that we drilled, if we could go back and refer to --

Q I'm a little confused so let me --

A Okay.

Q -- see if I can ask this question correctly.

You've drilled a number of infill wells. Have those all been injection wells?

A No. The five wells we drilled this last year are all producers.

Q They're all producers, okay, and what has been your experience with those five infill wells? You talked about some of the injectors that you kept on production for a period of time. What about those?

A The five wells that we drilled in late '83, early '84, we have been in the process of zone testing. We've actually been coming up and testing 30, 40 foot intervals.

Q So at this point you don't have the evidence as to what those -- whether those produce more than you would expect a typical older well to produce or not.

A No. They are probably producing about -- well, we would expect when we put them on to produce about the same as the other older wells, maybe with a lower water cut, but oil-wise we haven't really put them on. What we've done is test individual zones and individual zones would say that we're going to make more than 100 barrels per day per

well.

The average well in the field makes 80. There's not as sharp a differential with these as perhaps would seem to be.

Q Is there any reason why these, what was it, two injectors that you tested for some period of time were somewhat better than the average infill well?

A Yes. Again, if you refer to this Eleven, when -- when we drilled our -- the wells we're talking about here were injectors that were drilled in the middle of these areas and you have probably -- if you drew 20-acre circles around these corner wells, you have approximately, well, maybe 90 acres out here, so you have a much larger drainage area for what we observed in the first sequence of wells.

Now we're coming back and we're infill drilling in between here and the undisturbed area is smaller.

Q Fine. Thank you, I understand.

MR. STAMETS: Are there any other questions of Mr. Lancaster? He may be excused.

MR. FREDETTE: I would like to recall Mr. Van Akkeren at this time.

T. J. VAN AKKEREN,

being recalled and being previously sworn upon his oath, testified as follows, to-wit:

DIRECT EXAMINATION

BY MR. FREDETTE:

Q Mr. Van Akkeren, Shell Western proposes to directionally drill three of the 38 infill wells, Wells Nos. 28-242, 33-312, and 30-312.

Please describe the necessity for directionally drilling the wells and in this regard I direct your attention to what has been marked for identification as Shell Western's Exhibit Number Seventeen.

A Okay. Exhibit Number Seventeen is a recent aerial photograph of the Hobbs area, or the Hobbs townsite, with the base map of the North Hobbs Grayburg-San Andres Unit superimposed on it.

It also includes the proposed infill wells that are the subject of this hearing.

Because of surface obstructions that could not be avoided without seriously compromising our proposed pattern, three of the wells, which are identified by the red arrows, will have to be directionally drilled. Two of these are located within the Hobbs Townsite.

The upper arrow is Well No. 28-242. The desired bottom hole location is in a developed subdivision but there -- the desired bottom hole location is 1100 feet from the south line and 2400 feet from the west line of Section 28, which I said before is within that developed subdivision.

An acceptable surface location is avail-

able to the west at a location 1163 feet from the south line and 2014 feet from the west line of Section 28, and this approximately 391 feet away from the desired bottom hole location.

The desired botton hole location for 33-312, the arrow, the lower arrow on the right side, is 1330 feet from the east line and 10 feet from the north line of Section 33. This location is on Sanger Street in the City of Hobbs but there is an acceptable surface location in the Gulf Pipeyard at a location 1830 feet from the east line and 110 feet from the north line of Section 33. This is 510 feet away from the desired location.

The third location, Well No. 30-312, is indicated by the arrow in the middle of the unit area. This is outside the city limits but there is a road, some houses and powerlines located near the desired location, but there is a surface drilling -- acceptable surface drilling site available at 500 feet from the north line and 1448 feet from the east line of Section 30. That would result in a 504 foot kick to the bottom hole location at 10 feet the north line and 1330 feet from the east line of Section 30.

MR. FREDETTE: Mr. Examiner, our next three exhibits, Eighteen, Nineteen, and Twenty, are drilling prognosis and proposed survey for each fo the wells to be directionally drilled.

Now each of these wells will be drilled in essentially the same manner. For the sake of

saving time, I believe it is easier if we describe in some detail one of the wells and simply refer to any pertinent differences in the following two exhibits.

MR. STAMETS: That sounds just fine.

Q Mr. Van Akkeren, I direct your attention first to what has been marked for identification as Shell Western's Exhibit Eighteen and ask you to identify it.

A The Exhibit Number Eighteen is a drilling prognosis and a directional survey for the proposed Well 30-312.

The drilling prognosis shows the surface and proposed bottom hole locations, the estimated elevations, the formation tops, and the proposed drilling and casing program.

The well will be drilled to approximately 1520 feet, 20 feet into the Rustler anhydrite, and cased with 8-5/8ths inch 24-pound casing, which will be cemented to surface.

A 7-7/8ths inch bit will be used to drill below the 8-5/8ths inch casing.

As indicated on the directional survey, the kickoff point for directional drilling will be at 1700 feet. The hole angle will be built at a rate of 1-1/2 degrees per 100 feet until a maximum deviation of 12.46 degrees is reached, approximately 2551 feet.

At that point a straight hole assembly

will be run and to intersect a bottom hole target of a 75-foot radius circle centered on the desired bottom hole location at a true vertical depth of 4350 feet, which is the proposed TD of this well.

After reaching TD we plan to run 5-1/2 inch 14-pound casing which will be cemented to surface and the cement job will be confirmed with a cement bond log.

Q I direct your attention to what has been marked for identification as Shell Western's Exhibit Number Nineteen and ask you to identify and briefly describe that exhibit.

A Exhibit Number Nineteen is a drilling prognosis and directional survey for Well No. 28-242, again showing the surface and bottom hole locations, elevation, formation depths, drilling program.

The basic change is that the maximum hole angle will only be 9.28 degrees, which will be reached at approximately 2332 feet, and again we will drill to a bottom hole target of a 75-foot radius circle at 4350 feet true vertical depth.

Q And finally I refer you to what has been marked for identification as Shell Western's Exhibit Number Twenty and ask you to identify the exhibit and briefly describe what it shows.

A Exhibit Number Twenty is a drilling prognosis and directional survey for North Hobbs Unit Well No. 33-312 with similar information as shown on previous two ex-

hibits.

The main difference in this well is that the maximum hole angle will be 12.57 degrees, which will be reached at approximately 2563 feet measured depth and then the hole will be drilled with a straight hole assembly to a bottom hole target of a 75-foot radius around the proposed bottom hole depth, or bottom hole target.

Q Mr. Van Akkeren, were Shell Western's Exhibits Seventeen through Twenty prepared by you or under your supervision?

A Yes.

MR. FREDETTE: Mr. Examiner, we tender Exhibits Seventeen through Twenty.

MR. STAMETS: The exhibits will be admitted.

Are there any questions of the witness? He may be excused.

Does anyone have anything further they wish to add in any of these cases?

The cases will be taken under advisement and the hearing will be adjourned.

(Hearing concluded.)

C E R T I F I C A T E

I, SALLY W. BOYD, C.S.R., DO HEREBY CERTIFY that the foregoing Transcript of Hearing before the Oil Conservation Division was reported by me; that the said transcript is a full, true, and correct record of the hearing, prepared by me to the best of my ability.

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 _____ 19____.

_____, Examiner
Oil Conservation Division