BEFORE THE CONSERVATION COMMISSION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF STANOLIND OIL AND GAS COMPANY FOR A REVISION, MODIFICATION AND AMENDMENT TO EXISTING PRORATION ORDERS APPLICABLE TO THE HOBBS FIELD.	))))	RE: ORDER NO. 48 HOBBS POOL, LEA COUNTY, NEW MEXICO

STATEMENT OF STANOLIND OIL AND GAS COMPANY IN SUPPORT OF ITS POSITION WITH RESPECT TO REVISING, MODIFYING AND AMENDING THE EXISTING PRORATION PLAN OF THE HOBBS FIELD

Section 12 of the existing Conservation Law of the State of New Mexico, approved February 23, 1935, provides, in part, as follows:

> "Section 12. Whenever, to prevent waste, the total allowable production for any field or pool in the state is fixed by the Commission in an amount less than that which the field or pool could produce if no restriction were imposed, the Commission shall prorate or distribute the allowable production among the producers in the field or pool. Such proration or distribution shall be made on a reasonable basis. The rules, regulations or orders of the Commission shall, so far as it is practicable to do so, afford to the owner of each property in a pool the opportunity to produce his just and equitable share of the oil and gas in the pool, being an amount, so far as can be practicably determined, and so far as such can be practicably obtained without waste, substantially in the proportion that the quantity of the recoverable oil and gas under such property bears to the total recoverable oil and gas in the pool, and for this purpose to use his just and equitable share of the reservoir energy."

STANOLIND'S POSITION

(a) That the proration formula now in effect in the Hobbs Field, allocating 60 per cent of the production to acreage and 40 per cent to average unit potential, modified by shut-in bottom hole pressure adjustments, has failed to operate, and does not now operate in such manner as to afford Stanolind Oil and Gas Company an opportunity to produce its just and equitable share of the oil from said pool, which it can produce without waste, and which would be in proportion that the quantity of recoverable oil under its properties bears to the total recoverable oil in the pool, such being the opportunity to which

Stanolind is entitled under Section 12 of the Conservation Law of 1935 just cited.

(b) But, on the contrary, said proration formula denies to Stanolind an opportunity to produce its just and equitable share of the oil in said pool, which can be produced without waste in the proportion that the quantity of recoverable oil under Stanolind's properties bears to the total recoverable oil in the pool, and denies to Stanolind Oil and Gas Company the right to use its just and equitable share of the reservoir energy.

(c) That the conditions now existing in the Hobbs pool, with respect to the physical characteristics of the said reservoir are such that, if the proration plan for the Hobbs Pool is changed and modified, so that each 40 acre unit within said pool is permitted to produce the allowable oil which each unit can produce without waste, in the ratio or proportion that the acreage in each unit bears to the acreage of the entire pool, such modification will result, at least prospectively, in all producers being afforded an opportunity to produce their just and equitable share of the oil and gas in the pool, being an amount so far as can be practicably determined, and so far as can be practicably obtained without waste, substantially in the proportion that the quantity of recoverable oil under each owner's property bears to the total recoverable oil in the pool, and will afford each owner an opportunity to use his just and equitable share of the reservoir energy.

EVIDENCE

Formational Characteristics of Reservoir

The undisputed evidence by all interested parties was to the effect that the Hobbs Pool, located in the northeastern part of Lea County, New Mexico, covering some 9000 acres, is producing from a series of porous zones in the Permian White Lime, of which at least three have been definitely recognized. The testimony further indicates it to be an accepted fact that these

pay zones have varying degrees of permeability and porosity ranging from very tight pay sections to highly cavernous conditions. The first, or upper pay section is found at an approximate depth of 4050 feet. The second pay section is found at an approximate depth of 4100 feet, and the third recognized producing horizon is found at an approximate depth of 4150 feet. The upper, or first pay is recognized as the most extensive and prolific of the three pays. The second pay was originally considered a part of the first or upper pay, but from additional development it is now considered definitely to be a separate producing horizon and, although not as extensive or as prolific as the upper horizon, it has much the same producing characteristics. The third pay, or what is known as the Capps Lime, is generally less cavernous than the upper pay, and, although originally considered to contain less reserves, after acidizing has been found, as a result of recent study, to be much more prolific than at first thought, and to indicate a per acre recovery on a par with the first and second horizons.

Nature of Water Drive

There is clear evidence of water encroachment completely encircling the field, with the exception of a small part in the northeast flank. Difference in permeability varies greatly within each zone, as well as between zones (Card 14, 15 and 16). The upper, or first zone, had very high permeability across the southwest flank, which was evident when water entered the southwest area on a wide front, displacing oil ahead of it from the leases on which it was originally in place, to be produced by leases farther up structure. This oil was taken away from these southwest leases, many of which were owned by Stanolind, for three reasons (Exhibits B, C and D): First, large quantities of free gas and oil were withdrawn from the apex of the structure, leaving room for replacement from the outer edges; second, there was abundance of water energy available at the outer edges; third, the most permeable areas of the entire field in the first zone

lie along the southwest flank, allowing ready access for the water to drive oil from the upper zone of the southwest flank leases. Other evidence of water encroachment to some extent is shown on exhibits in the northwest end of the field, and to a lesser extent in the southeast portion. Leases suffering the greatest damage from the water movement across the southwest flank were those belonging to Stanolind, in Sections 4 and 5, in Township 19 South, Range 38 East.

Stanolind's Oil Losses on Southwest Flank Leases Resulted in Gains to Leases Up Structure, but Benefited Field Recovery as a Whole

Stanolind's wells in this southwest area had more than average potentials, as is evidenced by the early schedules which have been made a part of this record. Had not space voidance by heavy withdrawals of oil and gas up structure taken place, there would have been no broad water movement across Stanolind's southwest flank leases. When water began to make its appearance in this upper zone in Stanolind's leases, Stanolind had a choice of two things: It could disregard the rights of others to their proportionate share of the reservoir energy, and produce the water in large quantities, such as is being done by the Gulf and others in the northwest portion of the field at this time (Card, Pages 18 and 19, where Gulf was shown to be producing 82% water; Cities Service and others were shown to be producing 73%, 93%, 95%, and other large quantities of water along with the oil). Stanolind's producing costs, according to the testimony, might have been higher had water packers not been set, but by producing large quantities of water, not only would it have prevented this water from displacing oil from its properties, but it would have created opposite drainage by bringing oil from up-structure back down upon Stanolind properties. Card further testified that had Stanolind followed this procedure "many of these wells up here (up structure) would be pumping today, if packers had not been set in our wells, but they would not have as much oil as they have with the packers."

In the second place, Stanolind could practice true conservation, by setting packers, shutting off the upper pay from the lower pays, which would result in Stanolind abandoning forever all the oil to which it was entitled to recover, under the law, from the upper zone. In the first case, Stanolind could have operated at slightly higher lifting costs, and recovered hundreds and thousands of barrels of oil which it lost to up structure leases, and in so doing utilized more than its share of the reservoir energy, such as is now being done in the northwest portion of the field. Or, in the second case, which it followed, it could practice true conservation by setting water packers, thereby avoiding the production of huge quantities of water, and the consequent huge waste of reservoir energy, and obtained temporarily a slightly lower lifting cost.

Stanolind Oil Losses from Southwest Leases Were Not Denied But Actually Admitted

Mr. Card shows that after Stanolind set more water packers than any other company in the field, the loss of its oil by displacement in the upper zone by water was in excess of 1,550,000 barrels, which oil was produced from properties higher up structure. 518,000 barrels of this amount Mr. Card showed (Page 21) had been pushed off Stanolind's properties by the broad water movement since the effective date of the present Conservation Law, June 1, 1935. No witnesses disputed the fact that Stanolind lost this oil off its leases in the southwest flank. There was no attempt to refute or deny the testimony of Mr. Card regarding the loss of this oil in any manner. Lloyd Gray, witness for the Gulf, testified (Page 83) "The water encroached most rapidly progressively up structure in the areas adjacent to Stanolind's State No. 11, in the southwest of Section 5, and apparently followed the lines of least resistance, which was areas having high permeability and porosity."

Mr. Card (Page 21) testified that his estimate of Stanolind's losses of more than a million and a half barrels, was not based on acreage, but on Stanolind's proportion of acre-feet swept by water, as compared to the total acre-feet in the reservoir.

Other methods of calculation would have shown the loss to be greater.

Mr. Card's testimony as to drainage away from Stanolind, on its southwest flank properties, can be summarized by the statement that Stanolind lost more than one and a half millions of barrels of oil to other operators of the pool, which fact was not only uncontradicted, but was supported by Gulf testimony.

Stanolind Led All Operators in Setting Water Packers and Suffered Most Thereby, All For the Benefit of the Field as a Whole

Thus, it was shown that purely as a conservation measure, at the expense of Stanolind's own production, and for the benefit of the reservoir as a whole, and at the recommendation and insistence of the Hobbs Engineering Committee, Stanolind set 13 water packers on its properties. A total of 34 water packers have been set in the field (page 17). It will be noted that approximately 38% of all the water packers were set on Stanolind's properties, although Stanolind is the owner of but 22% of the acreage of the field. When Stanolind set these water packers, shutting off the oil from its first and second zones, its future recovery was limited to the third and lowest zone, known to be very low in permeability, and requiring much acidation to facilitate production therefrom.

Saturated Pay Now of Uniform Thickness Making Acreage Factor Alone Applicable

Card testified that due to the cavernous condition of the lime, porosity over the whole area of a unit was not determinable. That "Potential is a measure of the permeability, the pay thickness, and the bottom hole pressure of a particular well." That "permeability has no bearing at all on the oil in place. It is merely the measure of the ease with which a fluid flows out from the reservoir." That the original pay thickness could be roughly determined, but that "due to the development of a gas cap throughout the top of the structure, it has leveled off so that at present the oil saturated section is more or less uniform." In answer to the question "The gas cap and the water drive have

more or less made the remaining oil and gas in place uniform throughout the field -- sort of pancaked it and flattened it out?" he answered: "That's true"; and to the question "For that reason would an acreage basis probably more fairly represent the recoverable oil than it would perhaps in the beginning of production?" he answered: "At the present time, yes". And to the question "As to what is left there?" he also answered "Yes".

Potential Is Not a Measurement of Oil in Place in Lime Fields

He further testified, in support of his statement that potential cannot be used in calculating oil in place, that fields producing under wide open flow conditions proved his point. He cited the Hendrick Field "immediately south of the state line in Texas, on the same trend of the lime fields in New Mexico". He explained, using Exhibit A (page 13), that the Hendrick Field has produced under wide open flow conditions up to the present time, when it is practically depleted; that producing wide open, each well drained the oil from underneath its property within its local drainage area. When the oil underneath the property was produced, the high potential wells went to water, usually before the lower potential wells. He showed that of two wells of the same initial potential of 2200 barrels per day, one had recovered 10,000 to 11,000 barrels per acre, and the other 25,000 to 26,000 barrels per acre. He showed that there were four or five other leases having an average initial potential of twice 2200 barrels per day, with an average recovery of less than 5000 barrels per acre. His testimony further showed that if the Hendrick Field had been prorated, as has Hobbs been prorated, the high potential wells would not have gone to water, because the restriction to a low daily allowable would have prevented water coning. However, he testified when, under proration, as in the Hobbs Field, the high potential wells did not go to water, but drew oil from surrounding properties when their allowable, under a potential proration system permitted them to produce greater quantities than the neighboring wells. He testified that this potential was not due to the oil in place underneath the properties, but

to an open and permeable condition around the bore hole of the well, which allowed more oil to come to the well at no difference in pressure. Thus, he said, "The wells with high potential producing large volumes of oil, will drain oil from neighboring wells. Wells on the upper parts of the structure produce oil and have that oil replaced from edge wells, which are subjected to a water drive such as on the southwest flank of the structure". In this case he referred to the southwest flank of the Hobbs Field, where Stanolind's leases suffered more than a million and a half barrels of drainage under the present proration plan. Pointing to that particular area on the Hobbs map, he testified "Water encroached across the section (southwest -- upper pay) of the field at a very rapid rate, displacing oil from the upper pay, pushing the oil on up structure and replacing the oil produced from the up structure wells".

Acidation Results Ar Proof that Potential Is Not a Measure of Oil in Place

R. S. Dewe, Petroleum Engineer for the Humble Oil and Refining Company, tetified that 260 of the wells of the field were acidized, changng the permeability around the bore hole and increasing the potenials, and consequently the allowable withdrawal from the commn reservoir of each well treated. 70 wells, he said, were not trated because either they were packer wells, or because acid treament might result in dissipating the reservoir energy through by acdation the gas-oil ratio or the water production. These 70 wlls, he said, did not obtain an increase in potential through acdation, and therefore lost their right to more allowable from he common source of supply, and consequently have lost materiallyin their share of oil produced. He also showed that, due to he use of excessive amounts of acid in the treatment of wells, bnormally large allowables were obtained. Potential on 11 well in particular was increased approximately 400%, which, of coure, was directly reflected in giving these wells more oil from he common source of supply by the application of a large potentialfactor in the proration formula. Some wells, after having 12,000 allons of acid dumped into them, showed an

increase in potential of 6-1/2 times, and an enormous increase in allowable from the common source of supply of reservoir oil. It was Dewey's opinion that various operators had used excessive amounts of acid to take advantage of the potential proration plan, and that the potentials as a whole should be revised to a reasonable basis, so that the inequities caused, not by an increase in recoverable oil in place, but an increase in the amount of acid used to treat a well, would not continue in the future. Dewey testified: "Under the current statute governing New Mexico oil in place, my conception of potential is merely a very poor co-factor which might be applied with other factors to estimate roughly the oil in place". He testified that it was his belief that potentials obtained by acid treating did not represent natural permeabilities, and that such potentials should be adjusted. Dewey further testified (page 7) "potential indicates the permeability immediately around the bore hole and does not indicate necessarily oil in place". He condemned the use of the method used in Plan 2-A of corrected potentials.

In answer to the question, "Isn't it a fact that if any changes in bottom hole pressure come into existence in a pool, the result is a migration of oil which takes place from the high pressure area to the low pressure?", he said: "I have been unable to apply bottom hole pressure adjustments to potentials in the Hobbs Pool -- I should say in my own mind" (Pages 13 and 14).

Stanolind's Leases in the Southeast End of Field Did Not Benefit By Drainage from Leases of Other Operators

The shut-in bottom hole pressures as reflected by the Hobbs Engineering Committee Report were used in the various exhibits introduced by Witness Knappen. These covered the entire field as taken on December, 1931; October, 1933; August, 1936; September, 1939 (Gulf Exhibits Nos. 6, 7, 8 and 9). Attention is called to the fact, however, that these exhibits do not reflect the formation in which such pressures were taken, nor do they reflect, as a matter of fact, that such pressures were taken in different formations, at different periods, and in many cases comparative pressures for offset wells may have been for entirely

different formations. On cross examination Witness Knappen testified for the benefit of the Commission regarding the pressures in certain wells along the township line between Townships 18 and 19, as reflected by the 1935 survey of the Hobbs Engineering Committee. The testimony showed that Stanolind's properties are located generally south of the township line between Townships 18 and 19, while the properties of the Gulf Oil Corporation, Ohio Oil Company, Continental Oil Company, and others, lie immediately north of the line. Witness Knappen's testimony showed conclusively that, as a matter of fact, during the period represented by this pressure survey, the pressures in the wells to the south of said township line located upon Stanolind's properties were as high, and in many cases higher than in the wells to the north, on the properties of the Gulf, Ohio, Continental, Repollo, and others. For example, the Continental State No. 3-B well, in Section 33, Township 18, showed a pressure of 1210; while the Stanolind State No. 26, located in the northeast of Section 4, Township 19, lying to the south of the Continental well, showed a pressure of 1220 pounds; and Stanolind's Byers No. 8, in the northeast quarter of Section 4, Township 19, had the same pressure as the Continental well located to the north. When Witness Knappen was asked how, under his theory, the oil could drain from the low pressure wells to the high pressure wells of Stanolind's properties, he was forced to the absurd conclusion that it drained around the edge of the structure, or through those parts of the 40-acre units in which no wells were located (pages 175 to 179). Knappen's theory of oil draining around the edge of the structure, draining completely around high pressure wells, to get to a low pressure area on the other side of a high pressure, is just as logical as would be the statement that a lake on the western side of the Sierras, in California, for instance, would drain down the west coast ~~of~~ to the Isthmus of Panama, across the Panama Isthmus, back up the east side of the Sierras into the Great Salt Lake, if the lake on the west side of the Sierras be higher than the Great Salt Lake in Utah.

When Witness Knappen was asked why he had not prepared an exhibit of the pressures as shown in 1935, his answer was as follows: "We were afraid more would tire the Commission". Although Witness Knappen did not use the pressures as shown by the survey in 1935, such were made a part of the record, and the Commission will find, upon inspection of the pressures shown in the area in which Gulf claims drainage occurred to Stanolind, that drainage of oil away from Stanolind leases in the opposite direction will be shown on the basis of Witness Knappen's theory.

The purported drainage to Stanolind leases in the southeast part of the field is not apparent if all of the available data is considered. Pressure surveys of November 16 and December 11, 1931, show irregular pressures across the boundary line of Stanolind's leases along the south line of Twp. 18 S., and the section line between 33 and 34, Twp. 18 S., R. 38 E. Full data for Gulf's Exhibits 6 and 7 will be found opposite page 104 of the first "Hobbs Pool General Report", made part of the record. Comparing Stanolind's with offset leases shows Stanolind having an average pressure higher than that of offset leases. If drainage does exist in this area of low permeability, it would be off of, rather than on to Stanolind leases. The comparison follows:

Offset Leases			Stanolind Leases		
Gulf - W.Grimes No.5	Pressure	1470	McKinley No.6	Press.	1453
Continental State No. 33,Avg.of No.2-No.3	Pressure	1422	State A-4 No.8	Press.	1445
Gulf - E.Grimes No.1	Pressure	1460	Turner 29-M	Press.	1458
Average Pressure		1449			1456

Gulf Exhibit No. 7, showing the results of pressure survey No. 9, of October 17, 1933, does not show sufficient information to make the same comparison of pressures along the boundary line mentioned in the foregoing paragraph. If, however, only the packed off upper zone be considered, definite cross sections can be used. The first one is south to north, through the center of Section 32-18-38 and 5-19-38, as follows:

Gulf - West Grimes	No. 6	Press. 1383	This shows a continually lower pressure due to migration from south to north.
	No. 3	Press. 1360	
	No. 2	Press. 1355	
	No. 7	Press. 1340	

(The data on packers will be found on pages 290, 291 of the above report). Another south to north cross section through the center of Sections 33-18-38 and 4-19-38 shows a similar relationship as follows:

Stanolind - State-4 No. 3-K Pressure 1365
No.26-E Pressure 1360
No.11-C Pressure 1355

Continental-State-33 No. 6 Pressure 1345

Here again a continuous decrease in pressure from south to north, and away from Stanolind leases is indicated. Taken as a whole, the complete data for Gulf Exhibits 6 and 7, the only possible conclusion is that oil is moving away from Stanolind leases and not to them.

If Gulf Drainage Theory Hold True Stanolind Leases Would Drain to Stanolind Leases

Exhibit 12 of Gulf Oil Corporation is a contour map of the Hobbs Field showing a line drawn from the northeast to the southwest, through Stanolind's Capps No. 26 Well, in the SW¼ of Section 3, Township 19; Stanolind's State No. 8, in the NW¼ of Section 10, Township 19; and Stanolind's State No. 26, in the NE¼ of Section 9, Township 19, The exhibit also shows a series of wells in which pressures were taken at different times since the beginning of development, and on the basis of these pressures, theoretical calculations have been made to estimate the amount of oil which the witnesses alleged drained across this imaginary line as a result of the difference in pressure. In connection with this exhibit, it will be noted that Stanolind is the large owner of the properties lying on both sides of this line, and even though the witness's conclusion is conceded to be correct, the drainage shown to Stanolind's properties, therefore, comes in the main from other Stanolind properties. It will also be noted from an examination of this exhibit, and other maps introduced into evidence, that the imaginary line referred to by the witness is in excess of a mile south of the north line of Stanolind's properties.

Gulf Theory Based Upon Assumption Not Applicable to Hobbs

The testimony of the witness regarding the foregoing alleged drainage, on cross examination, developed the fact that the calculations referred to have been adjusted on the basis of laboratory tests. In adapting a formula which was developed for the flow of liquids only, it is necessary to estimate, or guess what the corrective factor in such formula would be if applied to the conditions in the southeast end of the Hobbs Field, where gas freely intermingled with the oil in the reservoir. The guess made as to the corrective factor to be used was 33%, which, it was assumed, would cover the element of error introduced into the calculations by using a formula developed for liquid flow, for a flow of a mixture of oil and gas bubbles. Attention is called also to the fact that the radial formula used to calculate the permeability across the whole zone in which drainage to Stanolind leases is alleged to have taken place would be applicable as used only in the case of absolutely uniform permeability throughout the entire area; a condition which all witnesses testified, or admitted did not exist. This is true because the use of a radial formula to determine the permeability ~~of~~ to flow across a given plane must assume a uniformity of cavernous conditions in all directions from a well, which, according to all testimony, is not true.

Knappen Testimony Introducing Published Statements of Stanolind Engineers Misleading?

On direct examination, Witness Knappen, for the Gulf Oil Corporation, maintained the position that originally the top part of the structure contained the thickest producing sections and the greatest amount of oil in place. In support of this testimony the witness read from page 77 of an article by Ronald K. DeFord and Edwin A. Wahlstrom, published in January, 1932, bulletin of the American Association of Petroleum Geologists. The paragraph read on direct examination is as follows:

> "The top productive member of the 'White Lime' is cavernous on the crest of the structure, fairly porous on the flanks, and off structure is in places only very slightly porous, in other places somewhat porous." (Transcript page 102).

On cross examination (Transcript page 198) the witness was asked

to read the last sentence of this paragraph, which reads as follows:

> "On the flanks the lower porous member, particularly the Capps pay (all relatively unimportant on the crest), generally yield much more oil than the top member."

When asked why the witness had not read the last sentence of the paragraph in his direct testimony, his answer was:

> "I had no thought of misleading the Commission; if I did, I am sorry." (Transcript pages 198 and 199).

Witness Knappen Testifies Permeability Is Not a Measure of Oil in Place

Further discussing the cross examination of Witness Knappen, attention is called to Transcript pages 189, 190 and 191, where it will be found that the testimony developed the fact that, prior to acidizing the wells located in the southeast flank of the field, they had a much lower potential than the wells on the crest of the structure, but that after acidizing, the wells were increased in potential comparable with the wells higher up on the structure. The testimony showed that the wells in the southeast flank were located in very tight or slightly permeable sections. However, the percentage of increase after acidizing was much greater than the percentage of increase experienced by the wells higher upon the structure located in the more cavernous or high permeable sections. The witness admitted that this showed that the low permeable sections contained the oil which was secured by acidation and that it was a mere question of getting it out of the producing section. The witness also admitted that when acid was used it increased the permeability and also admitted that potential is a measure of permeability; and when asked "When you prorate the field on potentials, you are prorating it on permeability?", the answer was "Surely." and again when asked "And permeability is no measure of the oil in place?". the answer was "No". (Transcript page 190).

Court Room Demonstration that Potential Is no Measure of Oil in Place, and that Tight or Low Permeability Areas Require More Reservoir Energy per Barrel to Produce

R. W. Tesch, Petroleum Engineer for Stanolind Oil and Gas Company, showed by visual experiment that permeability has no

relationship to recoverable oil in place. In so doing he took two tubes of equal size, one of which was filled with a coarse sand, the other with a fine sand. He made a visual demonstration that it took approximately the same amount of water to fill each tube, but that the tube of low permeability took about 2-1/2 times as long under the same pressure to produce its water. In other words, the tube containing the tight fine sand, or the one of low permeability, required about 2-1/2 times the energy to recover the same amount of liquid in the same length of time, as the tube having a high permeability. By the use of Dr. Muskat's formula, which the Gulf witnesses, including Dr. Muskat himself, maintained was applicable to Hobbs Field, Tesch demonstrated that the energy necessary to bring oil to the hole varied with the permeability, the energy requirements being in inverse ratio to the permeability of the formation. In other words, a well in a formation of low permeability might contain the same amount of recoverable oil as a well drilled into a formation of high permeability. If the permeability relationship was in the ratio of 10 to 1, that well whose permeability was 10 times greater, would require but 1/10th of the energy in order to produce its oil from the formation (pages 63 to 70). In filling the tubes, Witness Tesch demonstrated that the difference in permeability caused nothing more than a difference in potential, and that potential is no measurement of oil in place (page 67). Tesch said:

> "Getting back to the experiment again, everything is constant here except permeability. Both tubes hold the same amount of water, yet one you get twice as fast as the other.
>
> Q What does that mean in respect to potentials?
>
> A Well, it simply means this to me: The potential is no measure of oil in place.
>
> Q In other words, this more permeable tube produces its oil in place more than twice as rapidly as the other?
>
> A Yes, sir.
>
> Q So that rate of flow represents potential?
>
> A That is right.
>
> Q This well, by having higher potential, would have gotten rid of its oil in less than half the time the other one would have?

A That is correct.

Q If it continued to produce oil, this well would have to get its oil from some other place?

A That is the only way it could.

Q It takes more pressure to get oil out of the less permeable well?

A It takes more pressure to get it out at the same rate.

Q If you produce the oil in the same elapsed time, it would take --

A Twice as much differential in pressure.

Q For this well to produce its oil in the same time, it would require a pressure drop of twice what this well of low permeability requires?

A Approximately.

Q Do you have anything further from Mr. Muscat's book?

A No, I think that is enough.

Q You can see this has gone down almost twice as fast (referring to the experiment).

A This tube of low permeability is still laboring along -- it takes a while longer.

BY GOVERNOR MILES: This diagram (formula Exhibit F) you speak of, has that been considered at all in the production on this field?

A No. In other words, it has always been taken in the past that potential is the measure of oil in place, which, to my way of thinking, under the conditions you have in the Hobbs Pool, is entirely wrong. If you will notice, this formula (Exhibit F) is taken from this book (Hands the Governor the book the witness has been using).

This tube has already recovered twice the amount of oil in place. This tube has only recovered slightly less than 80%. I would like to add this for the record: In a field like Hobbs, where you have such variances in permeability, that what I have shown here is more true than ever -- even more reason why you should not use potential as a measure of oil in place."

Not Only Have Companies Who Set Water Packers Been Penalized by Surrendering All Claims to the Horizon Packed Off, but They Have Also Been Further Penalized by the Method of Applying Proration to Packer Wells

Dewey testified "These packer units have lost about 36% of their potentials" (page 2-2).

Card testified (page 17) when asked:

"Why weren't more packers set in the north end of the field?

A It would appear that due to the proration formula that has been in effect, that is, the correction of potentials by bottom hole pressure, and the assigning of the field

average pressure to packer wells, these wells would be assigned lower pressures after packers were set than they had before, or would have if packers were not set, and therefore their potentials and allowables would be reduced."

And again (page 23) he was asked:

Q By assigning the field average pressure to packer wells instead of declining their potentials by the field average decline in potential in other wells, have Stanolind wells been penalized?

A Yes.

Q How much greater would the present potential now be if they had been declined according to the field average decline instead of by assigning the field average pressure?

A The potential of Stanolind packer wells would now be 57,260 barrels greater than it is at the present time.

Q In other words, Stanolind has suffered a considerable loss in allowable by setting packers due to adjustment of potential on packer wells, and has also given up large quantities of oil to up structure leases?

A Yes, sir.

Q Which company at Hobbs has benefited the most due to bottom hole pressure adjustment?

A The Gulf.

Q How much has their allowable been increased by bottom hole pressure over and above what their allowable would have been if the potential had not been adjusted?

A Up to September 1, 1939, about 198,000 barrels, and at the present time it would no doubt be in excess of 200,000 barrels.

Q That is the increase in potentials of the Gulf wells?

A That is the increase in allowable.

Q In allowable.

A Yes.

Q Has that been in real oil produced during the period?

A Yes.

Q They have been given that many barrels by reason of this bottom hole pressure formula?

A Yes, bottom hole pressure formula.

Card further testified (page 21), that when Stanolind set their packers, the packer wells were in high pressure areas, and if the packers had not been set in these high pressure areas, "the potentials and therefore our allowables would have been increased on each pressure adjustment period". Card also testified

(page 18), that the Gulf wells in the north end of the field, producing large quantities of water, some as much as 82%, are high pressure wells in which packers have not been set.

Card was asked as to the manner of making a bottom hole pressure correction in the proration formula, the answer was:

> "The bottom hole pressure correction formula is the new well potential equals the old well potential times a fraction whose numerator is the new well pressure minus two thirds the present field average pressure, and the denominator is the previous field average pressure minus two thirds of the present field average pressure".

He explained that pressure adjustments were made every six months; that under this method, the potential of a well would be increased even though its pressure might be declined. He said:

> "Yes, the way this bottom hole pressure formula works, as long as the well's pressure during any particular survey is above the field average pressure, no matter if the pressure on that well increased or decreased from the previous survey, the potential on the well will be increased; and, on the other hand, if a well's pressure is below the field average, whether or not its pressure is increased or decreased, its potential will be declined. For example, if a well had a pressure of 925 pounds and increased from one survey to the next to 950 pounds, its potential would be declined, because its pressure is below the field average, which is now about 1180 pounds."

He stated that wells whose bottom hole pressures remain above the average of the field will continue to get an increase in potential, and therefore an increase in allowable every six months. He explained, by the operation of such a formula, wells capable of making "greatly in excess of their allowable" have been reduced to zero potential, and such wells are prohibited from participating in any manner in that part of the field's allowable given to potential of wells.

Card testified further that five wells of the field, due to the bottom hole pressure correction to potentials, had potentials allocated to them in excess of 26,000 barrels, which was the highest potential ever recorded any well in the field under actual potential test. Card believed that such a method was "certainly" inequitable. "The erroneous potentials which it has created is alone sufficient to condemn it".

ARGUMENT AND CONCLUSION

The analysis of the foregoing testimony conclusively shows:

That the formational characteristics of the Hobbs reservoir are so irregular, insofar as porosity and permeability are concerned, so composed of various pays separated by impermeable strata, that even though some consideration of bottom hole pressures and potentials may be desirable in other fields of uniform production sections, and of uniformity of permeability and porosity, it could not be applied in Hobbs without creating gross inequities.

That the nature of the water drive is such that Stanolind has lost more than a million and a half barrels of oil because the upper pays on Stanolind's southwest flank leases were of high potentials and high permeabilities, giving easier access to the water drive than any other portion of the field.

That the oil losses incurred by Stanolind in its southwest flank leases were converted into gains by more fortunately situated leases farther up structure; and that, because Stanolind practiced conservation, by avoiding producing large quantities of water such as is now done by the Gulf and others in the northern portion of the pool, the water energy was made available to be utilized in more efficiently recovering the oil from the reservoir as a whole. This has proved that not only did other than Stanolind leases gain more than a million and a half barrels in recovery, but the efficiency of recovery from the reservoir as a whole was increased through pressure maintenance brought about by the practice by Stanolind of conservation methods.

That the losses which Stanolind proved that it had incurred, and which Stanolind estimated, on a most conservative basis, to be a million and a half barrels, was not only not denied but corroborated by Gulf witnesses.

That Stanolind led all operators in setting water packers for the benefit of the pool as a whole, and in so doing suffered the greatest loss of oil thereby. The evidence conclusively showed that Stanolind did not set these packers to decrease its lifting costs. The evidence showed that had Stanolind not set these packers,

it could have produced large quantities of oil along with large quantities of water, and cut off the water energy from leases farther on up structure. Stanolind could have produced at such rates that oil could have been brought down structure. Gulf witnesses testified that in the conditions which are similar in the northern part of the structure, it is best for the operator to produce large quantities of water to obtain the oil before it passes on in the regional drainage movement of the field. It is readily apparent, on reading the testimony, that the Gulf proposes to defy conservation efforts, and produce large quantities of water in order to get the oil of others.

That the saturated pay remaining between the water table below and the gas cap above has reached a uniform thickness, which makes a straight acreage basis of proration the most equitable. It was submitted by Stanolind, and admitted by Gulf, that this uniform thickness actually exists. It was also proven by evidence on both sides that it is impossible to estimate with any degree of accuracy the actual amount of oil in place in each acre-foot within the reservoir; that permeability and potential are not a measurement of oil in place, consequently, in the absence of the ability to measure accurately the recoverable oil in place, the only thing left to do is to use straight acreage as the basis of proration, as is used in all other fields in Lea County except one.

That potential is not a measure of oil in place in lime fields. This is demonstrated by the actual record of a similar lime field which was produced wide open, so that interference was set up between wells to such an extent that the recovery of each well was approximately the oil in place beneath the leases. In the case of this field, it was shown that the higher potential wells did not recover the most oil per acre. On the contrary, some of the highest potential wells produced their oil, and went to water before low potential wells. This demonstrates that, under wide open flow, high potential wells will cone water before they drain extensively from their neighbors, but that when such wells are restricted, the differential in weight between the water and

oil is sufficient to hold the water in a horizontal plane, and allow the oil to come in from neighboring properties, wherever undue allowables or allowables out of all proportion to the relative recoverable oil in place are practiced.

That the acidation of wells resulted in further proof that potential is not a measure of oil in place. The evidence was produced to show that acidation raised the potential of wells 400% and more, but that it is a physical impossibility to increase the recoverable amount of oil in place by this proportion. Evidence further showed that the potential of the field as a whole was enormously increased, yet the engineers did not add at all to their estimate of the field's total recoverable oil in place. The testimony showed that acidation of wells, particularly the use of huge quantities of acid, had resulted in allowables which had no relationship to the recoverable oil in place underneath the property, and which had no reason to exist under the present proration law, even though such fictitious potentials had been created before the law was passed.

That Stanolind's leases in the southeast end of the field did not benefit by drainage from leases of other operators. It was shown and admitted by Gulf witnesses that, in order for Stanolind leases to benefit by drainage from leases lying to the northward, the oil would have to traverse a circuitous route, going down to the water edge of the field and returning around high pressure areas, in order to land on Stanolind leases to which it was alleged to have drained. The Gulf witness added to the absurdity of this theory by explaining that the oil alleged to have drained to Stanolind leases could have traversed through the gas cap, which, for the most part, had been separated from the remaining oil pay by gas and water packers. The flimsiness of the Gulf's drainage theory in this area of low permeability was evidenced in the flights of imagination used to explain it. After admitting that Stanolind's southeast leases were of the lowest permeability of the field, and partly surrounded by water, and after admitting that water flows more readily than oil (Witness Knappen stated, p. 188 "It (water) will not come through much faster"), Gulf

witnesses still contended that these leases of low permeability were receiving oil from a great distance in preference to water under high pressure immediately at hand.

That the Gulf drainage theory, if true, would indicate oil would drain away from Stanolind leases rather than toward them. This was shown by the fact that Gulf's own exhibit showed high pressure areas on Stanolind's own leases which would furnish oil for the purported drainage rather than leases of other companies lying at a greater distance in lower pressure areas.

That the Gulf theory is based upon assumptions which are not applicable to the Hobbs Field. In order to apply a formula developed for the flow of liquids, Gulf made assumptions of error for applying this same formula to a flow of mixtures of oil and gas. Whether or not the error factor of 33%, which they admitted having used, results in a correct formula for application in the Hobbs Field is indeterminable. The method of calculating the permeability of flow through the section towards Stanolind leases, also being based on assumptions which are not true for the Hobbs Field, makes the calculations further in error.

That the statement by Gulf witness that they would not mislead the Commission, should be taken for its true worth, after it was shown on cross examination that Witness Knappen failed to read that part of the published paper of Stanolind Engineer Wahlstrom which qualified Wahlstrom's conclusion.

That, although Gulf asked for increase in the potential factor in the proration formula, the witness admitted that permeability and potential are not a measure of the oil in place.

That the experimental demonstration showed visually that areas of low permeability may contain the same amount of recoverable oil in place as areas of high permeability, and that areas of low permeability require more energy per barrel to produce their oil, and thus necessarily require a higher differential, which will be reflected in a lower bottom hole pressure. That if the bottom hole pressure be equalized between areas of high and low permeability, the area of low permeability cannot recover its proportion of the oil.

That the method of correcting potentials, by use of the present bottom hole pressure corrective factor, is erroneous, inequitable and unjust, and has given hundreds of thousands of barrels to operators from the common source of supply, which cannot be justified under the law which provides that each operator shall be given the opportunity to produce his recoverable oil in place.

The only company vigorously protesting an acreage allocation plan for the Hobbs Field was the Gulf Oil Corporation. That corporation not only resisted the change to acreage allocation, but actually proposed that the allocation be made on the basis of 75% potential and 25% acreage. Not only did the Gulf insist on an increased potential factor, and in retaining to themselves abnormally high fictitious potentials which the bottom hole pressure formula had already given them, but they insisted that these fictitious potentials continue to be further increased by further periodic application of the erroneous bottom hole pressure correction factor as now used. So enthusiastic did Witness Knappen, of the Gulf, become in support of this erroneous method of correcting potentials by means of bottom hole pressure, that he alleged it to be the same formula to be used in many fields other than Hobbs, including Kettleman Hills and Yates. When questioned further as to the manner of applying bottom hole pressure corrections in Kettleman Hills and Yates, he was forced to admit he did not know what proration formulas were used in these two fields (Transcript page 206).

After reading and analyzing the testimony of the witness appearing for the Gulf Oil Corporation, and the cross examination of such witness, it appears even to one not familiar with the technicalities of oil proration, that the proposal of the Gulf was a camouflage, and a mere attempt to maintain and continue to enjoy an unfair, unjust, and inequitable advantage that they have enjoyed for years at the expense of the other operators in the field.

We earnestly submit that an order allocating the

production allowed from the Hobbs Pool should be placed on a straight acreage basis immediately, in line with other fields in Lea County, New Mexico, so that the Stanolind Oil and Gas Company, and other companies, will not be forced to suffer longer the inequities accumulating over the past years, and that they may have an opportunity to recover their equitable share of the remaining reserves in the Hobbs Pool.

Guy H. Woodward

Attorneys for Stanolind Oil and Gas Company.

Orders :

First Proration order : Dated 6-29-35

Case — Order No 1. "General State proration Order"
beginning at 7:AM - July 1, 1935 : and order Changed
by order of the Commission - (58,800 of one Daily) PS Minutes - Book
(See Manuscript) - Mr. K.E. Handwerker (author of Mk Laws)
sat as friend of Commission + guided the Meeting,
in adoption of procedural rules and No 4 General rules, of
as well as in temporary witness Testifying on
General State Proration order. - and the
fixing of allowable thereunder. (Trans - 7-8-9-10)
Hearing held after notice - order issued upon
recognition of existence and imminence of
waste of oil, and the Proration thereof authorized
by Ch 72. Laws 1935. 7th (Affirmed

Second Proration Order. Dated :

Case 5 - Order # 45 : Revision of Order No 1
provided only that "market demand"
as determined by the Commission, be considered
of less than allocation under 15 day periods.