BEFORE THE
OIL CONSERVATION COMMISSION
HOBBS, NEW MEXICO

IN THE MATTER OF:

Case Nos. 1573, 1632, 1633

TRANSCRIPT OF HEARING

APRIL 15, 1959

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I N D E X

BEFORE THE
OIL CONSERVATION COMMISSION
HOBBS, NEW MEXICO

IN THE MATTER OF:

Case 1573 Application of Southwestern, Inc. Oil Well Servicing for permission to make a "slim hole" completion. Applicant, in the above-styled cause, seeks an order authorizing it to utilize the "slim hole" method of completion for a well located in the SE/4 NW/4 Section 32, Township 16 South, Range 30 East, Square Lake Pool, Eddy County, New Mexico. Applicant proposes to utilize 2½ inch tubing as a substitute for casing in the above-described well in exception to Rule 107.

Case 1632 Application of Humble Oil and Refining Company for permission to make a "slim hole" completion. Applicant, in the above-styled cause, seeks an order authorizing it to utilize the "slim hole" method of completion for its State "M" Well No. 14 to be located 1980 feet from the North line and 660 feet from the East line of Section 31, Township 22 South, Range 37 East, Eumont Gas Pool, Lea County, New Mexico. Applicant proposes to utilize 2-7/8 inch tubing as a substitute for casing in the above-described well in exception to Rule 107.

Case 1633 Application of Humble Oil and Refining Company for permission to make a "slim hole" completion. Applicant, in the above-styled cause, seeks an order authorizing it to utilize the "slim hole" method of completion for its State "G" Well No. 19, to be located 580 feet from the South line and 1980 feet from the East line of Section 23, Township 21 South, Range 36 East, Eumont Gas Pool, Lea County, New Mexico. Applicant proposes to utilize 2-7/8 inch tubing as a substitute for casing in the above described well in exception to Rule 107.

Hobbs Auditorium
Hobbs, New Mexico
April 15, 1959

BEFORE:

A. L. Porter, Jr.
Murray Morgan
Governor John Burroughs

TRANSCRIPT OF HEARING

MR. PORTER: The hearing will come to order, please. At this time, we will take the "slim hole" cases, Cases 1573, 1632 and 1633.

MR. HINKLE: If the Commission please, Clarence Hinkle, Roswell, representing the Southwestern, Inc. Oil Well Servicing and the Humble Oil and Refining Company. Cases 1573 and 1632 and 1633 are all substantially the same, the only difference being in the depth of the wells and the location of the wells. I would like to move at this time that all three cases be consolidated and that the record of the testimony taken apply to all three cases.

MR. PORTER: Is there objection to the Counsel's motion for consolidation of these three cases?

Mr. Hinkle, as I understand, this would be consolidation for the purpose of testimony only and there would be three separate orders issued?

MR. HINKLE: Yes, I think on account of the well locations and the depths of the wells, I believe that it would be better to issue three separate orders; however, the record would apply

to all three cases.

MR. PORTER: Let the record show that these three cases have been consolidated.

MR. HINKLE: We have one witness, Mr. J. E. Willingham, I would like to have him sworn.

(Witness sworn in.)

J. E. WILLINGHAM

called as a witness, having first been duly sworn, testified as follows:

DIRECT EXAMINATION

BY MR. HINKLE:

Q State your name, please?

A I am J. E. Willingham.

Q By whom are you employed, Mr. Willingham?

A Humble Oil and Refining Company.

Q In what capacity are you employed?

A I am the Assistant Division Petroleum Engineer of the Western Division.

Q Are you a graduate engineer?

A Yes sir, I have a degree in Mechanical Engineering and a degree in Petroleum Engineering from Texas A & M.

Q What year did you graduate?

A 1942.

Q Have you practiced your profession since your graduation?

A Yes sir, I have.

Q State briefly to the Commission your experience as a petroleum engineer and engineer?

A Well, I went to work for Humble after the war in 1946 and I have been associated with field operations, equipment, drilling, corrosion, reservoir engineering, and I have had a general background in all the subjects that I'll discuss.

Q Has your experience been in the West Texas and New Mexico area?

A I have been in the West Texas area for a year and part of that time I was in the Southwest Texas Division.

Q Have you been closely associated in the last few years with the slim hole technique of drilling?

A Yes, sir, I have.

Q Can you briefly state to the Commission what your experience has been in that connection?

A In some of the workover techniques that I will discuss, I have performed workovers in the field at the well, I was the Southwest Texas Division Drilling Engineer associated with the slim hole drilling; I also supervised the corrosion, which will be brought out, and I was the Division Equipment Engineer, which covered much of the equipment that will be discussed.

Q Have you made a particular study of the slim hole technique?

A Yes sir, I have.

Q As applied to this area and West Texas and other areas?

A Yes sir, I have.

Q Have you published any reports or papers, or have there been any of your reports or papers published?

A Yes, I recently published an API paper entitled "Tubingless Completions" in the West Texas area. The "Tubingless Completions" referred to the 2-7/8 inch OD completion and slim hole.

Q Have you prepared, for the purpose of this case, a comprehensive report on slim completion, the technique in connection with it?

A Yes sir, we have it as an exhibit and it refers to all the techniques and equipment that are generally associated with the 2-7/8 inch completion.

Q Have you previously testified before the New Mexico Oil Conservation Commission?

A No, I haven't.

MR. HINKLE: Are the qualifications of the witness acceptable?

MR. PORTER: The witness' qualifications are acceptable.

(Thereupon, the document was marked as Humble's Exhibit Number One for identification.)

MR. HINKLE: If the Commission please, we have had

identified as Exhibit One the report to which Mr. Willingham has just referred to. I think each member of the Commission has a copy before them, as well as the staff members. Mr. Willingham has large copies of the exhibits or tables and graphs and plats that are shown in the exhibit here, and I am going to ask him now to refer to this Exhibit Number One of Humble's and to state in his own words, or give us a synopsis, a brief synopsis of the report without reading it in detail. At the conclusion of his testimony, we will offer this report in evidence. During his testimony, he will refer to the large plats which are the same as shown in Exhibit Number One.

MR. PORTER: Mr. Hinkle, do you have an extra copy, another copy of this?

A Yes sir, we have one right here.

MR. PORTER: I would like to ask you also, has this been published in any of the Oil Publications?

A No sir, part of it has, but this has not been published prior to this time.

MR. PORTER: Thank you, sir.

Q (By Mr. Hinkle) Mr. Willingham, proceed.

A Gentlemen, this book could be a week's discussion and therefore, I would like to summarize it, and briefly, in introducing it, the facts are this: That our increasing cost of the development of our wells in New Mexico, and combined with reduced allowables, have created a condition where the continued drilling

of wells in many areas is no longer justified due to the anticipated rate of return on our investment capitol. In an effort to reduce costs in similar situations in other parts of the country, the oil industry has resorted to the use of 2-7/8 inch OD casing. This might be called and could be called 2-1/2 inch tubing, but when you refer to casing, you refer to it by OD, so in this case we are asking for 2-7/8 OD casing. Under the present proration schedule, producing volumes may readily be obtained through much smaller tubular goods than has been the custom to employ in the past.

The history of slim hole dates for many years. We can most of us recall when we were drilling and setting 7-5/8 and 7-inch casing strings as the customary oil producing strings, and over the years, it has gradually gone to 5-1/2 and down to 5-inch, 4-1/2 and in some cases, 4-inch, and now we have reached the ultimate, we feel, in 2-7/8 inch OD casing. I believe it is imperative for us all to recognize that the conditions created by foreign oil and other forms of energy are actually threatening the survival of drilling operations in New Mexico for many areas. In order for the oil industry to remain competitive, it is necessary that we adopt techniques and equipment which will provide the highest rate of return. It wasn't until around six years ago that the development of wire-line tools for wire-line servicing and permanent type completion equipment was developed, and this is the reason that we consider 2-7/8 inch casing completions

a practical reality.

Now, by that, to explain it, several years ago the technique of setting your tubing on a packer and doing your workover work through this tubing was followed to reduce cost. There's no reason that this technique couldn't be applied to 2-7/8 inch casing also. There have been improvements of artificial lift equipment, such as pumpout subsurface hydrill, small sucker or hollow sucker rods and small type pumps, small gas lift valves and small mandrills and so forth.

There was initially some basic objections to the use of 2-7/8 inch casing, the first being the fear that we wouldn't get good wells from fracking with low rates on 2-7/8 inch casing. In order to evaluate this, during 1958, my company performed 70 frack operations, of which many were at low rates below 15 barrels per minute, in order to really evaluate what happened when you do frack with low rates down this tubing. The reason you frack with low rates is because of the friction lost going through these small casing strings, and my company found that there was no hindrance in the quality of the well with fracking at low rates. In other words, we got just as good as well fracking with low rates as we got at high rates.

Another objection was the fear that you couldn't drill the wells as fast and thereby it would cost you more money. We have found since that you can drill wells comparable in cost to conventional completions. In fact, there are indications for the

future of small rigs with three-men crews that will be able to drill the wells cheaper; however, that remains in the future.

The third thing was the objection that we wouldn't be able to produce volumes with artificial lift equipment that we could with our conventional completions. We have found through actual field application that we can produce volumes comparable to conventional completions in the same areas.

A review of the New Mexico Oil Conservation Commission rules indicated that 2-7/8 inch casing is in accordance with all the rules except 107-D, which states: 1, all flowing wells shall be tubed. 2, all gas wells shall be tubed. 3, tubing shall be set as near the bottom as practical and tubing perforations shall not be more than 250 feet above the top of the pay.

The wells we are proposing in the Eumont Field, as shown by the red arrow, as a basis of orientating everybody with what we have, these will be four 1,000-foot wells. These are theoretical calculations --

Q Mr. Willingham, may I interrupt you?

A Yes, sir.

Q Can you refer to these exhibits, as you turn to them, by number?

A Yes sir, I can. The map is not in the book, the figure here is Figure 1 in the exhibit, shown after Page 2. There are several different ways to produce with artificial lift through 2-7/8 inch casing. Naturally, you can produce through the casing

without any small strings or any lift equipment when the well is flowing. The various methods we have, you can rodpump inside the 2-7/8 inch casing through a hollow rod pump, in other words, bringing the production up the hollow rod, or you can rodpump inside inch and a half tubing, upset tubing, you can use a hydraulic subsurface pump, or you can gas lift. In most cases to date, we have selected the Number Two, our hollow sucker rods to pump through as shown on this graph. For example, with theoretical calculations at 4,000 feet, which are the Eumont wells that we propose, you can produce better than 200 barrels per day. at 85 per cent pump efficiency. This is far greater than the allowable, so there is no reason to believe that these casing strings are going to limit our production.

This next figure, we are not showing all of this figure because this could go on for days if we go into all of this. This is Figure 7 in your book and it follows Page 9, it is right after Page 9. Gentlemen, this is the surface arrangement of equipment, and to explain basically what this typical arrangement would be, we would have 7-inch casing set and 2-7/8 inch, your 7-inch casing being your surface pipe and the 2-7/8 inch casing would be your string and would be set on a slip type packer at the wellhead. We could have an arrangement where we could pump up the hollow rod and cross over and go out through a flow line. Some people use this technique, using flexible hoses to produce from. However, this arrangement, we feel, is superior because there won't be any

chance of breakage and loss of oil, and all of this equipment is readily available, it is routine, the only difference from conventional equipment is it is much cheaper.

In order to really evaluate tubing completions , we must consider the workover operations. This is Figure 9 that follows Page 10. We will find, due to the necessity of changing our ways of working over wells, we are going to find that our workovers are going to be cheaper. In the past, whenever you complete a well, you spend a considerable part of the original investment, in fact, you, in some cases, you spend 50 or 60 per cent of your original investment working a well over. And I wanted to bring this to you to show you that you can work your well over much cheaper. For example, if we had two reservoirs and we wanted to abandon the lower one, all we would need is a wireline truck to set a plug on the setting nipple. Another way you could do it is you could go and set a plug on a wireline, you don't have to have a setting nipple. This means that you could abandon this lower formation for much less than you could with your conventional technique of moving the workover rig on. When we would abandon this zone in this manner, why we could perforate that upper reservoir and it would be in production and the only thing we use is a wireline truck.

Another method we could use is to use a dump bailer, wireline dump bailer, dump cement, abandon this lower formation and then be ready to perforate. Another method we could use in the

event of a casing leak, we could use a double packer patched tool that you could see the wireline to shut off the casing leak. Another method we could use, we could abandon the upper formation with a patched tooling through a perforating gun, perforate the lower interval, and with all four methods you can work the well over without a workover unit.

Q Mr. Willingham --

A Yes, sir.

Q --are these the only methods of workover, or the only techniques that are available or are there a lot of them?

A There are, I could stand here and talk for at least a week on the workover operations alone and the various tools that are available. That is, there are just hundreds and hundreds of different equipment that is available on the market today. This technique shows the use of a workover rig in which we have used --

Q What is the number?

A This is Figure 10 following Figure 9. This is using a workover rig and a small tubing string, and in recent years we have developed a technique of using low pressure squeeze techniques. The purpose of this technique is that you don't leave nodules in the casing where you can't get your wireline tools through, so we developed a jell-type cement which does not leave nodules and therefore you can work your wireline through after the job is over.

Another thing that we found in the fractured limestone reservoirs, that often we have a flowback and we have had to resort to a granulated plastic as a filter aid in obtaining your squeeze cement job. I know this is getting technical, but it is necessary to go over this to really explain why this operation has arrived. But in this example where we squeeze this reservoir off with low pressure techniques, we recess the cement out, pull the tubing out, and then we could go in and either re-perforate this formation or we could perforate above. Another technique would be to set the pipe above the formation, squeeze with the low pressure techniques, leave a plug in it, reverse it and be ready to perforate in the upper reservoir. This particular illustration is run on consolidated sands and doesn't apply to the New Mexico area. In the operations that I am thinking of is where sands are consolidated and this is to eliminate sand production.

This particular figure is Figure 12, follows Page 12. Gentlemen, the reason that this view graph is presented is first to give you some background. Many people are of the opinion that you have external, or that external casing corrosion is serious in the West Texas-New Mexico area when actually the real serious corrosion problem is internal. A survey of my company's casing failures in the West Texas-New Mexico area indicates that only 7.6 per cent of the failures were due to external corrosion and 54 per cent of them were internal corrosion. The reason I want to

bring this out is to show that internal corrosion can be controlled with 2-7/8 inch completions; external corrosion would be the same as you would have on your conventional well, you can control that by either cementing across the offending formation or use cathodic protection. The various means that we could control corrosion internally are this: For hollow sucker rod installations, you can either put the hollow sucker rod up the annulus, let's assume we were pumping the annulus, we could inject the inhibitor down the hollow sucker rod and let it flow back with the oil production, thereby controlling our internal corrosion of our pipe. Another method we could use if we were flowing the hollow sucker rod, we could leave the annulus packed off and leave a dead oil with an inhibitor inside of it. Another method we could use is inch and a half tubing inside the 2-7/8 inch tubing with small sucker rods inside of it. This would be similar to a conventional completion, and we could record pressures in our annulus between our inch and a half and 2-7/8 inch. Another type of completion is our hydraulic subsurface pumps where we could inject oil down the small tubing string with an inhibitor mixed, with the inhibitor flowing back up the annulus with the oil production. Another method would be the parallel string method where we use a sub-surface hydraulic pump where we pump treated oil down the 2-7/8 inch and produce up our inch and a half or inch and a quarter and these two strings would both be cemented in the hole. The last method I want to show is the gas lift. This isn't too popular a

method in this area because of the lack of gas, but you could put an inhibitor in your gas to lift.

This is Figure 14. Gentlemen, I wanted to explain this, that these figures are well cost reductions have actually been greater and in fact are substantially greater than this. However, we have adjusted these figures to reflect the savings that are directly attributable to the 2-7/8 inch casing. Now, some of the techniques that are associated with this cause a well, cause a reduction to be much greater than this. But basically, during 1958, we drilled twenty wells as a test program to evaluate this type of operation. We found that the average cost reduction directly attributable to the 2-7/8 inch casing averaged 16 per cent, but I want to reiterate that this is a very conservative figure and we don't want anybody to be misled by what we said. During the year, and after the first month or two after the turn of 1959, we arrived at the fact that this was a good economic tool and we started an extensive development program in West Texas. Currently, we have five 2-7/8 inch completions, we have five rigs running drilling more, we've got eleven locations waiting on rigs.

And generally, in conclusion, I wish to say that the future will result, in my opinion, in many other reductions in 2-7/8 inch completions due to the development of small portable rigs operating with one or two or three men, and the development of improved equipment for 2-7/8 inch casing though we have much good equipment available at the current time. But in summary, the results of our

operation is to indicate that 2-7/8 inch completions are a more economic tool for the oil industry and they should allow us to continue development operations in areas which we can't afford to develop at the present time.

Q Mr. Willingham, one or two questions. Why did you consider it necessary to obtain an exception to any of the rules of the Oil Conservation Commission to go ahead and engage in this sort of completion?

A Well, this is because of our Rule 107-D, which states that all flowing oil wells shall be tubed and all gas wells shall be tubed.

Q Completing wells under this slim hole technique, it might be a question as to whether or not that rule would be complied with, is that right?

A Yes sir, in some cases, if the well is flowing, for instance, a gas well, it will be produced directly through the 2-7/8 inch casing; in an oil well, it might be produced up the hollow sucker rod or it could be produced in the annulus instead of through the hollow sucker rod.

Q In the case of the hollow sucker rod instead of directly through the tubing, though, that would comply with the present rule?

A Providing you were pumping inside the hollow sucker rod, but if you pumped through the annulus, that would in a sense be voilating the intent of this rule.

Q So it is just a technicality then?

A Yes, sir.

Q Through the drilling program that Humble has carried on up to date and the surveys which have been made by you and others in the Humble organization, has the Humble Company performed any general policy with respect to the adoption of this method of completion?

A This method of completion is being used widely in my company at the present time. We have operations in Southwest Texas, Gulf Coast, North Texas and the Eastern Division, which includes the State of Louisiana, Alabama, Florida and so forth.

Q Are there any rules or regulations in Louisiana or Texas or any of the other States you operate, or have drilled in that would prohibit the completion of wells of this kind?

A No sir, there are not.

Q Do you have to obtain an exception or do they approve them as a matter of routine?

A They are approved as a matter of routine. In fact, in many cases, we are making dual and triple 2-7/8 inch completions; in fact, we run two strings of 2-7/8 inch and send them to different formations and in others, we run three strings of 2-7/8 inch and send them to three different formations.

Q I understood you to say that there's no greater corrosion problem presented with the slim hole technique than on larger holes, is that right?

A I can emphatically state that.

Q So corrosion is not a major problem any more in a slim hole than it would be in any other hole?

A That's right.

MR. HINKLE: That's all.

CROSS EXAMINATION

BY MR. PORTER:

Q Mr. Willingham, in general, your company uses seven-inch surface casing, generally speaking?

A Mr. Porter, that would vary according to the locality and in some cases, we use seven-inch, in some cases seven and five. I anticipate that before this is all over, we will start using five and a half inch surface casing as small rigs become available and we can drill, we can afford to drill with short, small bits and still come out ahead.

Q Are there any disadvantages to this method of completion that Humble would consider seriously as objections, or objectionable features?

A The only question that enters our minds is your fishing problem. In the event that you have say a parted hollow sucker rod string, and which we feel that they can be recovered, we have recovered them, that it is just a matter of learning to do our business differently with our various workover and fishing tools and so forth. We feel that the casing corrosion problem can be handled easily, though. I mean, if we had a casing, a hole in our

casing, there are many ways of repairing that hole.

Q Have you made calculations as to the savings in cost to Humble on these two particular wells in question here today?

A Well, Mr. Nutter, I would say this--I mean, excuse me, Mr. Porter, that if I were making an estimate, I would state it at 16 per cent, but we have actually had cost reductions that ranged as high as 45 per cent due to the techniques that we were required to use with 2-7/8 completions.

Q Your average is about 16 per cent, although you may have a wide variation?

A Now, the average that we say is directly attributable to the 2-7/8 inch completion; the well cost reduction has averaged from 15 to 45 per cent.

MR. PORTER: Anyone have any questions of Mr. Willingham? Mr. Nutter?

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Willingham, are the wireline tools which are available, which you use through this 2-7/8 inch tubing as efficient as tools that you would use through normal size casing?

A In answer to your question, can you, in other words, can you abandon a zone as efficiently, I'll say you can, yes.

Q I had primarily in mind, Mr. Willingham, the case where you were completing a well, for instance, perforating and so forth?

A Well, in answer to that question, Mr. Nutter, I'll say this: That reservoir calculations, from a theoretical standpoint, bear out the fact that it doesn't matter, the depth of your penetration doesn't matter as long as you are fracturing because in fracturing, if you have a quarter of an inch penetration, it's good enough. But with these particular tools that we are using to perforate with, we have had quite a bit of penetration; in fact, we have had holes as large as, if I recall right, that were better than nine inches that were washed out, that were perforated through with our tubing guns and got, in this particular case, I believe we got an open flow potential of around fifteen million in a gas well.

Q In other words, you feel that--first of all, jet perforations or bullet shots through this tubing is not as powerful as the ordinary larger size jets or bullet perforations, is that correct?

A That would be generally true.

Q But you feel that the actual power of the shot is not so important as long as you make some penetration at all and then later frack that zone?

A Yes, sir. Now, I want to say this, Mr. Nutter: We have, for several years, been going through the tubing with tubing perforators and perforating our formation, even in our five and a half inch and seven inch casing and if that were an objection, it would have occurred long ago, and not only were we

perforating a much larger casing, but we were getting satisfactory results. We couldn't use bullet perforators in the 2-7/8 inch completions, however, we would stick to jet perforations, or we have to date.

Q How about the shots per foot, is there any difference in the shots per foot that you use in the slim hole as compared to the larger size hole?

A In recent years, the trend has been to less and less shots per foot, and my company has found out actually that the quality of our wells is much greater with the lower shots per foot and we believe that is due to the fracturing techniques, as you are putting more fractures out on the perforations, you are doing a better job, but normally, we have been shooting two shots per foot in our tubing in the 2-7/8 inch completions.

Q What is the normal procedure in the five and a half inch casing string?

A Well, a year ago it was four and six shots a foot; now it is one shot a foot or two shots a foot.

Q Do you think there's any correlation between these lower frack rates which you have mentioned and the smaller number of shots per foot?

A No sir, we don't because we frack in all different types of perforations.

Q And you still are of the conclusion that the lower frack rates are desirable whether you have larger or smaller

number of shots per foot?

A Yes, sir. I don't say they are desirable, I say they are just as good. The higher frack rate would be your limiting factor; in fracturing, that's the limiting factor.

Q Mr. Willingham, one of your sketches in here shows a sleeve being used to repair a casing leak; how would you detect that casing leak to start with?

A Well, there are several different ways that you could detect it; you could detect it from your operating pressure, you could detect it from temperature surveys, you could detect it from bottomhole pressure surveys. There wouldn't be any reason to believe that you couldn't detect it just as well as you could on a conventional well.

Q In a conventional well, you have a direct annulus pressure reading as well as a tubing pressure reading to compare if you have a pressure leak, don't you?

A However, now, in 2-7/8 inch completion wells through the annulus and the operation that we are using mostly, the hollow sucker rod with the dead oil in the annulus, we have a pressure on that, and the other, if we get an area, say we moved and drilled in an area with 2-7/8 inch completions and found that we were in a corrosive area, we would probably revert to the technique of inch and a half tubing so that we do do just what you said. The fact that it is economically--some of the light inch and a half pipe, you can set that as economically as you can the other

installations. The reason is you can use a smaller pumping unit due to the lighter rod string, which makes it as cheap.

Q Would you agree, Mr. Willingham, for practical purposes, that it is probably better to use a hollow sucker rod string of inch and a half tubing in that well than to use a conventional rod string and pump in the tubing?

A Mr. Nutter, I would hate to be tied down to that installation. Now, you can harnass a technique with so many rules that you can kill it, but what I am saying is that this type of operation is going to go fine until the final stages in which your fluid production is going to be at a rapid rate, then you might have to resort to the rod strings. I think what you say in general is --

Q For shallow wells on low allowable rates, or not producing too much fluid, is that what you referred to --

A Yes, sir.

Q --to use hollow sucker rods?

A Another good way is your subsurface hydraulic pump. Of course, you don't have a moving rod string.

Q Now, if you had this casing leak and you repaired it with this sleeve, what kind of a seal do you have there that this sleeve provides?

A You would have a--there are several different ways, it could be done with a Chevron packing or you could have just a rubber packing through expansion.

Q Now, would either section of the sleeve in this tubing cause any difference as far as running your pump or running your quarter --

A You could run a perforating gun through it, but could not run a pump through it; therefore, if it occurred above your producing interval, you would not use that technique to repair the casing leak. What you would do is you would use your low pressure technique to repair it and you would use pressure squeeze techniques and repair your hole that way.

Q In other words, you would depend on this cement to effect a seal and to prevent --

A Yes sir, like we do in a conventional well.

Q What size hole is normally drilled for a tubingless completion?

A To date, we have used 6-3/4 and 6-1/4; the trend has been more and more to 6-1/4, however, I anticipate that before many more months have passed, we'll be drilling 5-5/8, we have done some of that already.

Q Does this provide the same annular space, or what I'm trying to say is, does this provide as much area in the hole for a cement sheath around that tubing as is provided in the normal size hole with 5-1/2 inch casing?

A It would, approximately so; however, in some cases, we have reduced the hole through the producing interval and made the sheath smaller, but the secret to that--I see what you're

getting at, because certainly you have to have a cement sheath to stop communication, but the secret there is in making sure that your interval is centralized and your casing string is held away from the wall. That is very important and we do that.

Q You use centralized --

A Yes, sir.

Q --size casing?

A Yes.

Q What is the depth range that you would recommend slim holes?

A To date, our wells have ranged from 1500 to 4700 feet. And now--that's in the Western Division, in some in the Northern Division we have gone deeper, and I think as time and knowledge and experience comes, it will be deeper and deeper.

Q Mr. Willingham, is there any more danger of losing the hole in attempting to effect a slim hole type of completion than in conventional drilling?

A Yes sir, there would, it would be more of a hazard. I would be unrealistic if I said there wasn't, because you have less hole to work in. However, I want to answer that with a deliberate answer to bring out the economic picture. For example, if we took a field and we were going to drill five wells in it and we were able to take the saving that we got from those five wells and re-invested it at ten per cent, in ten years we could drill four of those five wells over.

Q At the end of ten years?

A Yes, sir.

Q In this little economic analysis in Figure 14, Mr. Willingham, you state that in the field, A, B, C, D and E, you have effected twenty slim hole completions?

A Yes, sir.

Q Did you lose any wells in those fields?

A We had one that we abandoned prematurely because we had lost some equipment in the hole; however, we had already tested the well and found that it wasn't worth the trouble of going in and trying to get the equipment out. Essentially, it was already a dry hole before we abandoned it, but we did have to abandon that one.

Q Are fishing jobs more difficult in a slim hole than in a conventional hole?

A I would say no, they are no more difficult, I would say that you could get into conditions where they would be more difficult; however, they are also much cheaper than they are in conventional fishing.

Q Would you recommend slim hole for wildcatting?

A No, normally we would not because of the limitations in running diameters. In other words, in your associated equipment, first of all, you have to set large casing strings so that you can set protective strings in the event you run into abnormal pressures, and normally, we would not use them in wildcats. However,

we have drilled wildcats and found out that we had a discovery and set 2-7/8 inch casing in it, but in this case I believe we set 8-5/8 inch surface pipe and drilled a large hole.

Q Is there any material in which you show the cementing program on one of these wells as compared to a conventional well?

A Basically, there is none except we have one sketch that shows the surface equipment we have used because of the fact when you--the pipe between your cementing trunk and your wellbore, which normally you don't worry about that little amount of cement or where you might get a little bit of fill-up in the tubing, and therefore we have made arrangements to be sure that that is cleaned and flushed out so that they don't get inside of your tubing.

Q Mr. Willingham, do you feel that the Commission or the operators should have any more concern over the advisability of using tubingless completions in one area as compared to another or in developed fields, fields in the stage or development, are they as good in one place as they are in another or are there any areas where they shouldn't be used?

A To date, we have avoided areas which we knew that we had severe paraffin problems. We have used them in areas where we had paraffin; however, where we had severe paraffin, we have avoided them, though that largely is due to salesmanship. We didn't want to use it and have some trouble, we tried to put it in places we considered a cinch to start with, and I think that

later on we will go to paraffin areas, but we don't have the experience now to say that it will operate inside of them, and we will have to find ways of treating paraffin, too.

Q You mentioned that there were ways of treating corrosion. Now, do you think that in highly corrosive areas, that this shouldn't be used?

A I would say that if you had a very corrosive area, you should be able to treat 2-7/8 inch completions every bit as easily as you could treat the larger except it won't take nearly as much material and it will be cheaper.

MR. NUTTER: I believe that's all, thank you.

MR. PORTER: Mr. Willingham, did you state that you had right now in the West Texas area completed 52 wells in this manner and I believe you are drilling 5 more and anticipate maybe 11 more at the present time?

A Yes, sir.

MR. PORTER: Have you run into any serious problems in producing this type of completion more than you would expect otherwise?

A We did have some trouble in one well in which we did not put a pump setting nipple in the bottom and we had to resort to a slim-type holddown, and we learned a hard, bitter lesson and we don't leave them out any more.

MR. PORTER: In general, you would say that it has proven satisfactorily?

A Yes, sir.

MR. PORTER: Anyone else have a question of Mr. Willingham?

GOVERNOR BURROUGHS: Would this be a definite factor in determining whether or not a well would be profitable in a restricted drilling acreage area?

A Yes, sir; in fact, we have been able--this is the way, how this got started: We took marginal properties that we couldn't afford to develop and determined a minimum cost well program for it and moved into this area and were able to develop it economically and made money out of it, and therefore, I think that the industry will find that this will open up drilling that in some cases has been left idle due to the fact that the rate of return is so low.

GOVERNOR BURROUGHS: In other words, it would make you a little happy with 40-acre spacing versus 80-acre spacing in some areas?

A I didn't come prepared to speak of that, but I think our past history will speak for itself, sir.

MR. PORTER: Do you have any further questions?

GOVERNOR BURROUGHS: No.

MR. PORTER: I would like to ask one more. When did you complete your first well in this manner in West Texas among these 52?

A We completed it, it was either in April or May of 1958 was when we first started.

MR. PORTER: About a year ago?

A Yes,sir.

MR. PORTER: Mr. Payne I believe has a question.

MR. PAYNE: Mr. Willingham, I believe you testified that the 2-7/8 inch OD casing was the ultimate in this type of completion. Did you mean by that that you should not use casing or tubing any smaller than that?

A We'll get into this problem, for instance, if we wanted to use 2-inch tubing, we get down to the point that our small string inside will be so small that we can't handle the fluid, and it could be in some cases we'll use 2-3/8, but I think that probably we'll standardize it on 2-7/8.

MR. PAYNE: In view of your answer, I would like to ask Mr. Hinkle a question. Mr. Hinkle, the Southwestern Oil Well Servicing application asks for 2-1/2 inch, it doesn't make clear whether you are talking about OD or not.

MR. HINKLE: I believe that Mr. Willingham testified right at the beginning of his testimony that these types of completions were referred to sometimes as 2-1/2 inch completions. Actually, when they, I think when Southwestern filed their application, they had in mind using 2-7/8 inch casing, but it is a common term in the industry to refer to the tubing as 2-1/2. Now, Mr. Willingham can explain that.

A Yes sir, that's right. Now, why they did this, I don't know, but the old timers started calling tubing in normal sizes of 2-1/2 inch casing by OD, and 2-1/2 inch tubing is

actually 2-7/8 inch OD.

MR. PAYNE: In other words, all three of these applications are asking for 2-7/8 inch OD?

A Yes sir, that's correct.

MR. PAYNE: Thank you.

GOVERNOR BURROUGHS: This is, of course, calling for a projected answer and I realize that, but with the savings that would accrue from associated techniques in this method of drilling, would you think that over the course of years, you might get to a point where you could make say an average of a fifty per cent saving in well completion jobs?

A No sir, I don't believe that, I don't think so. I would say that probably in what we are making now, you understand that this is a very difficult thing to say, what savings are attributed to this and what savings are due, what technique causes other savings, but I would say the average well cost reduction has been around 25 per cent, but we believe in being fair about it and in being conservative, we don't want to mislead anybody, and we say that 16 per cent is the average savings that is directly attributable.

GOVERNOR BURROUGHS: I am speaking about a figure that is a total figure, not necessarily directly attributable, but the overall savings.

A I would guess around 25 per cent.

GOVERNOR BURROUGHS: Around 25 per cent, thank you.

MR. PORTER: Mr. Fischer?

CROSS EXAMINATION

BY MR. FISCHER:

Q Mr. Willingham, have you tried a pattern, the drilling of these slim holes on any type of drive, either a gas drive or water drive, or have you carried the completing of the slim hole in any particular type of producing mechanism?

A Mr. Fischer, we, my company--I am talking about the Western Division--in the Western Division, we have used, probably we have had them in gas drives and dissolved gas drives, but in other parts of the company, we have completed them in all different types of reservoirs.

Q In speaking about shallow completions, say 5,000 feet or less, would these slim hole type completions be essentially or 100 per cent two string casing design wells where you would open two strings of casing?

A I would say that in most cases, in fact, about four of the majority of the cases, they will be two casing programs, the surface casing and the producing string.

Q As to cementing, if you didn't care to cement all in one stage, or couldn't, for some reason or other, could you two-stage this as --

A They don't make them that way, but there are other ways. You could put sliding sleeve mandrills or leave perforation seals. There are various methods of that nature, but generally

in the shallower wells, you don't have to bring cement all the way back; generally, you can, in some cases, you can't.

Q Basically, when you drill a large hole in the beginning, if you drilled a smaller hole, you couldn't --

A Well, I would say that you could get your cement pumps in there in the smaller hole as well as you could the larger hole providing you realized it was a smaller hole and slowed your pumps down.

Q We are still talking about shallow holes?

A Yes, sir.

Q In the Eumont, will you plan to drill some of these wells through and do you plan to protect your casing in salt sections?

A In answer to that question--now, I know that I am getting into a realm where I am talking without direct experience, but I'll say this: I can say from the bottom of my heart that salt sections do not cause corrosion. If it were true that you do have, then in the Gulf Coast area, you would have a problem to keep the corrosion out, and there is no reason to believe that this salt water section ought to cause corrosion. It is possible that if you have a lot of water in the salt section, you could have a current flowing down and leaving this salt section due to the conductivity of the formation, but cement isn't necessarily going to protect that because in most wells, they are cork-screwed and your pipe will be laying against your wall in places.

Q Possibly if you found, if you had a slim hole and you found out that your salt section, there was a chemical reaction or something, and that salt section was causing the corrosion, would you recommend to your company that they go to a different protection in that case?

A Yes sir, we probably would do either one of two things. I am sure that we would use cathodic protection, and in answer to your question, if we knew what was causing it was a section like that, we knew that was corrosive, I am almost sure we would put inch and a half tubing inside similar to a conventional completion. In that manner, you could tell when your casing leak occurred.

MR. FISCHER: Thank you, sir.

MR. PORTER: Anyone else have a question of Mr. Willingham? Mr. Hinkle?

MR. HINKLE: I would like to ask one more question. Do you consider the slim hole technique as a safe method of completion, that is, as far as handling high pressures is concerned, whether the 2-7/8 inch OD casing will withstand high pressures the same as other types of casing, larger --

A 2-7/8 inch tubing gives much more protection from internal burst ratings than conventional casing strings; the smaller the tubing, the higher the burst rating. In answer to your question, I know you are safer from that standpoint with 2-7/8 inch completions.

MR. HINKLE: That's all I have.

MR. PORTER: Anyone else?

The witness may be excused.

A Thank you.

(Witness excused.)

MR. HINKLE: If the Commission please, we have one other witness, whose testimony will be very brief, and that's Mr. Hollis of Southwestern, Inc., corroborate this testimony.

MR. PORTER: Would you have Mr. Hollis sworn, please?

MR. HINKLE: Mr. Hollis?

(Witness sworn in).

T. J. HOLLIS

called as a witness, having first been duly sworn, testified as follows:

DIRECT EXAMINATION

BY MR. HINKLE:

Q State your name, please?

A T. J. Hollis.

Q What is your position with Southwestern, Inc.?

A I am president and owner.

Q Is that company engaged in the slim hole drilling business to any extent?

A Not at the present time; we have this application before the Commission for the permission to do a slim hole.

Q You have heard the testimony of Mr. J. E. Willingham

in this case; do you agree with his testimony?

A Yes sir, I certainly do, I do whole-heartedly.

Q Have you had any independent experience with slim hole drilling that you would like to give for the benefit of the Commission?

A No sir, none other than the fact that I have been engaged for some number of years in well servicing and workovers. For the last twenty-five years, I have been engaged in production drilling in the State of Texas, Louisiana, Oklahoma and New Mexico. I have drilled several wells and I have worked over several wells with small rigs and small tools.

Q Mr. Hollis, in your application which you filed with the Commission in Case Number 1573, it has been advertised that you propose to utilize 2-1/2 inch tubing as a substitute for casing. What did you mean by that?

A I was proposing to use 2-7/8 inch tubing, generally speaking, the industry calls it, as an oil string.

Q It is often referred to as 2-7/8 and 2-1/2 inch tubing sometimes?

A Yes sir, it is quite commonly spoken of in the oil industry as that.

MR. HINKLE: That's all.

MR. PORTER: Any questions of Mr. Hollis?

You may be excused.

A Thank you. (Witness excused.)

MR. PORTER: Anybody else desire to present testimony in these cases?

Anyone have any comments, any statements to make?

Mr. Christie?

MR. CHRISTIE: I would like to make a statement, R. S. Christie for Amerada Petroleum. We believe Humble's presentation on slim hole drilling and operations is very timely. We need to explore every possible means to reduce the cost of exploration and development, this is one important advance in that direction, and we feel and believe that the Commission should grant these applications. Furthermore, if the present rules prohibit slim hole drilling pending a hearing, we think the rules probably should be amended so the hearing won't be required.

MR. PORTER: Anyone else have a statement?

MR. McPETERS: Kenneth McPeters representing John M. Kelly. We would like to support Humble and Southwestern in this case, and speaking of the New Mexico industry, we believe that this technique is better, better to rising costs in the oil industry.

MR. PORTER: Anyone else have a statement?

We will take the case under advisement.

At this time, we will recess the hearing until one o'clock so that you may get in ahead of the noon rush hour.

(Noon recess.)

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MR. HINKLE: If the Commission please, the reporter has called my attention to the fact that he is missing the Exhibit Number One in the slim hole cases, which were consolidated. I would like to substitute this copy, which is the same, and offer it in evidence. Can we re-open those cases for that purpose? Somebody picked up his copy off the desk.

MR. PORTER: Is there objection to Mr. Hinkle's motion for entering this exhibit in the three consolidated cases of this morning?

Let the record show that this Exhibit Number One is part of the record.

STATE OF NEW MEXICO)
: ss
COUNTY OF BERNALILLO)

I, JERRY MARTINEZ, Notary Public in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Hearing were reported by me in Stenotype, and that the same was reduced to typewritten transcript by me and contains a true and correct record of said proceedings, to the best of my knowledge, skill and ability.

DATED this 15th day of May, 1959, in the City of Albuquerque, County of Bernalillo, State of New Mexico.

Jerry Martinez
Notary Public

My Commission Expires:

January 24, 1962