CASE 3105: Application of PUBCO for recision of admin. determination under Order No. R-333-F.

CASE NO. 3105

Application,
Transcripts,
Small Exhibits
ETC.

No. 1

Phone DAvis 5-2393

TEMPERATURE * B&R SERVICE, INC * SURVEYS * *

BOX 1048 - FARMINGTON, NEW MEXICO

Pressure Survey

COMPANY PUBCO DEVELOPMENT CORP. LEASE PUBCO STATE WELL 6

FIELD

LOCATION

COUNTY SAN JUAN

STATE NEW MEXICO

DATE 4-2-63

SHUT-IN FLOWING

ELEVATION

ZERO POINT TBG. GATE

TBG. PRESSURE 662 DWT

CASING PRESSURE 575 DWT

TBG. DEPTH

CASING SET

PACKER SET

CASING PERF

MAX TEMP

FLUID LEVEL NONE

DEPTH	PSIG	GRADIENT
LUBE	659	---
1000	680	.02
2000	699	.02
3000	717	.02
4000	742	.02
4500	747	.01
4700	749	.01
4800	751	.02
4900	753	.02
4949	755	.04

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Pubco Exhibit No. 1
Case No. 3105

No. 2

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

State of New Mexico
Oil Conservation Commission

LAND COMMISSIONER
E. S. JOHNNY WALKER
MEMBER

STATE GEOLOGIST
A. L. PORTER, JR
SECRETARY - DIRECTOR

1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO
March 1[illegible], 1964

Pubco Petroleum Corporation
P.O. Box 14[illegible]
Albuquerque, New Mexico

Gentlemen:

The annual deliverability testing schedule [illegible] in this office indicates that your Pubco State #[illegible] well [illegible] now on deliverability test and will have the shut-in pressure measured on Monday, March 23, 1964. We are [illegible]ucting a bottom pressure study in this area and are requesting that bottom hole pressures be measured on this well at the time the surface pressure is determined.

Please have your local representative contact us by telephone when these pressures will be measured [illegible] in order that we may have a witness present.

Yours very truly

[illegible]
[illegible]
[illegible]

[illegible]

cc: Pubco Petroleum Corp.
Box [illegible]
Aztec, New Mexico

BEFORE THE
OIL CONSERVATION COMMISSION
S nta Fe, New Mexico
Pubco Exhibit No. 2
Case No. 3105

No. 3

Phone DAvis 5-2393

TEMPERATURE ★ B&R SERVICE, INC. ★ SURVEYS ★ ★

BOX 1048 - FARMINGTON, NEW MEXICO

Pressure Survey

COMPANY PUBCO PETROLEUM CORP. | LEASE PUBCO STATE | WELL #6

FIELD | LOCATION

COUNTY SAN JUAN | STATE B NEW MEXICO | DATE 3-23-64

SHUT-IN 7 DAYS | ELEVATION | DATUM

ZERO POINT TBG. GATE | TBG. PRESSURE 685' DWT | CASING PRESSURE 685 DWT

TBG. DEPTH | CASING SET | P. B. T. D.

PACKER SET | CASING PERF. | MAX. TEMP.

FLUID LEVEL NONE

DEPTH	PRESSURE	GRADIENT
LUBE	687	
1000	708	.02
2000	727	.02
3000	741	.02
4000	762	.02
4500	772	.02
4900	779	.02
4949	781	.04

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Pubco Exhibit No. 3
Case No. 3105

Ac 4

NEW MEXICO OIL CONSERVATION COMMISSION
1000 RIO BRAZOS ROAD
Aztec, New Mexico
August 17, 1964

Pubco Petroleum Corporation
P.O. Box "P"
Aztec, New Mexico

Gentlemen:

Effective August 1, 1964 the calculated deliverability for your *State #6* well, located *L-36-31N-9W*, *Blanco Mesaverde* Pool is being corrected pursuant to Chapter II, Section II, Paragraph C of Order R-333-F of the New Mexico Oil Conservation Commission.

It is the Commission's position that the shut-in pressure previously measured and used for the 1963 annual deliverability test was abnormally low and does not accurately reflect the average reservoir pressure. We have therefore corrected the shut-in pressure used in the deliverability calculation by averaging its pressure with the deadweight pressures measured on the offset wells listed below.

WELL	LOCATION	PRESSURE
Delhi-Taylor Prichard #2	*H-1-30N-9W*	873
Pubco Petroleum State #5	*H-36-31N-9W*	789
EPNG Turner State #2	*A-2-30N-9W*	~~725~~ 724
Pubco State #6	*L-36-31N-9W*	708
Union Texas Johnston #9	*H-35-31N-9W*	[illegible]

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Pubco Exhibit No. *4*
Case No. *3105*

Gas supplement number NW ~~8493~~ *7492* is being issued this date correcting your gas allowable effective August 1, 1964. The corrected deliverability for your well as recalculated is *8913* MCFPD. Revised Form C-122-A is attached.

If you have any question regarding the above action or find errors in the deliverability recalculation please contact this office.

Yours very truly,

Emery C. Arnold

Emery C. Arnold
Supervisor, District #3

PUBCO PETROLEUM CO.
RECEIVED
AUG 1964
AZTEC, NEW MEXICO

cc: OCC, Santa Fe
Transporter, *EPNG, Farmington*

BEFORE THE
O.L CONSERVATION COMMISSION
Santa Fe, New M xico
Pubco Exhibit No. 4-A
Case No. 3105

Form C-122-A
Revised April 20, 1955

NEW MEXICO OIL CONSERVATION COMMISSION
GAS WELL TEST DATA SHEET - - SAN JUAN BASIN

(TO BE USED FOR FRUITLAND, PICTURED CLIFFS, MESAVERDE, & ALL DAKOTA EXCEPT BARKER DOME STORAGE AREA)

Pool Blanco Formation Mesaverde County San Juan
Purchasing Pipeline El Paso Natural Gas Company Date Test Filed 5-1-63

Operator PUBCO PETROLEUM CORP. Lease State Well No. 6
Unit L Sec. 36 Twp. 31N Rge. 9W Pay Zone: From 4493 To 5191
Casing: OD 5 WT. 15 Set At 5200 Tubing: OD 2 WT. 4.7 T. Perf. 4949
Produced Through: Casing X Tubing Gas Gravity: Measured .663 Estimated
Date of Flow Test: From 3-30-63 To 4-7-63 * Date S.I.P. Measured 4-14-63
Meter Run Size 4 Orifice Size 3.000 Type Chart Sq. Rt. Type Taps Flange

OBSERVED DATA

Flowing casing pressure (Dwt)	575	psig + 12 =	587 psia	(a)
Flowing tubing pressure (Dwt)	662	psig + 12 =	674 psia	(b)
Flowing meter pressure (Dwt)	550	psig + 12 =	562 psia	(c)
Flowing meter pressure (meter reading when Dwt. measurement taken:				
Normal chart reading		psig + 12 =	psia	(d)
Square root chart reading (7.5)^2 x spring constant	10	=	568 psia	(d)
Meter error (c) - (d) or (d) - (c)	±	=	-1 psi	(e)
Friction loss, Flowing column to meter:				
(b) - (c) Flow through tubing: (a) - (c) Flow through casing		=	25 psi	(f)
Seven day average static meter pressure (from meter chart):				
Normal chart average reading		psig + 12 =	psia	(g)
Square root chart average reading (7.65)^2 x sp. const.	10	=	585 psia	(g)
Corrected seven day avge. meter press. (p_f) (g) + (e)		=	584 psia	(h)
P_t = (h) + (f)		=	609 psia	(i)
Wellhead casing shut-in pressure (Dwt)	696	psig + 12 =	708 psia	(j)
Wellhead tubing shut-in pressure (Dwt)	696	psig + 12 =	708 psia	(k)
P_c = (j) or (k) whichever well flowed through		=	708 psia	(l)
Flowing Temp. (Meter Run)	77 °F + 460	=	537 °Abs	(m)
P_d = ½ P_c = ½ (l)		=	566 psia	(n)

FLOW RATE CALCULATION

Q = 6974 (integrated) x ($\sqrt{(c)}$ 562 = 23.70654 / $\sqrt{(d)}$ 563 23.72762 = .99911) = 6968 MCF/da

DELIVERABILITY CALCULATION

D = Q 6968 $\left[\dfrac{P_c^2 - P_d^2 = 180,908}{P_c^2 - P_w^2 = 56,344}\right]^n$ (3.2107)$^{.75}$ = 2.399 = 16,716 MCF/da.

216,225 / 155,705 1.2791 = 8913

"D" at 512 - 9407

SUMMARY

P_c =	708	775	psia
Q =	6968	6968	Mcf/day
P_w =	587	667	psia
P_d =	566	620	psia
D =	16,716	8913	Mcf/day

Company PUBCO PETROLEUM CORP.
By H. E. Maxwell, Jr.
Title Mgr. Aztec District
Witnessed by Glen O. Rhodes
Company PUBCO PETROLEUM CORP.

RECEIVED
MAY 2 1963
OIL CON. COM.
DIST. 3

* This is date of completion test.
* Meter error correction factor

REMARKS OR FRICTION CALCULATIONS

R	(1-e^{-s})	$(F_cQ)^2$	$(F_cQ)^2$ (1-e^{-s}) / R^2	P_t^2 (Column i)	$P_t^2 + R^2$	P_w
3201	.211	349.241	74.039	370.881	444,920	667

No. 1

DELIVERABILITY FORMULA

$$D = Q \left[\frac{(P_c^2 - P_d^2)}{(P_c^2 - P_w^2)} \right]^n$$

Where:

D = Deliverability Mcfd at the deliverability pressure, (P_d), (at Standard Conditions of 15.025 psia and 60°F).

Q = Daily flow rate in Mcfd, at wellhead pressure (P_w).

P_c = 7-day shut-in wellhead pressure, psia, determined in accordance with Section 2 of Chapter II.

P_d = Deliverability pressure, psia, as defined above.

P_w = Average static wellhead working pressure, as determined from 7-day flow period, psia, and calculated from New Mexico Oil Conservation Commission "Pressure Loss Due to Friction" Tables for San Juan Basin.

n = Average point slope of back pressure curves.

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Pubco Exhibit No. 2
Case No. 3105

No. 6

Phone DAvis 5-2393

TEMPERATURE ★ B&R. SERVICE, INC. ★ SURVEYS ★ ★

BOX 1048 - FARMINGTON, NEW MEXICO

Pressure Survey

COMPANY PUSCO PETROLEUM CORP.

FIELD

LEASE STATE

COUNTY SAN JUAN

LOCATION

WELL #6

SHUT-IN

STATE NEW MEXICO

ZERO POINT MASTER VALVE

ELEVATION

DATE 9-4-64 TO 9-11-64

TBG. DEPTH

TBG. PRESSURE

DATUM -700

PACKER SET

CASING SET

CASING PRESSURE

FLUID LEVEL

CASING PERF.

P. B. T. D.

MAX. TEMP 168°F

RUN 7 DAY BUILD-UP PRESSURE @ 4949'

DEPTH	PRESSURE	~~GRADIENT~~	Calculated Surface Pressure*
4949' (0 HR. 11:30 A.M. 9-4-64)			
1 HOUR	708 PSIG		
2 HOUR	710		
3 HOUR	711		646
4 HOUR	712		647
8 HOUR	713		648
10 HOUR	714		649
15 HOUR	715		650
20 HOUR	717		651
35 HOUR	718		652
45 HOUR	719		654
55 HOUR	720		655
95 HOUR	722		656
96 HOUR	722		657
167 HOUR	722		658
	722		658
			658
			658

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Pubco Exhibit No. 6
Case No. 3105

WELL SHUT IN 30 MINUTES BEFORE (0) HOUR.

*Surface pressure calculated using U.S.B.M. formula as presented in Monograph 7. Surface pressure measured with DWT to be 659 psia on 9/9/64.

DELIVERABILITY CALCULATION FORMULA

$$\text{Deliverability} = Q \times \left[\frac{(\text{Shut-in pressure})^2 - (\text{Deliverability Pressure})^2}{(\text{Shut-in pressure})^2 - (\text{Working Pressure})^2} \right]^N$$

1. Q is the average daily volume of gas that a well flowed during the test period.

2. Shut-in Pressure. This is a measured pressure at the wellhead after the well has been shut in seven days.

3. Working pressure is a pressure which is measured while the well is flowing. If the well is flowing through the tubing it is measured on the casing. If it is flowing through the casing it is measured on the tubing. The difference in pressure between the shut-in pressure and the working pressure is known as the draw down. A general statement which can be made is that "all other things being equal, the smaller the draw down the higher the deliverability. Also the smaller the draw down the greater the element of potential mathematical error in the deliverability calculation.

4. Deliverability pressure is not a measured pressure but is set by the Commission for each pool. In the Blanco Mesaverde Pool it is 80% of the Shut-in pressure (Pc). In the Basin Dakota Pool it is 50% of the Shut-in pressure.

5. N = average pool slope of the back pressure curve.

As may be seen from the formula it is very important that the shut-in pressure be an accurate pressure because it appears twice in the formula and the deliverability pressure is directly related to the shut-in pressure. If the shut-in pressure used is erroneously low the effect is always to increase the deliverability of a well. The reason for this is two fold. First, if the shut-in pressure of a well is lower than other wells in the pool then the deliverability pressure, being directly related to the shut-in pressure, is also low. Secondly, if the shut-in pressure is low it approaches a value nearer the value of the working pressure, making it appear that the well has drawn down less than it actually has. Mathematically the effect of this in the above mentioned formula is to make the denominator in the formula smaller and this causes the resulting multiplier to be larger, therefore the effect of using an erroneously low shut-in pressure is to give an erroneously high deliverability which does not truly reflect the ability of the well to produce gas. Theoretically, the shut-in pressure used in the deliverability calculation should be the reservoir pressure in the well's drainage area and this is not necessarily the pressure measured at the wellbore.

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
OCC Exhibit No. 1
Case No. 3105

file
Case 3105

OIL CONSERVATION COMMISSION
1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO

File
Case 3105

August 28, 1964

W.H. Hudson
1126 Mercantile Securities Building
Dallas 1, Texas

Attn: Mr. J.B. Avant

Re: #1 Fairfield, A-14-27N-13W
Basin Dakota Pool, San Juan
County, New Mexico

Dear Sir:

We have your letter of August 25, 1964, asking for a clarification of the re-calculation of the 1963 deliverability test for the above well.

Your well is one of approximately 60 wells on which 1963 deliverability tests have been re-calculated because we feel that pressures used in the deliverability calculations were not representative of the reservoir pressure. We take the position that the deliverability formula used in calculating well deliverabilities anticipates that the reservoir pressures in a given reservoir will be near the same pressure for all wells producing if the wells are in communication with each other. The lack of pressure stabilization in the Basin Dakota Pool is causing the measurement of abnormally low pressures on several wells and this pressure, when used in the deliverability calculation, exaggerates the well's deliverability. This happens because the low shut-in pressure causes the well to appear to have drawn down less than it actually has and as the deliverability pressure is directly related to the shut-in pressure in that it is a fixed percentage of the shut-in pressure it also causes the well's deliverability to be calculated to a lower base than other wells in the pool. We feel that if this situation is not corrected, particularly in the Basin Dakota Pool, serious inequities will result.

The above ruling has been challenged, specifically by the Pubco Petroleum Corporation, and a hearing has been set for September 16, 1964 at the Land Office Building in Santa Fe at 9:00 A.M. At this hearing Pubco in their application have stated that they wish to rescind the Commission's action in correcting the deliverability on one of their wells. I would

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF THE STATE OF NEW
MEXICO FOR THE PURPOSE OF
CONSIDERING:

CASE No. 2695
Order No. R-333-F

THE APPLICATION OF THE OIL CONSERVATION COMMISSION UPON ITS OWN MOTION FOR AN ORDER REVISING, AMENDING, OR DELETING CERTAIN PORTIONS OF ORDER R-333-C & D AS AMENDED BY ORDER R-333-E PERTAINING TO GAS WELL TESTING PROCEDURE APPLICABLE TO GAS WELLS COMPLETED IN SAN JUAN, RIO ARRIBA, McKINLEY, AND SANDOVAL COUNTIES, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on November 8, 1962, at Santa Fe, New Mexico, before Daniel S. Nutter, Examiner duly appointed by the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission," in accordance with Rule 1214 of the Commission Rules and Regulations.

NOW, on this 30th day of November, 1962, the Commission, a quorum being present, having considered the application, the evidence adduced, and the recommendations of the Examiner, Daniel S. Nutter, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That there is need for a number of additions to and revisions of Order No. R-333-C & D as amended by Order No. R-333-E, heretofore entered by the Commission, said order outlining a testing procedure for gas wells completed in the Counties of San Juan, Rio Arriba, McKinley, and Sandoval, New Mexico.

(3) That the following rules and regulations should be adopted, and that said rules and regulations are in the interest of conservation.

IT IS THEREFORE ORDERED:

(1) That the following Special Rules and Regulations governing gas well testing in the San Juan Basin (Counties of San Juan, Rio Arriba, McKinley, and Sandoval, New Mexico), superseding the rules and regulations contained in Commission Order No. R-333-C & D, as amended by Order No. R-333-E, are hereby promulgated and adopted as an exception to Rules 401 and 402 of the general statewide rules and regulations of this Commission relating to gas well testing procedures.

GAS WELL TESTING RULES AND PROCEDURES
SAN JUAN BASIN, NEW MEXICO

CHAPTER I TYPE OF TESTS REQUIRED

Section 1: Initial Deliverability and Shut-In Pressure Tests for Newly Completed Wells

A. Immediately upon completion of each gas well in the San Juan Basin, a shut-in pressure test of at least seven days duration shall be made.

B. Within 60 days after a well is connected to a gas transportation facility, the well shall have been tested in accordance with Section 1 of Chapter II of these rules, "Initial Deliverability and Shut-In Pressure Test Procedures," and the results of the test filed with the Commission's Aztec office and with the gas transportation facility to which the well is connected. Failure to file said test within the above-prescribed 60-day period will subject the well to the loss of one day's allowable for each day the test is late.

C. The requirements for Initial Tests and Annual Deliverability and Shut-In Pressure Tests and the notification requirements and scheduling of such tests which apply to newly completed wells shall also apply to reworked or recompleted wells.

D. Any tests taken for informational purposes prior to pipeline connection shall not be recognized as official tests for the assignment of allowables.

Section 2: Annual Deliverability and Shut-In Pressure Tests

A. Annual Deliverability and Shut-In Pressure Tests shall be made on all gas wells during the period from January 1 through December 31 each year except as follows:

1. An Annual Deliverability and Shut-In Pressure Test will not be required during the current year for any well connected to a gas transportation facility after October 31. Such tests may be taken at the option of the operator of the well, however.

2. When the Initial Deliverability and Shut-In Pressure Test required by Section 1-B above has been taken in accordance with the annual testing procedure outlined in Section 2 of Chapter II of these rules, the initial test may be considered the annual test for the year in which the test was completed. Provided however, that if an operator intends to use such initial test as the first annual test, he must notify the Commission and the gas transportation facility to which the well is connected of his intent in writing prior to the conclusion of the 14-day conditioning period.

B. All Annual Deliverability and Shut-In Pressure Tests required by these rules must be filed with the Commission's Aztec office and with the appropriate gas transportation facility within 30 days after the end of the month during which the test is completed. Provided however, that any test completed between December 1 and December 31 must be filed not later than January 10. Failure to file any test within the above-prescribed times will subject the well to the loss of one day's allowable for each day the test is late. No extension of time for filing tests beyond January 10 will be granted except after notice and hearing.

Section 3: <u>Scheduling of Tests</u>

A. <u>Annual Deliverability Tests</u>

By December 1 of each year, each gas transportation facility shall, in cooperation with the operators involved, prepare and submit a schedule of the wells to which it is connected which are to be tested during the ensuing January and February. Said schedule shall be entitled, "Annual Deliverability and Shut-In Pressure Test Schedule," and shall be submitted in triplicate to the Commission's Aztec office. At least one copy shall also be furnished each operator concerned. The schedule shall indicate the date of tests, pool, operator, lease, well number, and location of each well. At least 30 days prior to the beginning of each succeeding 2-month testing interval, a similar schedule shall be prepared and filed in accordance with the above.

The gas transportation facility shall be notified immediately by any operator unable to conduct any test as scheduled. In the event a well is not tested in accordance with the test schedule, the well shall be re-scheduled by the gas transportation facility, and the Commission and the operator of the well so notified in writing. Notice to the Commission must be received prior to the conclusion of the 14-day conditioning period.

It shall be the responsibility of each operator to determine that all of its wells are properly scheduled for testing by the gas transportation facility to which they are connected, in order that all annual tests may be completed during the testing season.

B. Deliverability Re-Tests

An operator may, in cooperation with the gas transportation facility, schedule a well for a deliverability re-test upon notification to the Commission's Aztec office at least ten days before the test is to be commenced. Such re-test shall be for good and substantial reason and shall be subject to the approval of the Commission. Re-tests shall in all ways be conducted in conformance with the Annual Deliverability Test Procedures of these rules. The Commission, at its discretion, may require the re-testing of any well by notification to the operator to schedule such re-test.

Section 4: Witnessing of Tests

Any Initial or Annual Deliverability and Shut-In Pressure Test may be witnessed by any or all of the following: an agent of the Commission, an offset operator, a representative of the gas transportation facility connected to the well under test, or a representative of the gas transportation facility taking gas from an offset operator.

CHAPTER II PROCEDURE FOR TESTING

Section 1: Initial Deliverability and Shut-In Pressure Test Procedure

A. Within 60 days after a newly completed well is connected to a gas transportation facility, the operator shall complete a deliverability and shut-in pressure test of the well in conformance with the "Annual Deliverability and Shut-In Pressure Test Procedures" prescribed in Section 2 of this chapter. Results of the test shall be filed as required by Section 1 of Chapter I of these rules.

B. In the event it is impractical to test a newly completed well in conformance with Paragraph A above, the operator may conduct the deliverability and shut-in pressure test in the following manner (provided, however, that any test so conducted will not be accepted as the first annual deliverability and shut-in pressure test as described in Paragraph A-2 of Section 2, Chapter I):

1. A 7- or 8-day production chart may be used as the basis for determining the well's deliverability, providing the chart so used is preceded by at least 14 days continuous production. The well shall produce through either the casing or tubing, but not both, into a pipeline during these periods. The production valve and the choke settings shall not be changed during either the conditioning or flow period with the exception of the first week of the conditioning period when maximum production would over-range the meter chart or location production equipment.

2. A shut-in pressure of at least seven days duration shall be taken. This shall be the shut-in test required in Paragraph A, Section 1 of Chapter I of these rules.

3. The average daily static meter pressure shall be determined in accordance with Section 2 of Chapter II of these rules. This pressure shall be used as P_t in calculating P_w for the Deliverability Calculation.

4. The daily average rate of flow shall be determined in accordance with Section 2 of Chapter II.

5. The static wellhead working pressure (P_w) shall be determined in accordance with Section 2 of Chapter II.

6. The deliverability of the well shall be determined by using the data determined in Paragraphs 1 through 5 above in the deliverability formula in accordance with Section 2 of Chapter II.

7. The data and calculations for Paragraphs 1 through 6 above shall be reported as required in Section 1 of Chapter I of these rules, upon the blue-colored Form C-122-A.

Section 2: <u>Annual Deliverability and Shut-In Pressure Test Procedure</u>

This test shall be taken by producing a well into the pipeline through either the casing or tubing, but not both. The production valve and choke settings shall not be changed during either the conditioning or flow periods except during the first seven days of the conditioning period when maximum production would over-range the meter chart or the location production equipment. The daily flowing rate shall be determined from an average of seven consecutive producing days, following a minimum conditioning period of 14 consecutive days production. The first seven days of said conditioning period shall have not more than one interruption, which interruption shall be no more than 36 continuous hours in duration. The eighth to fourteenth days, inclusive, of said conditioning period shall have no interruptions whatsoever. All production during the 14-day conditioning period plus the 7-day deliverability test period shall be at static wellhead working pressures not in excess of 75 percent of the previous annual 7-day shut-in pressure of the well if such previous annual shut-in pressure information is available; otherwise, the 7-day initial deliverability shut-in pressure of the well shall be used.

In the event that the existing line pressure does not permit a drawdown as specified above with the well producing unrestrictedly into the pipeline, the operator shall request an exception to this requirement on Form C-122-A. The request shall state the reasons for the necessity for the exception.

Instantaneous pressures shall be measured by deadweight gauge during the 7-day flow period at the casinghead, tubinghead, and orifice meter, and shall be recorded along with instantaneous meter-chart static pressure reading.

When it is necessary to restrict the flow of gas between the wellhead and orifice meter, the ratio of the downstream pressure to the upstream pressure shall be determined. When this ratio is 0.57, or less, critical flow conditions shall be considered to exist across the restriction.

When more than one restriction between the wellhead and orifice meter causes the pressures to reflect critical flow between the wellhead and orifice meter, the pressures across each of these restrictions shall be measured to determine whether critical flow exists at any restriction. When critical flow does not exist at any restriction, the pressures taken to disprove critical flow shall be reported to the Commission on Form C-122-A in the "Remarks" section of the form. When critical flow conditions exist, the instantaneous flowing pressures required hereinabove shall be measured during the last 48 hours of the 7-day flow period.

When critical flow exists between the wellhead and orifice meter, the measured wellhead flowing pressure of the string through which the well flowed during test shall be used as P_t when calculating the static wellhead working pressure (P_w) using the method established below.

When critical flow does not exist at any restriction, P_t shall be the corrected average static pressure from the meter chart plus friction loss from the wellhead to the orifice meter.

The static wellhead working pressure (P_w) of any well under test shall be the calculated 7-day average static tubing pressure if the well is flowing through the casing; it shall be the calculated 7-day average static casing pressure if the well is flowing through the tubing. The static wellhead working pressure (P_w) shall be calculated by applying the tables and procedures set out in the New Mexico Oil Conservation Commission Manual entitled "Method of Calculating Pressure Loss Due to Friction in Gas Well Flow Strings for San Juan Basin."

To obtain the shut-in pressure of a well under test, the well shall be shut in immediately after the 7-day deliverability flow test for the full period of seven consecutive days. Such shut-in pressure shall be measured within the next succeeding twenty-four hours following the 7-day shut-in period. The 7-day shut-in pressure shall be measured on both the tubing and the casing when communication exists between the two strings. The higher of such pressures shall be used as P_c in the deliverability calculation. When any such shut-in pressure is determined by the Commission to be abnormally low, the shut-in pressure to be used shall be determined by one of the following methods:

1. A Commission-designated value.

2. An average shut-in pressure of all offset wells completed in the same zone.

3. A calculated surface pressure based on a measured bottom-hole pressure. Such calculation shall be made in accordance with the New Mexico Oil Conservation Commission "Back Pressure Mannual," Example No. 7.

All wellhead pressures as well as the flowing meter pressure tests which are to be taken during the 7-day deliverability test period as required hereinabove shall be taken with a deadweight gauge. The deadweight reading and the date and time according to the chart shall be recorded and maintained in the operator's records with the test information.

Orifice meter charts shall be changed and so arranged as to reflect upon a single chart the flow data for the gas from each well for the full 7-day deliverability test period; however, no tests shall be voided if satisfactory explanation is made as to the necessity for using test volumes through two chart periods. Corrections shall be made for pressure base, measured flowing temperature, specific gravity, and supercompressibility; provided however, if the specific gravity of the gas from any well under test is not available, an estimated specific gravity may be assumed therefor, based upon that of gas from near-by wells, the specific gravity of which has been actually determined by measurement.

The 7-day average flowing meter pressure shall be calculated by taking the average of all consecutive 2-hour flowing meter pressure readings as recorded on the 7-day flow period chart. The pressure so calculated shall be used in calculating the wellhead working pressure, determining supercompressibility factors, and calculating flow volumes.

The 7-day flow period volume shall be calculated from the integrated readings as determined from the flow period orifice meter chart. The volume so calculated shall be divided by the number of testing days on the chart to determine the average daily rate of flow during said flow period. The flow chart shall have a minimum of seven and a maximum of eight legibly recorded flowing days to be acceptable for test purposes. The volume used in this calculation shall be corrected to New Mexico Oil Conservation Commission standard conditions.

The average flowing meter pressure for the 7-day or 8-day flow period and the corrected integrated volume shall be determined by the purchasing company that integrates the flow charts and furnished to the operator or testing agency when such operator or testing agency requests such information.

The daily volume of flow as determined from the flow period chart integrator readings shall be calculated by applying the Basic Orific Meter Formula:

$$Q = C' \sqrt{h_w P_f}$$

Where:

Q = Metered volume of flow Mcfd @ 15.025, 60° F., and 0.60 specific gravity.

C' = The 24-hour basic orifice meter flow factor corrected for flowing temperature, gravity, and supercompressibility.

h_w = Daily average differential meter pressure from flow period chart.

P_f = Daily average flowing meter pressure from flow period chart.

The basic orifice meter flow factors, flowing temperature factor, and specific gravity factor shall be determined from the New Mexico Oil Conservation Commission "Back Pressure Test Manual."

The daily flow period average corrected flowing meter pressure, psig, shall be used to determine the supercompressibility factor. Supercompressibility Tables may be obtained from the New Mexico Oil Conservation Commission.

When supercompressibility correction is made for a gas containing either nitrogen or carbon dioxide in excess of two percent, the supercompressibility factors of such gas shall be determined by the use of Table V of the C.N.G.A. Bulletin TS-402 for pressures 100-500 psig, or Table II, TS-461 for pressures in excess of 500 psig.

The use of tables for calculating rates of flow from integrator readings which do not specifically conform to the New Mexico Oil Conservation Commission "Back Pressure Test Manual" may be approved for determining the daily flow period rates of flow upon a showing that such tables are appropriate and necessary.

The daily average integrated rate of flow for the 7-day flow period shall be corrected for meter error by multiplication by a correction factor. Said correction factor shall be determined by dividing the square root of the chart flowing meter pressure, psia, into the square root of the deadweight flowing meter pressure, psia.

Deliverability pressure, as used herein, is a defined pressure applied to each well and used in the process of comparing the abilities of wells in a pool to produce at static wellhead working pressures equal to a percentage of the 7-day shut-in pressure of the respective individual wells. Such percentage shall be determined and announced periodically by the Commission based on the relationship of the average static wellhead working pressures (P_w) divided by the average 7-day shut-in pressure (P_c) of the pool.

The deliverability of gas at the "deliverability pressure" of any well under test shall be calculated from the test data derived from the tests hereinabove required by use of the following deliverability formula:

$$D = Q \left[\frac{\left(P_c^{\,2} - P_d^{\,2}\right)}{\left(P_c^{\,2} - P_w^{\,2}\right)} \right]^n$$

Where:

D = Deliverability Mcfd at the deliverability pressure, (P_d), (at Standard Conditions of 15.025 psia and 60°F).

Q = Daily flow rate in Mcfd, at wellhead pressure (P_w).

P_c = 7-day shut-in wellhead pressure, psia, determined in accordance with Section 2 of Chapter II.

P_d = Deliverability pressure, psia, as defined above.

P_w = Average static wellhead working pressure, as determined from 7-day flow period, psia, and calculated from New Mexico Oil Conservation Commission "Pressure Loss Due to Friction" Tables for San Juan Basin.

n = Average pool slope of back pressure curves as follows:

Mesaverde Formation	0.75
Dakota Producing Interval	0.75
Fruitland Formation	0.85
Farmington Formation	0.85
Pictured Cliffs Formation	0.85
Other Formations	0.75

(Note: Special Rules for Any Specific Pool or Formation May Supersede The Above Values. Check Special Rules If In Doubt.)

The value of the multiplier in the above formula (ratio factor after the application of the pool slope) by which Q is multiplied shall not exceed a limiting value to be determined and announced periodically by the Commission. Such determination shall be made after a study of the test data of the pool obtained during the previous testing season. The limiting value of the multiplier may be exceeded only after the operator has conclusively shown to the Commission that the shut-in pressure (P_c) is accurate or that the static wellhead pressure (P_w) cannot be lowered due to existing producing conditions.

Any test prescribed herein will be considered unacceptable if the average flow rate for the final 7-day deliverability test is more than ten percent in excess of any consecutive 7-day average of the preceding two weeks. A deliverability test not meeting this requirement shall be invalid and the well shall be re-tested.

All charts relative to initial or annual deliverability tests or photostats thereof shall be made available to the Commission upon its request.

All testing agencies, whether individuals, companies, pipeline companies, or operators, shall maintain a log of all tests accomplished by them, including all field test data.

All forms heretofore mentioned are hereby adopted for use in the San Juan Basin Area in open form subject to such modification as experience may indicate desirable or necessary.

Initial and Annual Deliverability and Shut-In Pressure Tests for gas wells in all formations shall be conducted and reported in accordance with these rules and procedures. Provided however, these rules shall be subject to any specific modification or change contained in Special Pool Rules adopted for any pool after notice and hearing.

CHAPTER III <u>INFORMATIONAL TESTS</u>

A. A one-point back pressure test may be taken on newly completed wells before their connection or reconnection to a gas transportation facility. This test shall not be a required official test but may be taken for informational purposes at the option of the operator. When taken, this test must be taken and reported as prescribed below:

<u>ONE-POINT BACK PRESSURE POTENTIAL TEST PROCEDURE</u>

1. This test shall be accomplished after a minimum shut-in of seven days. The shut-in pressure shall be measured with a deadweight gauge.

2. The flow rate shall be measured by flowing the well three hours through a positive choke, which has a 3/4-inch orifice.

3. A 2-inch nipple which provides a mechanical means of accurately measuring the pressure and temperature

of the flowing gas shall be installed immediately upstream from the positive choke.

4. The absolute open flow shall be calculated using the conventional back pressure formula as shown in the New Mexico Oil Conservation Commission "Back Pressure Test Manual."

5. The observed data and flow calculations shall be reported in duplicate on Form C-122, "Multi-Point Back Pressure Test for Gas Wells."

6. Non-critical flow shall be considered to exist when the choke pressure is 13 psig or less. When this condition exists the flow rate shall be measured with a pitot tube and nipple as specified in the Commission's Manual of "Tables and Procedure for Pitot Tests." The pitot test nipple shall be installed immediately downstream from the 3/4-inch positive choke.

7. Any well completed with 2-inch nominal size tubing (1.995-inch ID) or larger shall be tested through the tubing.

B. Other tests for informational purposes may be conducted prior to obtaining a pipeline connection for a newly completed well upon receiving specific approval therefor from the Commission's Aztec office. Approval of these tests shall be based primarily upon the volume of gas to be vented.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

EDWIN L. MECHEM, Chairman

E. S. WALKER, Member

S E A L

A. L. PORTER, Jr., Member & Secretary

esr/

suggest that you make arrangements to attend this hearing in order that you may make your opinion known.

If we can be of any further service in this matter, please contact us.

Yours very truly

Emery C. Arnold
Supervisor, District #3

ECA:ks

cc: Mr. A. L. Porter
OCC, Santa Fe, N.M.

The deliverability test for gas wells as required by Order R-333-F is a back-pressure test. The test result or deliverability is then used as a reflection of reserves for a drill tract in the assignment of gas allowable to a well.

The calculated deliverability, as a reflection of reserves, must decrease ~~as the reserves must decrease~~ as the reservoir is depleted. Pressure errors can cause a mathematical reversal of the deliverability calculation, and thus, show an increase of reserves as the reservoir is depleted. This is contrary to all reservoir history.

OCC Exhibit No. 10 shows a wide variation in seven-day pressures in the Blanco-Mesaverde Pool in the immediate area of the Pubco State #6 well located L-36-31N-9W.

The texts refered to by OCC Exhibit No. 8 are not expounding on theory. Their use is educational, to demonstrate the most accurate methods known to calculate tests and reserves of wells. Craft and Hawkins, on page 31 and 32 of their Applied Petroleum Reservoir Engineering list the well average system as the first of three methods ~~of~~ of determining an accurate usable pressure.

Reserve calculations by the volumetric method concerns the following factors: pressure, acreage, pay thickness, porosity, water saturation, oil saturation, gas saturation and recovery factor. The only factors which change in the life of a well are the pressure and recovery factor. They are changed only by production. The primary change caused by production is pressure reduction. The recovery factor must be reduced as the reservoir is depleted.

Pressure is directly related to reserves; i.e., when the pressure is reduced to half, the reserves are reduced to half.

Pressure relief of a reservoir is dependent upon production, either by sales, leaks or vents.

The well average pressure determination we used is an accepted and necessary method used for reserve calculations in partially depleted reservoirs. Our gas allocation formula uses the calculated deliverability to represent reserves. However, in reserve calculations the reservoir pressure is used only one time for each calculation. The reservoir pressure appears twice in the deliverability calculation a s shown on Pubco's Exhibit No.7. OCC Exhibit No. 7 shows the effect low drawdown applies to any small error of whatever cause. Drawdown being the difference between the shut-in pressure (P_c) and the working pressure (P_w).

OCC Exhibit No.2 shows an annual recap of the pressure changes shown by Exhibit No. 10. It proves, by the seven-day shut-in pressure history, that ~~of~~ the Pubco State #6 well has produced a greater percent of its reserves than the average offset well during the ten-year period shown. Actually, the Pubco State #6 well produced 32.1% of its reserves since 1954 while the average ~~xxx~~ status of the offset wells shows only 18.7% depletion of the 1954 reserves. The highest depletion percentage of the offsets is only 20.2% which is less than 2/3 rds. that of the Pubco State #6.

OCC Exhibit No.2 also shows the low drawdown of the Pubco State #6 well during the 1963 annual deliverability test. Any error in the shut-in pressure used to calculate the deliverability is magnified more as the percent of drawdown decreases. The actual value of drawdown on the Pubco State #6 well was 5.8%. This position on the curve of OCC Exhibit No. 7 shows high amplification of any error in data used in the test calculation.

Paragraph

The pressures determined to be "abnormally low" are those seven-day shut-in pressures where the wells did not attain 13.36% drawdown during the test. This percent of drawdown is where the deliverability multiplier value is 1.5. No specific pressure was selected for any pool; because, an average pressure for an entire pool would cause the deliverability pressure to be higher than the shut-in pressure for some of the edge wells which in turn would make the deliverability calculation impossible. for those wells.

The supporting statement by Tenneco Oil Company was not based upon the fact that they now own the Prichard #2 well located H-1-30N-9W, but was based upon the fact that thru similar treatment of their Callow Gas Unit "A" #1 in the Basin Dakota Pool they suffered a deliverability loss of 11,926 MCFPD and their San Juan Gravel Gas Unit "A" #1 had a deliverability loss of 1385 MCFPD.

The supporting statement by Southern Union Gas Company was prompted by a total deliverability loss of 3348 MCFPD on a total of six wells in two pools.

El Paso Natural Gas Company stated that they own a minor interest in the Pubco State #6 well and others which had received similar treatment. They operate 15 wells which had a total deliverability loss of 4303 MCFPD by similar treatment.

Union Texas Petroleum Corporation owns one well which had a deliverability loss of 12,105 MCFPD. They did not support Pubco Petroleum Corporation even though their loss was more than one and one half times that of Pubco. They did not ~~attend the~~ enter an appearance at the hearing.

Amerada Petroleum Corporation entered an appearance at the hearing. Their one-well deliverability loss was 1170 MCFPD, yet, they did not support Pubco. The deliverability loss of 1571 MCFPD on two wells did not cause Caulkins Oil Company to enter an appearance at the hearing.

RE-SUMMARY FOR THE OIL CONSERVATION COMMISSION - CASE 3105

The first determination which must be made in Case 3105 in order to decide the correctness of the tehcnical arguments is whether or not the Commission accepts the conclusion that the Area encompassed by The Pubco State #6 well and its direct offsets is in pressure communication within the Blanco Mesaverde reservoir. If this segment of the pool is in pressure communication, then certainly pressure stabilization is not being attained in any single proration unit of the five in question and gas is certainly moving from the area of high pressure to the areas of low pressure. This is fundamental. The portion of the Blanco Mesaverde pool encompassed by the proration units of the Pubco State #6 and its offsets is certainly in an above average portion of the pool, has better than average permeability and hence, communication would be expected. Geological cross sections across this portion of the field indicate continuity of stratigraphy, at least in so far as the Major sand bodies in the Mesaverde formation are conscerned. Definite evidence of both vertical and horizontal fracturing also has been noted in Mesaverde formations in this area. This would also aid communication. Communication is also clearly indicated by a study of pressure history in the area. The pressure history also shows that withdrawls have not been in accordance with reserves. This conclusion is mandatory if communication between the units is accepted. If withdrawls are not in accordance with reserved in place, then pressure ~~dl~~ differentials between the wells will occur, particularly in a relatively low permeability reservoir such as the Blanco Mesaverde pool. The more disproportionate the withdrawals, the longer the time needed for pressure stabilization between tracts and obviously seven days is not long enough to attain pressure stabilization in the area of these wells.

It is fundamental that the only proper pressure to be used in the deliverability calculation formula is the stabilized pressure for that area which is in pressure communication, whether it be an entire pool or a small segment of a pool. The authority cited on this point was not even challenged by Pubco.

The opponents to the use of average pressures in selected instances maintain that it is inconsistent to select particular tests for correction when probably the majority of the wells in the pool do not reach pressure stabilization in seven days and we have made no corrections in the vast majority of the wells in the pool. They claim that this is inconsistent and in fact they are right. However as was pointed out at the hearing, in the vast majority of cases on average and smaller wells, pressure inaccuracies do not cause large deliverability errors. Errors on most wells are small both from a percentage standpoint and from a total volume standpoint.

It is granted that it might be preferable to make offset pressure comparisons through out all fields and therby correct all low pressures. The administrative problems connected with this approach would be very large and it is doubtful if it could be accomplished with our present manpower. However the argument that large obvious errors should be overlooked and forgiven simply because perfection on all wells cannot be attained is not a sound argument and will lead us into flagrant violations of correlative rights.

The Pubco State #6 well has now produced 18+ billion cu. ft. of gas. This is over 56 million cu.ft. per acre. At the original proration hearing in the Blanco Mesaverde pool the most general accepted average Mesaverde reserve was 17 million cu.ft. per acre. The maximum Mesaverde reserve calculated by the Commission staff was 27 million cu. ft. per acre. The wildest estimate of possible Mesaverde reserves was 29 billion cu. ft. per 320 acre unit or 81.5 million cu.ft. per acre. This last figure was Pubco's own estimate for the State #6 well based upon a pressure decline versus production study during the first year of production. (Transcript case 330-330-A, volume 1, page 77 & 78). The initial reservoir pressure for the State #6 was 1114 lbs. The pressure at the time of the 1963 annual test as measured was 708 psia or 44.638 million cu.ft. per pound of pressure drop. This would calculate to a recoverable reserve to 100 psia abandonment of 45.26 billion cu.ft. or 141.45 million cu.ft. per acre. You will note that this figure, 141.45 million cu.ft. per acre is larger than Pubco's original estimate of 91.5 million cu.ft. per acre by 49.95 million cu.ft. per acre.

Another useful comparison maybe made by using a volumetric approach in calculating possible reserves in this poration unit and comparing this with the volume calculated from the pressure decline method. Pubco did not present any volumetric reserve calculations at this hearing. However in the original proration hearing they testified that 439 ' of perforations were open in the well bore of the State #6 well. They also testified that the maximum porosity was 15% (which incidentally is about 4% better than most other wells claim). The minimum interstital water was estiminated to be 30%. These are all maximum volumes in so far as reserve determination is conserned. No other wel l in the pool claims over 150 ft. of pay, 40% is the usual water saturation used and the average porosity used is about 11%. However, even when we use all the maximum parameters mentioned by Pubco in the original hearing, and we certainly deny that this is a realistic or fair approach, the arrived at reserve for this tract does not justify the production this well has been allowed. Using their figures the volumetric reserve calculates approximately 44 billion cu. ft. The pressure decline versus production reserve of 45.26 billion even exceeds this figure by 1.26 billion.

To say in the face of this kind of evidence that this well is not in communication with its offsets is sheer nonsense. It is not only in communication with its offsets, but has already drained substantial areas outside its proration unit.

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

State of New Mexico
Oil Conservation Commission

'64 SEP 28 AM 8 ...

LAND COMMISSIONER
E. S. JOHNNY WALKER
MEMBER

1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO

STATE GEOLOGIST
A. L. PORTER, JR.
SECRETARY - DIRECTOR

September 25, 1964

N.M.O.C.C.
Box 2088
Santa Fe, N.Mex. 87501

Attn: Mr. James Durrett

Dear Jim:

Enclosed is our summary of Case #3105, which you may use in any way that you wish. If there is duplication it is because I wrote part of it and Al wrote part of it and we did not necessarily divide the subject matter. For that reason I am sure you may want to consolidate the information. You may also wish to tone down my language in a place or two.

I read Marshall Smith's brief summary in the Statehouse Reporter and would like to take exception with the wording he has used. He said that I said, quote; "....Theoretically, the shut-in pressure used in the deliverability calculation should be the reservoir pressure in the well's drainage area and this is not necessarily the pressure measured at the well bore". I do not recall mentioning that the above idea was theoretical. We take the position that the above mentioned method is fundamental. Any departure from this method is theoretical. If we didn't prove anything else in the case, I believe we proved that!

Let me know if you need any further information.

Yours truly,

Emery C. Arnold

Emery C. Arnold
Supervisor, Dist. #3

ECA/bj

BEFORE THE OIL CONSERVATION COMMISSION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF PUBCO PETROLEUM CORPORATION SEEKING REVIEW AND RECISION OF THE COMMISSION'S ACTION IN DETERMINING UNDER ORDER R-333-F THAT THE SHUT-IN PRESSURE FOR DELIVERABILITY CALCULATION PURPOSES WAS ABNORMALLY LOW IN ITS STATE NO. 6 WELL, UNIT L, SECTION 36, TOWNSHIP 31 NORTH, RANGE 9 WEST, NMPM, BLANCO MESA-VERDE POOL.

Case No. 3105

SUPPLEMENTARY STATEMENT SUBMITTED BY
PUBCO PETROLEUM CORPORATION

At the time this matter was heard before the Commission, permission was granted to interested parties to file within a two-week period following the hearing a statement of position of such party with relation to the matters considered at the hearing. Pubco Petroleum Coporation, through its counsel, assumes that such permission did not exclude the applicant from submitting such a statement. In brief form, the position of the applicant is restated as follows:

1. The provisions of Order R-333-F were not intended to and do not apply to situations where the shut-in pressure (P_c) for the purposes of deliverability calculation through the use of deliverability formula for Northwest New Mexico is conceded to be an accurate measured pressure not influenced or rendered inaccurate by the presence of liquids in the well or some other extraneous mechanical substances.

2. The substitution of an assumed pressure not representative of the accurate measured shut-in pressure

into the deliverability formula distorts the interdependency and relationship between the deliverability formula factors so that the deliverability, as calculated, is not representative of an individual well's deliverability and consequently denies to that well the use of the formula upon which allowable is based.

3. The use of an average shut-in pressure of the offsetting wells to the well in question is not justified, even under Order R-333-F, for the reason that the offset wells and the subject wells are not producing from the same zone, as required by the Order.

At the hearing, the point was made by the applicant that Order R-333-F has no application to an individual well whose shut-in pressure is measured accurately for the purposes of annual deliverability tests and when such measured pressure is conceded to be accurate. Reference was made to the testimony in Oil Conservation Commission Case 2695, in which hearing the provisions of Order R-333-F were considered and explained, following which the Order was adopted. The members of the Commission asked for specific reference to the testimony in Case 2695 supporting this contention. The following page references are to the transcript of the hearing:

Page 7. Questions by Mr. Durrett; Answers by Mr. Utz.

Q. Do your rules provide methods for taking shut-in pressure on wells which cannot have both casing and tubing measured and shut-in pressure which appear to be low due to liquids in the bore?

A. Yes. On page 6, down about the fourth paragraph, the latter part of that paragraph we have entered this wording, some of which I will recommend a deletion, the second word, beginning with "the high of such pressures," that should be "the higher of such pressures shall be used as P_c in the deliverability calculation. When any such shut-in pressure has been determined by the Commission to be abnormally low, the shut-in pressure to be used shall be determined by one of the following methods:," then we list three methods.

These three methods are as follows: "A Commission designated value." Well, first, I had better elaborate slightly on the portion that I would like deleted from this paragraph. After the words "abnormally low" I would suggest that we delete "or when only one pressure is available." In some instances it is not possible to get the second pressure or annular pressure normally on conventional wells, and even on dual completions where you can take but one pressure, if that pressure appears to be a normal shut-in pressure I doubt the feasibility of compelling the operator to prove that it is actually an accurate pressure by some other means.

The first method would be "A Commission designated value." This would be, it would have to be done only in instances where the shut-in pressure appeared to be abnormally low. The Commission may designate a value from its records. In other words, it is our intention to contour the previous year's pressures for each pool, which would give you a very good indication by location as to whether or not the pressure was abnormally low.

The second would be an average shut-in pressure of all offset wells completed in the same zone. Where this is possible the average shut-in pressure from all offset wells would be applicable pressure or acceptable pressure.

The third method would be the calculation of surface pressure based on a measured bottom hole pressure, and this calculation should be made in accordance with the Example No. 7 in the Commission Back Pressure Manual, which simply means that you would run a bomb and determine the bottom hole pressure and calculate back to the surface on a gas gradient.

Page 11. Mr. Durrett and Mr. Utz.

Q. Do your rules propose that a limiting multiplier be used concerning wells which report a very low shut-in pressure or that cannot achieve a 25% drawdown?

A. Yes, they do. Even though we propose a deliverability pressure determined as stated, we know that in some instances where we have liquid problems and known liquid problems, that we will have shut-in pressure, surface shut-in pressures that are abnormally low. These surface shut-in pressures we know are not accurate.

The deliverability formula itself presumes that the P_c in the formula be an accurate indication of the reservoir pressure, static reservoir pressure. Therefore, to take care of these instances where we have abnormally low shut-in pressures, and in order to control those exaggerated deliverabilities, we believe that the multiplier, which is the value inside the brackets of the deliverability formula, after it's been raised to the power, should be limited to some value to be determined by the Commission.

To go a little farther with that, while the rule does not specifically state how that should be done, I believe that I will recommend that ~~multiplier be,~~ ~~the~~ maximum multiplier be determined in this manner, by the use of the lowest seven-day shut-in pressure in the pool which is determined to be accurate. In other words, no other reservoir conditions affecting that pressure. And the pool average working pressure be put in the deliverability formula to determine what the multiplier is under those conditions, and that no multiplier should be used higher than that.

It is conclusive that Order R-333-F has no application to Pubco State No. 6 Well, since the measured seven-day shut-in pressure is conceded to be accurate and that the test was not influenced by liquid problems, by variations in tubing casing pressure, or by the failure of the reservoir pressure from which this well is producing not having stabilized within the test period. This was demonstrated conclusively by the shut-in pressure test recently conducted by Pubco, the evidence of which is before the Commission, which indicated that the well stabilized in 55 hours and thereafter the pressure increased not one pound or fraction thereof during the remainder of the seven-day test period. The reservoir pressure was therefore conclusively established as the bottom hole pressure of the well after stabilization. This stabilized pressure is in line on a decline curve basis showing decreasing deliverabilities for this well for the years 1960, 1962, 1963, 1964 and the most recent test in 1964. Admittedly, the 1961 deliverability pattern of the decline sharply reversed, indicating the inaccuracy of the 1961 test. However, it is unusual engineering practice to assume that of five tests following the same curve, the sixth which seems not to follow the curve is the correct test. The decline curve demonstrated to the Commission at the hearing was prepared on the basis of decreasing deliverability vs. accumulated production, which is the usual basis in customary engineering practices.

The use of an average offset well shut-in surface pressure under Order R-333-F is qualified by the fact that an accurate pressure reading is not available, and when used, the Order specifically states, "an average shut-in pressure of all offset wells completed in the same zone." It was demonstrated at the time of the hearing of this matter that the various sections of the Mesaverde Formation, including the Menafee, the Point Lookout and the Cliff House, open in the State No. 6 Well, greatly exceeded by several times that of any of the offset wells with the exception of Pubco State No. 5 Well. The accurate pressure measured in the State No. 6 Well is a composite pressure of all the reservoirs in which the State No. 6 Well is open and its positive stabilization at 55 hours in a seven-day test is indicative that that pressure represents reservoir pressure and not simply well bore pressure. Such evidence of test accuracy is not available from the offset wells. It would therefore seem incongruous to use an average pressure when an accurate pressure is available. Order R-333-F was not intended to provide a means for the Commission to adjust allowables to conform to what the Commission staff thinks they should be, and while it might be convenient for the purpose of accomplishing that end to use an average shut-in pressure of offset wells, such use exceeds the authority granted by the Order to the

Commission staff. We therefore respectfully submit that the action resulting in the substitution of an unrepresentative pressure for an accurate pressure in the 1963 deliverability test for the Pubco State No. 6 Well results in discrimination in the use of the deliverability formula to which all operators are subject and not to be allowed legally, in equity or in good conscious. The deliverability for 1963 of the Pubco State No. 6 Well should be established on the basis as originally reported by the operator prior to change by the Commission.

Respectfully submitted,

MODRALL SEYMOUR SPERLING ROEHL & HARRIS

By James E Sperling

ON BEHALF OF PUBCO PETROLEUM CORPORATION

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JAMES P. SAUNDERS, JR.

JAMES A. PARKER
HENRY G. COORS

JOHN F. SIMMS (1885-1954)

MAIN OFFICE '64 SEP 29 AM 8 3?

September 28, 1964

Mr. A. L. Porter
N. M. Oil Conservation Commission
Post Office Box 2088
Santa Fe, New Mexico

Re: Case No. 3105

Dear Mr. Porter:

I am enclosing herewith for inclusion in the record the Supplementary Statement of Pubco Petroleum Corporation, applicant in the captioned case. I am sending a copy of the statement directly to Mr. Durrett for his use.

As you are aware, this is a matter of extreme concern to Pubco Petroleum Corporation, as operator, as well as other interest owners in the well affected, and an expeditious decision consistent, of course, with full and adequate consideration, is respectfully requested.

Very truly yours,

James E. Sperling

James E. Sperling

JES/sd

Encl.

cc: Mr. Frank Gorham
Pubco Petroleum Corporation

BEFORE THE OIL CONSERVATION COMMISSION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF PUBCO PETROLEUM CORPORATION SEEKING REVIEW AND RECISION OF THE COMMISSION'S ACTION IN DETERMINING UNDER ORDER R-333-F THAT THE SHUT-IN PRESSURE FOR DELIVERABILITY CALCULATION PURPOSES WAS ABNORMALLY LOW IN ITS STATE NO. 6 WELL, UNIT L, SECTION 36, TOWNSHIP 31 NORTH, RANGE 9 WEST, NMPM, BLANCO MESA-VERDE POOL.

Case 3105

APPLICATION

1. Pubco Petroleum Corporation seeks review of and relief from the effect of the action of the Commission in determining under Order R-333-F that the shut-in pressure measured and used for 1963 annual deliverability test was abnormally low in applicant's State No. 6 Well, located in Unit L, Section 36, Township 31 North, Range 9 West, NMPM, Blanco Mesaverde Pool.

2. The action of the Commission has adversely affected applicant by reducing allowable assigned to said well.

3. That applicant's correlative rights are adversely affected, and applicant should have an opportunity to be heard and given opportunity to show that the measured shut-in pressure is not abnormally low so as to require arbitrary recalculation.

4. That the action of the Commission heretofore taken, as reflected in notice from the Commission's District No. 3 Office dated August 17, 1964, is not justified and should be rescinded.

5. That should the action of the Commission result in loss of allowable pending review and recision

DOCKET MAILED

Date 9-4-64

of the Commission's action complained of, applicant should be permitted to make up such allowable.

WHEREFORE, applicant prays that this matter be set for hearing before the Commission on its next hearing date, and following such hearing, a determination be made that the shut-in pressure, as measured in applicant's State No. 6 Well, is normal and should be used in the determination of said well's allowable and that any loss of allowable resulting from the recalculation made by the Commission effective August 1, 1964 be restored to said well and allowed to be produced therefrom.

PUBCO PETROLEUM CORPORATION

BY W. A. KELEHER, ATTORNEY
FIRST NATIONAL BANK BUILDING
ALBUQUERQUE, NEW MEXICO

AND

MODRALL SEYMOUR SPERLING ROEHL & HARRIS

BY James E Sperling
Attorneys for Applicant

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

State of New Mexico
Oil Conservation Commission

LAND COMMISSIONER
E. S. JOHNNY WALKER
MEMBER

STATE GEOLOGIST
A. L. PORTER, JR.
SECRETARY - DIRECTOR

P. O. BOX 2088
SANTA FE

October 2, 1964

Mr. James E. Sperling
Modrall, Seymour, Sperling, Roehl
& Harris
Attorneys at Law
Suite 1200 - Simms Building
Albuquerque, New Mexico

Re: CASE NO. 3105
ORDER NO. R-2774
APPLICANT PUBCO PETROLEUM

Dear Sir:

Enclosed herewith are two copies of the above-referenced Commission order recently entered in the subject case.

Very truly yours,

A. L. Porter, Jr.

A. L. PORTER, Jr.
Secretary-Director

ir/

Carbon copy of order also sent to:

Hobbs OCC x

Artesia OCC

Aztec OCC x

OTHER Mr. W. A. Keleher
Mr. Richard S. Morris
Mr. Ben Howell
Mr. J. D. Moon

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF NEW MEXICO FOR
THE PURPOSE OF CONSIDERING:

CASE No. 3105
Order No. R-2774

APPLICATION OF PUBCO PETROLEUM CORPORATION
FOR RECISION OF AN ADMINISTRATIVE DETERMINATION UNDER ORDER NO. R-333-F, SAN JUAN COUNTY,
NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on September 16, 1964, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission."

NOW, on this 1st day of October, 1964, the Commission, a quorum being present, having considered the testimony presented and the exhibits received at said hearing, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That the applicant, Pubco Petroleum Corporation, seeks recision of an administrative determination that the 1963 Annual Shut-In Pressure reported for the applicant's State Well No. 6 located in Unit L of Section 36, Township 31 North, Range 9 West, NMPM, Blanco-Mesaverde Pool, San Juan County, New Mexico, was abnormally low and should be averaged with the shut-in pressure of all offset wells in the Blanco-Mesaverde Pool under the provisions of Chapter II, Section 2, of the Gas Well Testing Rules and Procedures established by Order No. R-333-F.

(3) That the Commission's administrative action was based upon an administrative determination that the Pubco State Well

No. 6 is located in a low pressure area or production pressure-sink, that the measured 7-day shut-in pressure in the Pubco State Well No. 6 does not accurately reflect true stabilized reservoir pressure, and that use of the measured shut-in pressure in the deliverability calculation formula results mathematically in the assignment of a disproportionately large allowable to the Pubco State Well No. 6.

(4) That Order No. R-333-F and its supporting record do not specifically authorize the administrative determination made by the Commission in this case.

(5) That the Commission's administrative determination concerning the 1963 shut-in pressure of the Pubco State Well No. 6 should be rescinded.

IT IS THEREFORE ORDERED:

(1) That the Commission's administrative determination that the 1963 Annual Shut-In Pressure reported for the Pubco State Well No. 6 located in Unit L of Section 36, Township 31 North, Range 9 West, NMPM, Blanco-Mesaverde Pool, San Juan County, New Mexico, should be averaged with the shut-in pressure of all offset wells in the Blanco-Mesaverde Pool is hereby rescinded.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

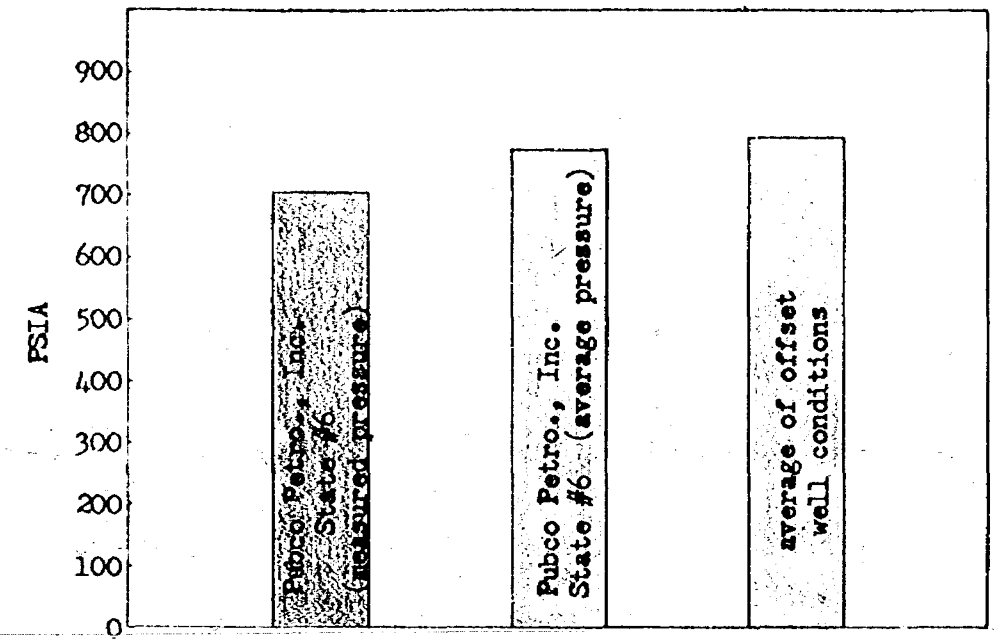
STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

Jack M Campbell
JACK M. CAMPBELL, Chairman

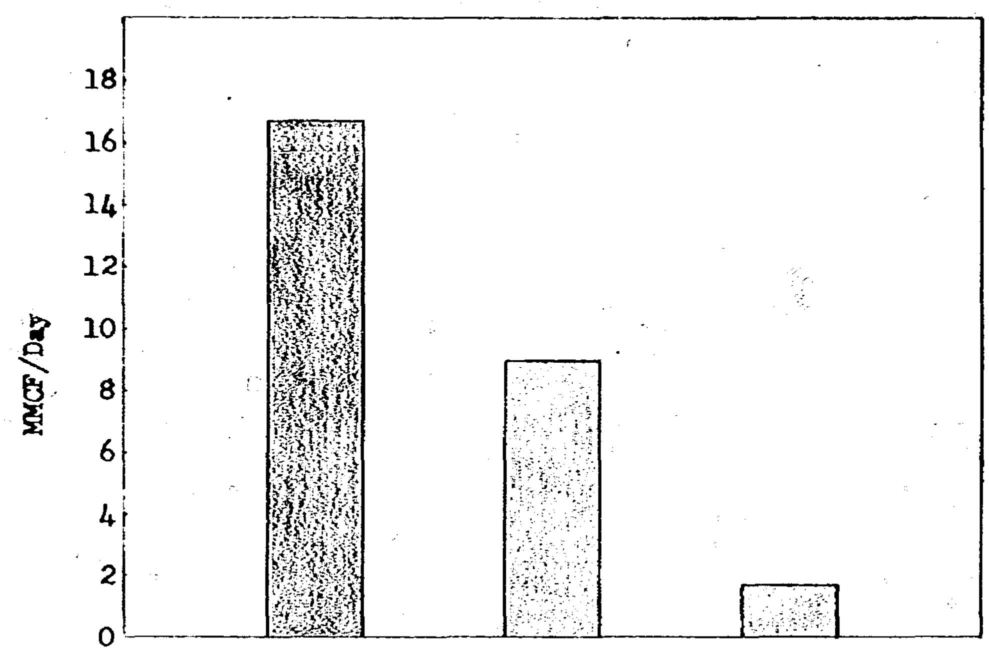
E S Walker
E. S. WALKER, Member

A. L. Porter, Jr.
A. L. PORTER, Jr., Member & Secretary

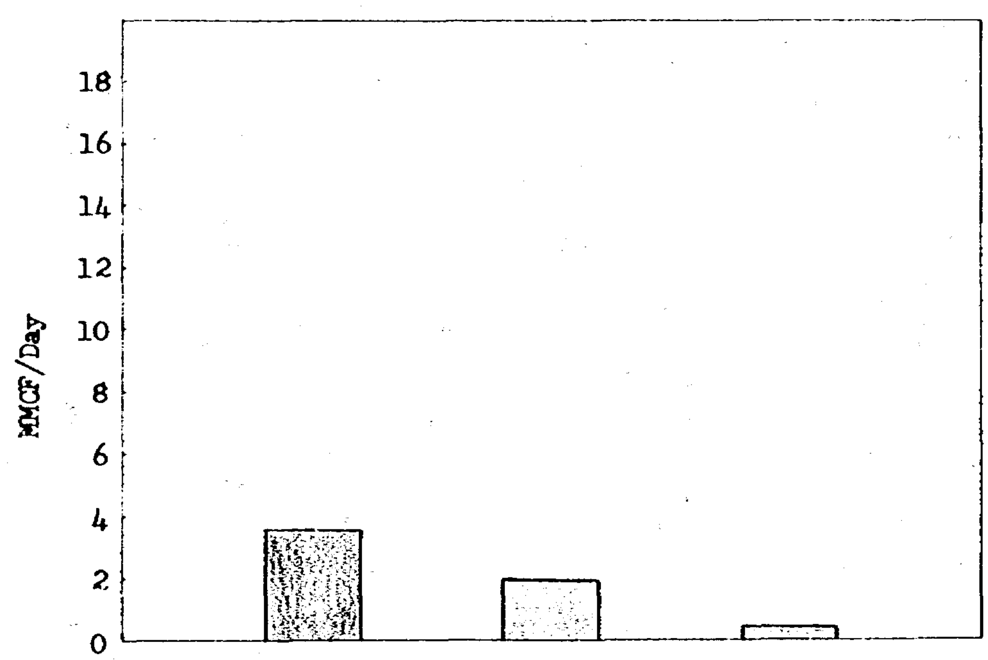
esr/



PRESSURE



DELIVERABILITY



ALLOWABLES

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
OCC Exhibit No. 5
Case No. 3105

EXHIBIT SHOWING EFFECT OF USING OFFSET AVERAGE PRESSURES IN
DELIVERABILITY CALCULATION - WELL, PUBCO STATE #6

Average Pressure of Five Wells
(Pubco State #6 and Its Offsets)

		Press. psia
Delhi-Taylor #2 Pritchard	H-1-30N-9W	873
Pubco Petroleum #5 State	H-36-31N-9W	789
El Paso Nat. Gas #2 Turner State	A-2-30N-9W	724
Union Texas #9 Johnston	H-35-31N-9W	782
Pubco Petroleum #6 State	L-36-31N-9W	708
	Total 5 Wells	3876
	Average Pressure	775

Deliverability Calculation Comparison

Q = 6968

	Press. psia	*Del mcf/d	*Allowable mcf/mo.
Using Actual Measured Pressures on Pubco State #6	708	16,716	107,078
Using 5-Well Average of 4 Offset Wells & Pubco State #6	775	8,913	57,903

Offset Deliverability Test & Allowable Comparison

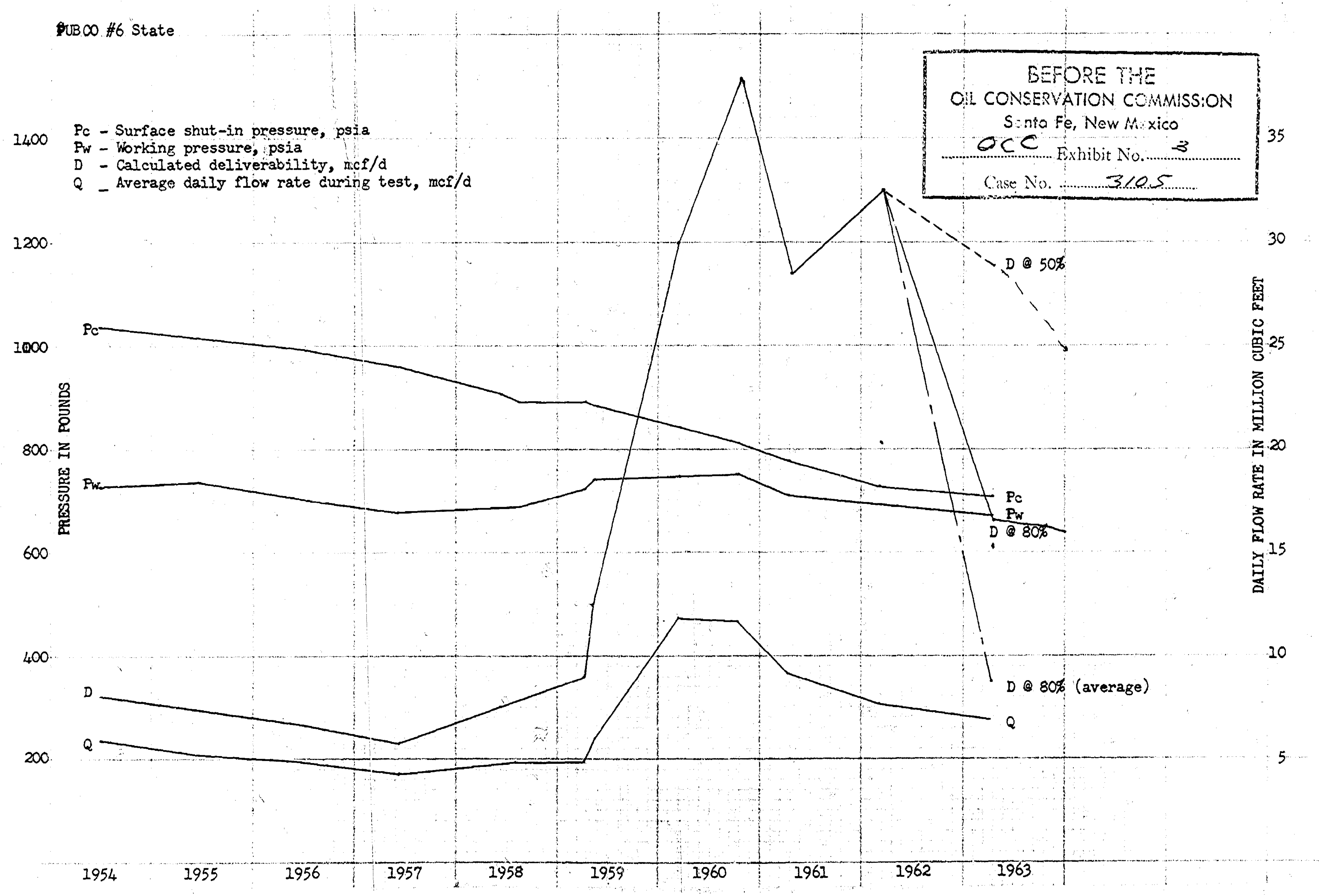
		Press. psia	Q. mcf/d	*Del mcf/d	*Allowable mcf/mo.
Delhi-Taylor #2 Pritchard	H-1-30N-9W	873	4,549	3,772	
EPNG #2 Turner State	A-2-30N-9W	724	528	518	
Pubco State #5	H-36-31N-9W	789	1,642	1,543	
Union Texas #9 Johnston	H-35-31N-9W	782	853	692	
Four Offset Wells, Average Values		792	1,893	1,631	12,011

*Allowable based on average of allocation factors for 12 months period Mar.1,1963 through February 29, 1964

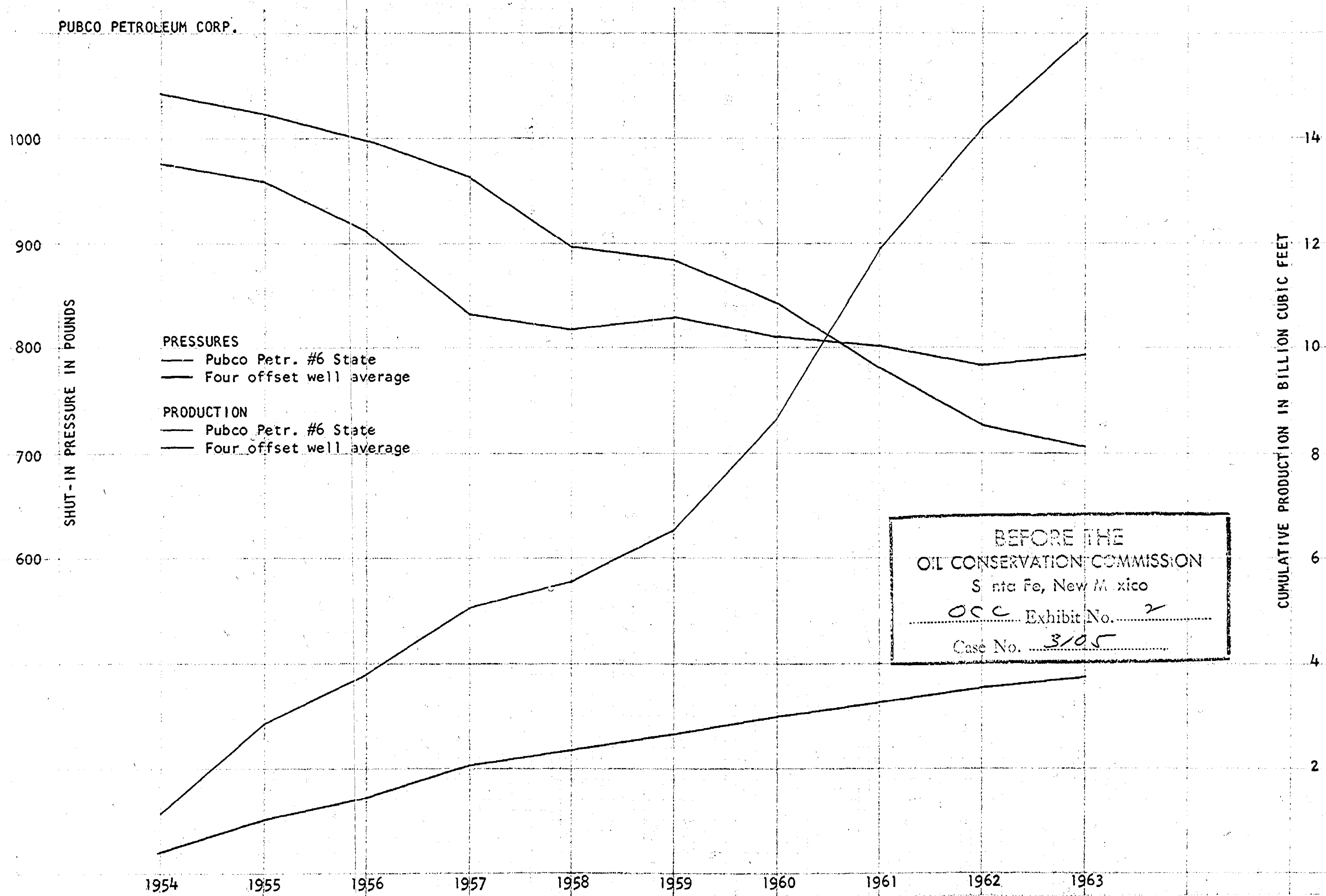
*All deliverability date from 1963 annual tests.

PUBCO #6 State

BEFORE THE
OIL CONSERVATION COMMISSION
Santo Fe, New Mexico
OCC Exhibit No. 3
Case No. 3105



PUBCO PETROLEUM CORP.



BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
OCC Exhibit No. 2
Case No. 3105

DELIVERABILITY CALCULATION FORMULA

$$\text{Deliverability} = Q \times \left[\frac{(\text{Shut in pressure})^2 - (\text{Deliverability Pressure})^2}{(\text{Shut in pressure})^2 - (\text{Working Pressure})^2} \right]^N$$

1. Q is the average daily volume of gas that a well flowed during the test period.

2. Shut-in pressure. This is a measured pressure at the wellhead after the well has been shut-in seven days.

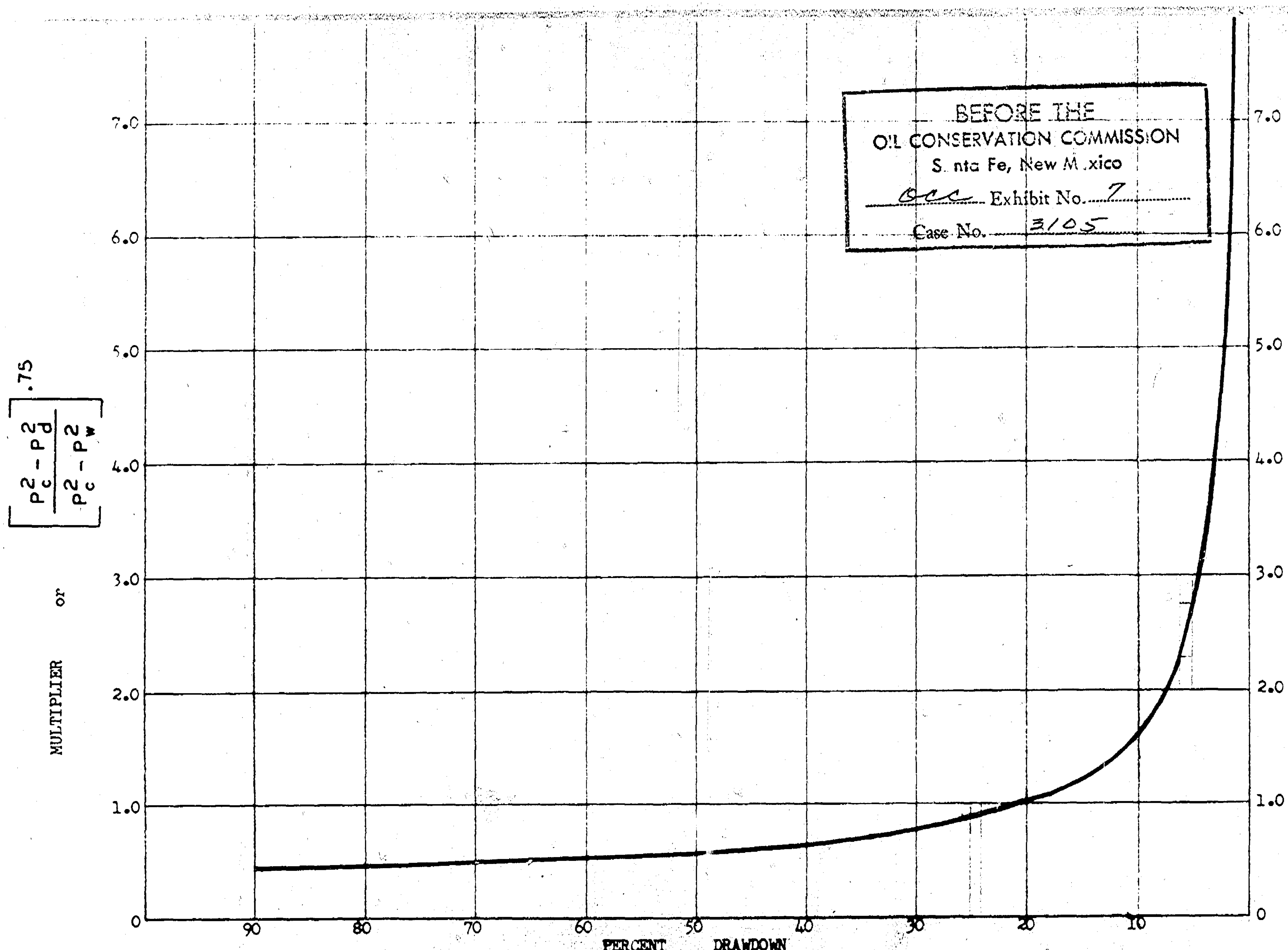
3. Working pressure is a pressure which is measured while the well is flowing. If the well is flowing through the tubing it is measured on the casing. If it is flowing through the casing, it is measured on the tubing. The difference in pressure between the shut-in pressure and the working pressure is known as the draw down. A general statement which can be made is that "all other things being equal, the smaller the draw down the higher the deliverability". Also the smaller the draw down the greater the element of potential mathematical error in the deliverability calculation.

4. Deliverability pressure is not a measured pressure but is set by the Commission for each pool. In the Blanco Mesaverde Pool it is 80% of the Shut-in pressure (Pc). In the Basin Dakota Pool it is 50% of the Shut-in pressure.

5. N = Average pool slope of the back pressure curve.

As may be seen from the formula, it is very important that the shut-in pressure be an accurate pressure because it appears twice in the formula and the deliverability pressure is directly related to the shut-in pressure. If the shut-in pressure used is erroneously low the effect is always to increase the deliverability of a well. The reason for this is two fold. First, if the shut-in pressure of a well is lower than other wells in the pool then the deliverability pressure, being directly related to the shut-in pressure, is also low. Secondly, if the shut-in pressure is low it approaches a value nearer the value of the working pressure making it appear that the well has drawn down less than it actually has. Mathematically the effect of this in the above mentioned formula is to make the denominator in the formula smaller and this causes the resulting multiplier to be larger, therefore the effect of using an erroneously low shut-in pressure is to give an erroneously high deliverability which does not truly reflect the ability of the well to produce gas. Theoretically, the shut-in pressure used in the deliverability calculation should be the reservoir pressure in the well's drainage area and this is not necessarily the pressure measured at the wellbore.

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
OPC Exhibit No. 1
Case No. 3185



MULTIPLIER or $\left[\frac{P_c^2 - P_d^2}{P_c^2 - P_w^2}\right]^{.75}$
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
90
80
70
60
50
40
30
20
10
PERCENT DRAWDOWN
BEFORE THE
OIL CONSERVATION COMMISSION
S. nta Fe, New M. xico
Occ Exhibit No. 7
Case No. 3105

<u>AUTHORITIES</u>

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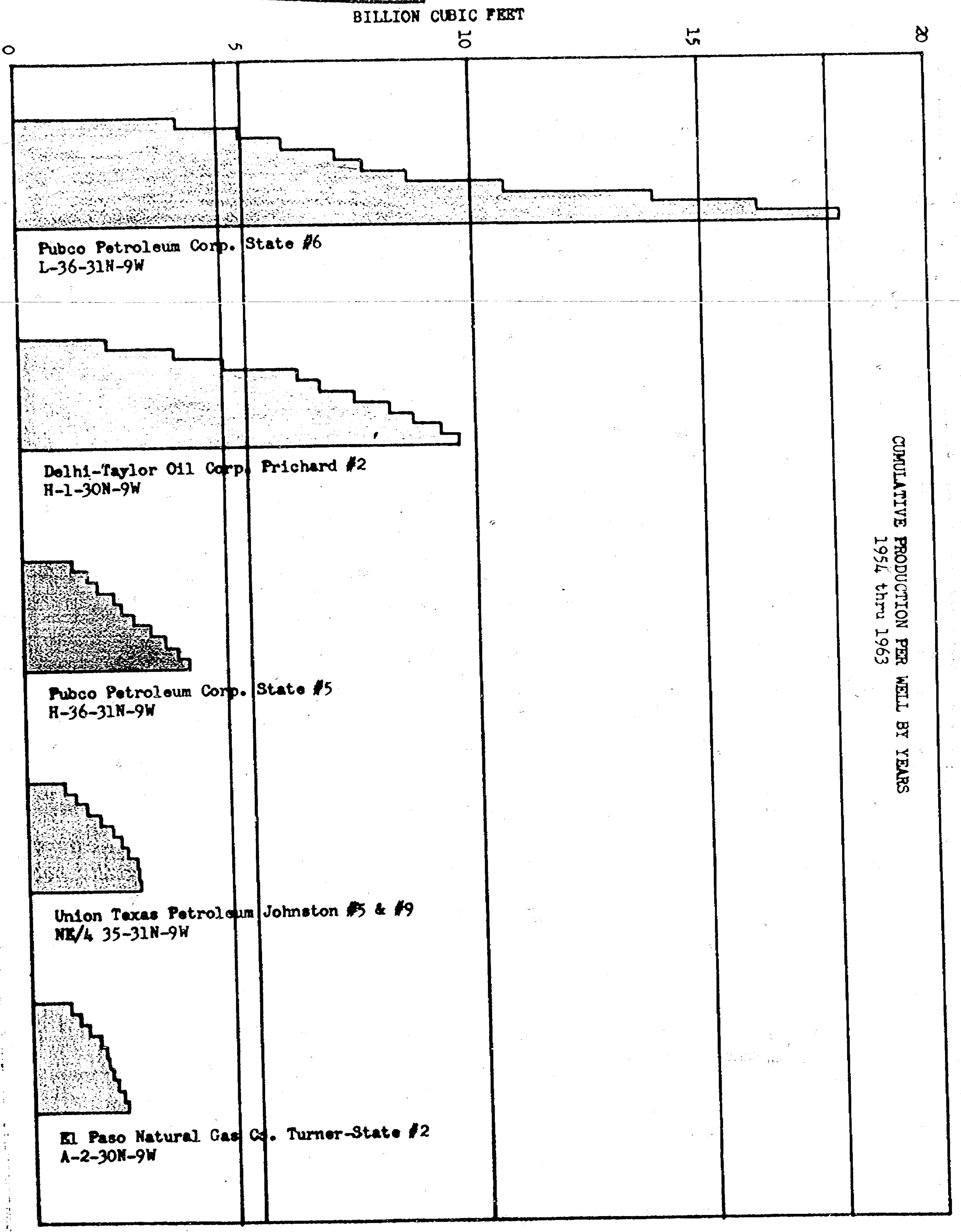
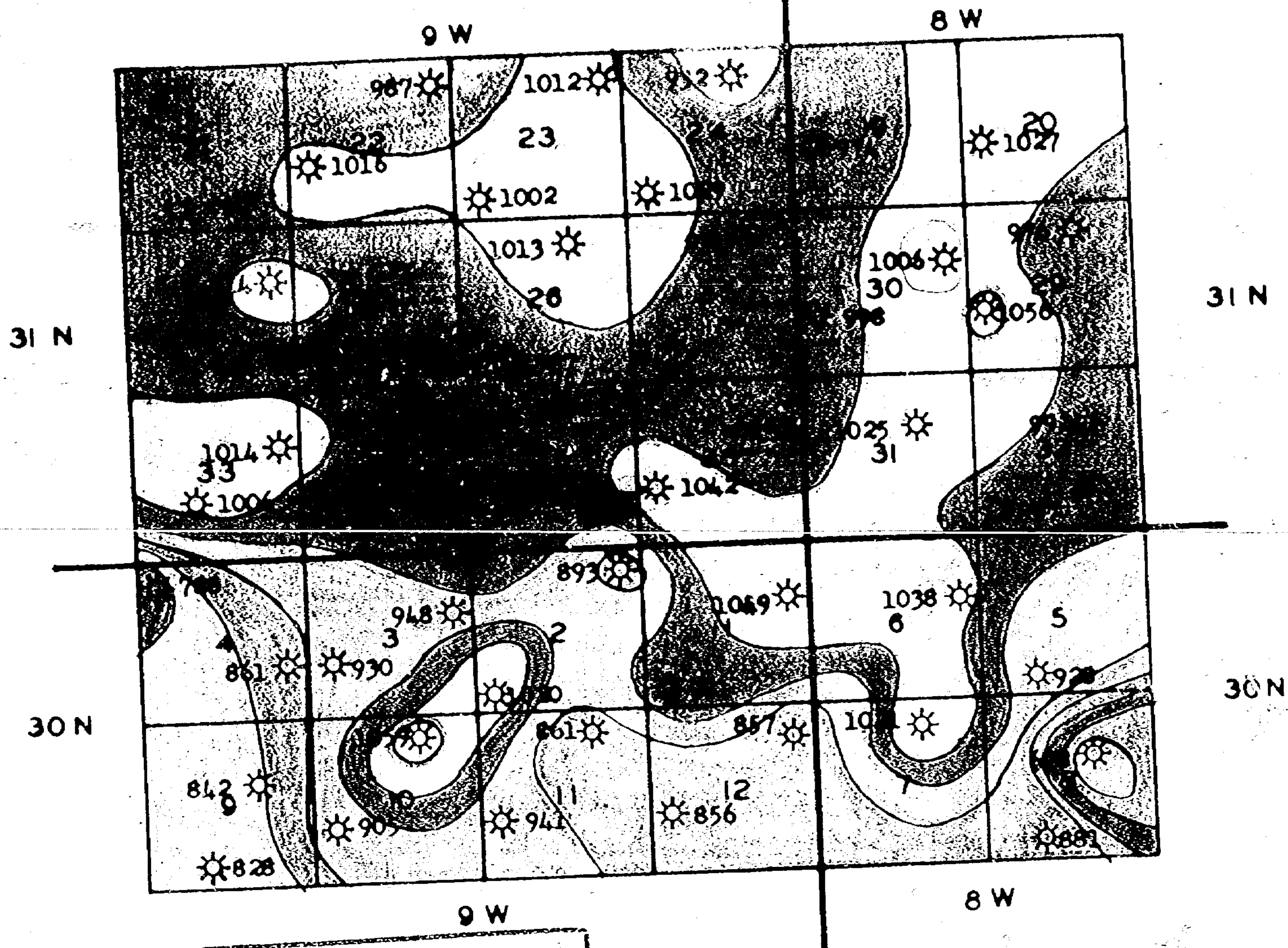
1.	E. R. Corliss, SOUTHWESTERN GAS MEASUREMENT SHORT COURSE, 1957	287
2.	Craft and Hawkins, APPLIED PETROLEUM RESERVOIR ENGINEERING	31
3.	John M. Campbell, OIL PROPERTY EVALUATION	146
4.	Katz, et al., HANDBOOK OF NATURAL GAS ENGINEERING	422, 436, 462
5.	Rawlins and Schellhardt, BACK-PRESSURE DATA ON NATURAL GAS WELLS AND THEIR APPLICATION TO PRODUCTION PRACTICES, MONOGRAPH 7 OF THE U. S. BUREAU OF MINES	12

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
OCC Exhibit No. 8
Case No. 3105

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Exhibit No. 9 O-C-C
Case No. 3105

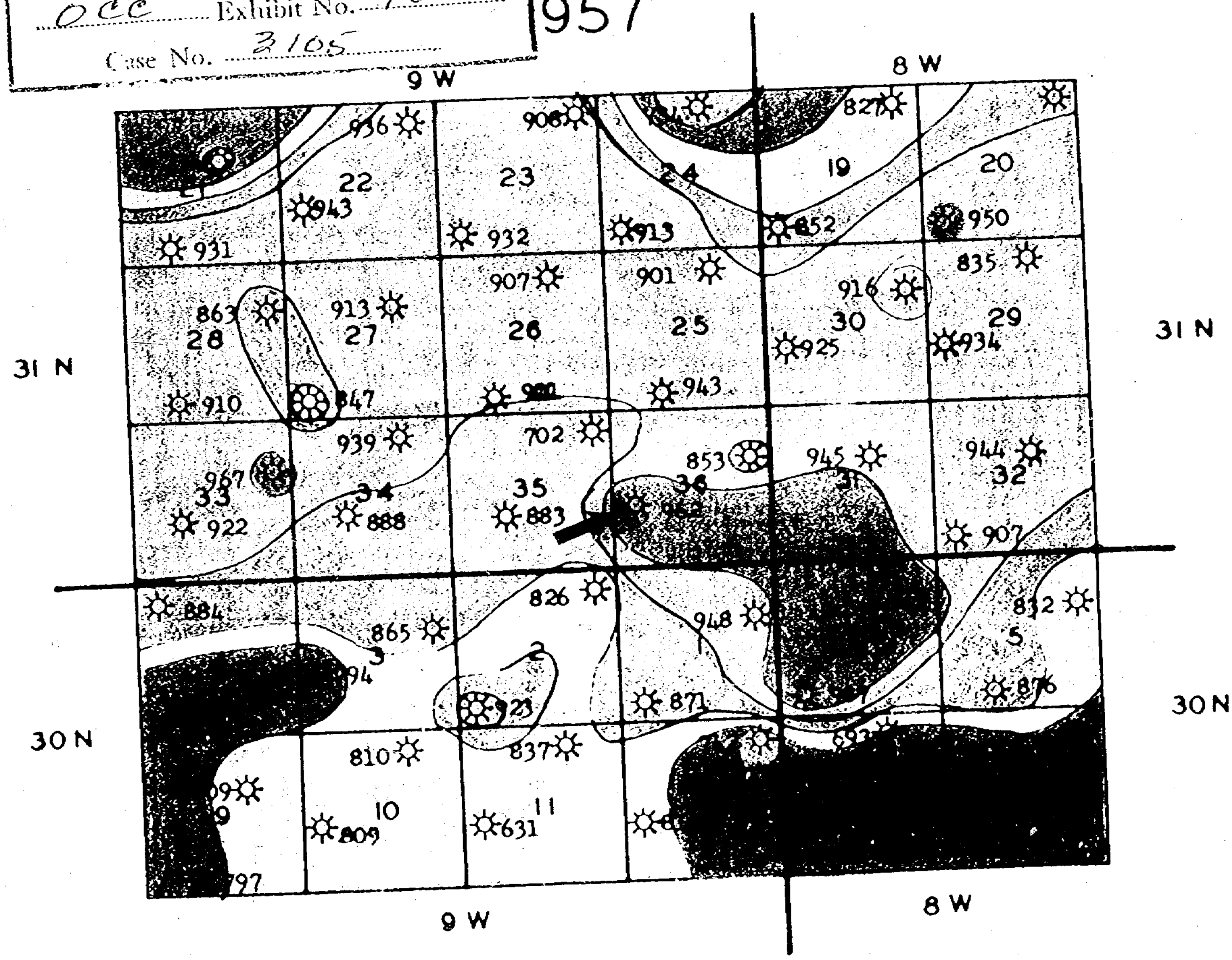


1954

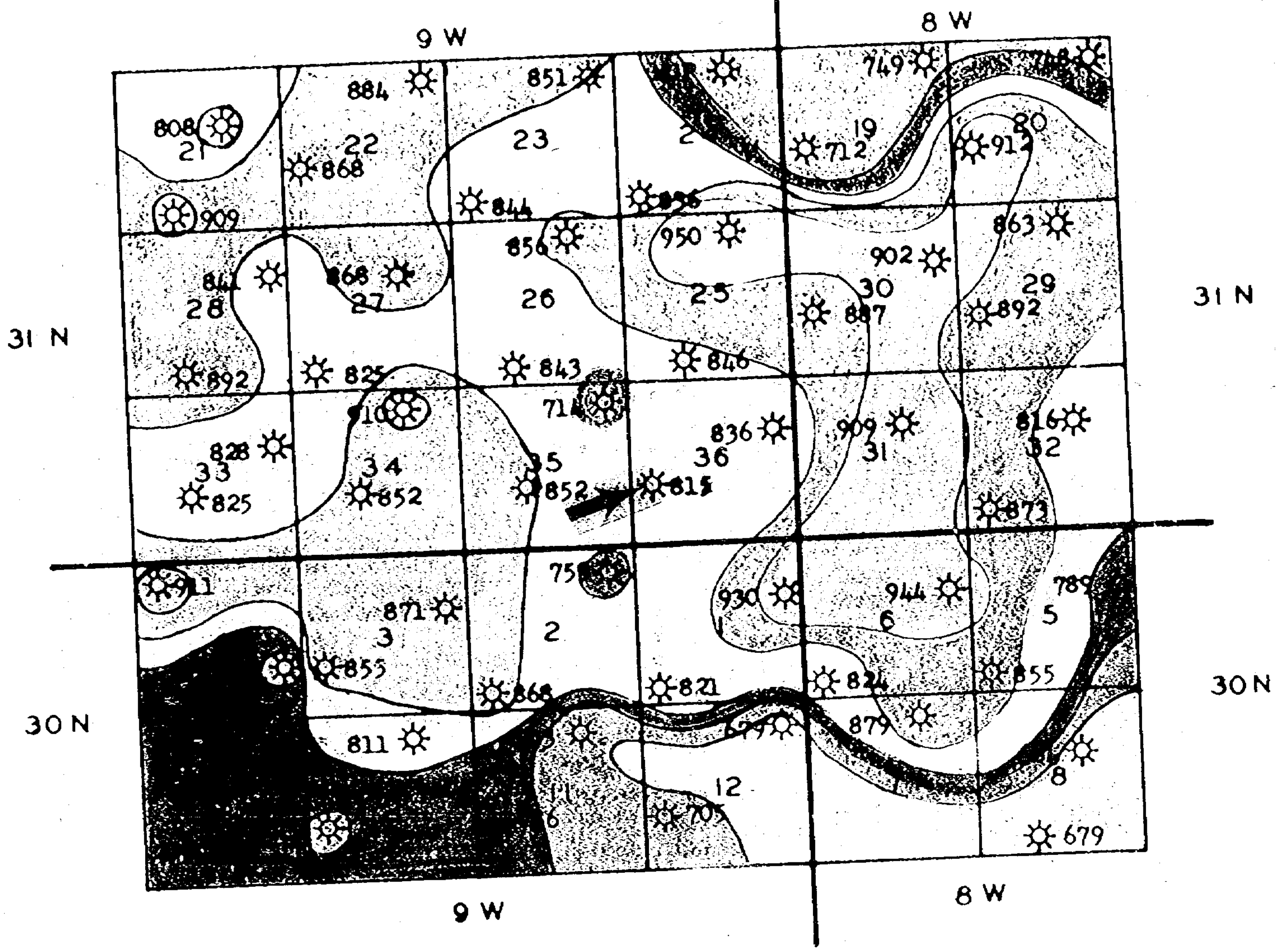


BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
OCC Exhibit No. 10
Case No. 3105

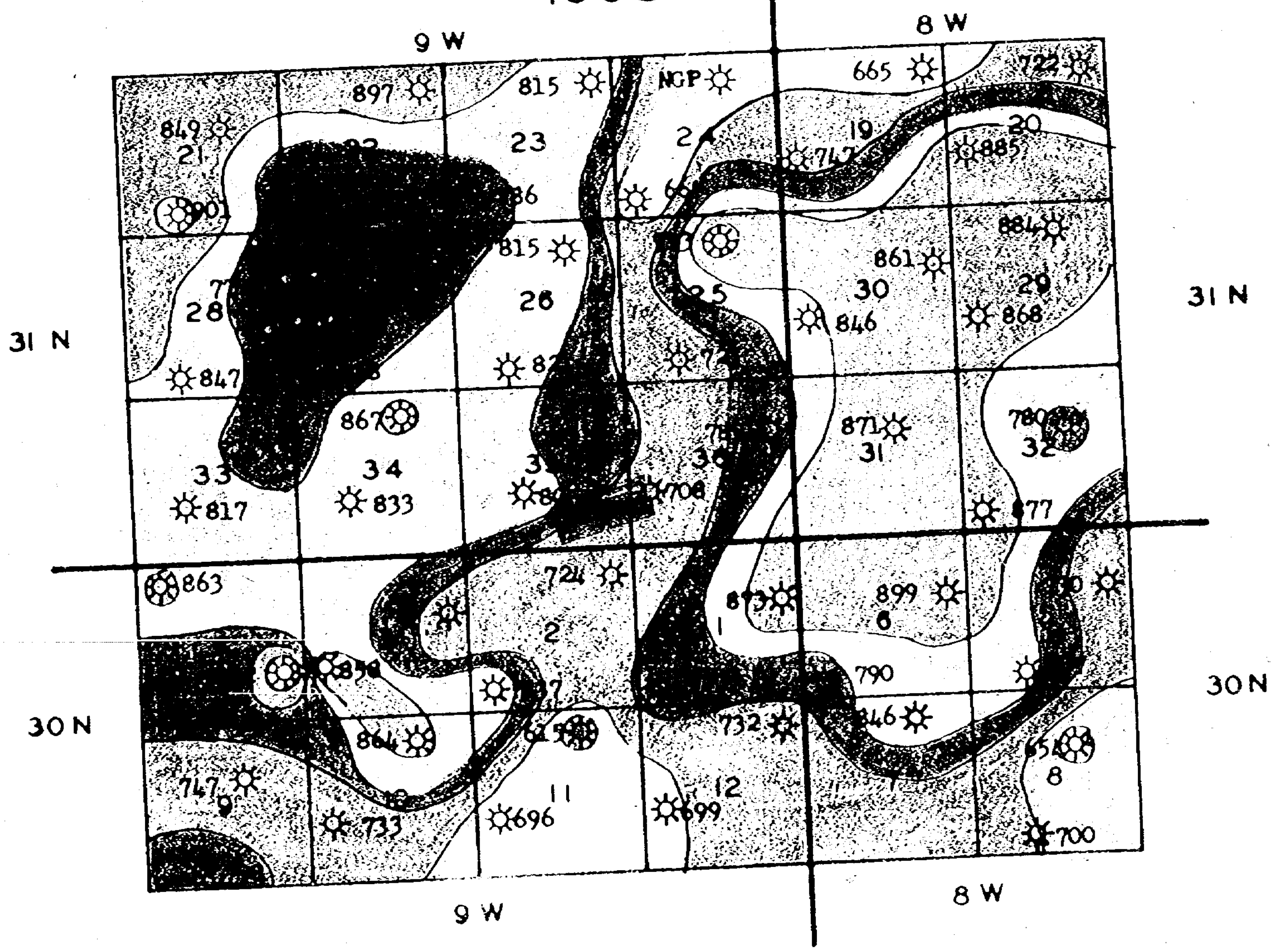
1957



1960



1963



Extra copies of Statements
filed in CASE NO. 3105

MAIN OFFICE OCC

'64 SEP 30 PM 3

BEFORE THE NEW MEXICO
OIL CONSERVATION COMMISSION

IN RE APPLICATION
OF PUBCO PETROLEUM
CORPORATION.

Case No. 3105

STATEMENT BY TENNECO OIL COMPANY

Tenneco Oil Company wishes to advise the Commission that it concurs in and supports the application of Pubco Petroleum Corporation in the captioned matter.

Tenneco Oil Company is the owner and operator of numerous gas wells in the San Juan Basin, including the Delhi-Taylor No. 2 Pritchard, located H-1-30N-9W, which is one of the wells that the Commission used in making its determination in the captioned case. Tenneco's wells range from poor to excellent as to their deliverability characteristics. Tenneco has definite plans to conduct extensive reworking operations in order to attempt to make certain that its poor wells more nearly conform to actual reservoir conditions.

Recent action by the Oil Conservation Commission in adopting a method of regulation which penalizes a high productivity well on the arbitrary basis that such a well deviates from the average of certain other wells marks a departure from the Commission's orderly system of regulation. The Commission apparently has ignored the practical probability that a well may be more favorably situated structurally, has better reservoir conditions or a superior completion.

Further, the Commission has refused to accept an operator's well test, although such test was accurately taken in accordance with procedures prescribed by the Commission, solely on the premise that such test should not be considered valid because it is "abnormally low," when related to certain other wells, when no showing is made that the tests on the other wells are accurate.

The Commission purports to justify its action under its Order R-333-F, which order essentially provides that whenever the Commission determines a shut-in pressure test to be "abnormally low," it may choose another pressure by one of three alternative methods; to-wit

(1) The Commission may require a bottom hole pressure test to be taken in the Commission prescribed manner when there is reason to suspect that an inaccurate pressure is being obtained due to liquid in the hole or mechanical obstructions; or

(2) The pressures of offsetting wells, completed in the same zone, may be averaged with the pressure deemed to be "abnormally low" by the Commission; or

(3) The Commission may designate a value.

It appears obvious from consideration of the evidence from which said rule was promulgated, that these alternative procedures should be used only where a well test could not be accurately obtained in accordance with the Commission's prescribed well testing procedures. In the event physical

conditions should prevent an accurate test, then the pressure would be obtained by running a "pressure bomb"; if this procedure could not be employed, then, but only then, would the method of averaging pressures in offset wells completed in the same zone, be utilized; the third alternative would never be reached unless the first and second methods could not be used.

In the case of the Pubco State Well No. 6 and other wells affected by the Commission's action, calculated surface pressures based on measured bottom hole pressures were obtained in the manner prescribed by the Commission. In addition, evidence was adduced showing that the pressures were stabilized during the 7 day test period and no evidence was presented indicating that the pressures were not stabilized. The Commission, notwithstanding such showing or lack of showing, has nevertheless refused to recognize these true pressures and has resorted to the second alternative of using an average of pressures in offset wells as a substitute. This action has been based not upon any claim that the well tests were inaccurately taken, but upon the faulty premise that the test must be inaccurate when it deviates substantially from the "average" of certain wells in the pool.

The statutes under which the Commission operates require the Commission to afford to each operator the opportunity to produce its just and equitable share of recoverable gas reserves. The statutes further authorize the Commission to establish for each pool an allocation formula in order to effectuate this mandate. So long as the allocation formula is applied equally to all operators in the pool, no operator should be heard to object; except, perhaps, as to the formula itself.

In connection with the captioned matter, the Commission has not presented a case to change the allocation formula even though such is the result and effect of the Commission's action upon high deliverability wells. By its unilateral action, the Commission has simply decided that the formula does not work when applied to high deliverability wells. It is apparent in such cases that the operators of these wells are not being given the opportunity to produce the amount of gas which should be allocated to them under the existing allocation formula and, therefore, these operators are denied the opportunity to produce their equitable share of recoverable gas reserves; which action is in direct violation of the statutes governing the Commission's action.

The Commission in the captioned case appeared to say that it was protecting the interests of the offset operators. Yet not one of the affected offset operators appeared in support of the Commission's position. Conversely, most, if not all, of the offset operators are supporting Pubco's position. Each of these offset operators have knowledge of the capabilities of Pubco's wells and have had the same opportunity to attempt the same procedures as Pubco, but for some reason or reasons, or for no reason, have elected not to do so.

Tenneco Oil Company supports the application of Pubco Petroleum Corporation in this case and respectfully requests that the Commission review its action as to all wells affected by the averaging procedure and that the Commission rescind such action and restore each well to its proper position under the existing allocation formula.

Tenneco Oil Company further respectfully requests that this statement become a part of the record in the captioned case and made a part of the transcript of said case.

Respectfully submitted,

J. D. Moon

J. D. MOON
Division Attorney
4th Floor, 201 Wall Building
Midland, Texas

SETH, MONTGOMERY, FEDERICI & ANDREWS
Richard S. Morris
By: Frank Andrews
350 East Palace Avenue
Santa Fe, New Mexico

Attorneys for Tenneco Oil Company

MAIN OFFICE OCC
'64 SEP 30 PM 3

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SETH, MONTGOMERY, FEDERICI & ANDREWS
Richard S. Morris
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CASE 3105 (PUBCO PETROLEUM)

STATEMENTS - 1964

BEFORE THE OIL CONSERVATION COMMISSION

OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE APPLICATION OF PUBCO PETROLEUM CORPORATION SEEKING REVIEW AND RECISION OF THE COMMISSION'S ACTION IN DETERMINING UNDER ORDER R-333-F THAT THE SHUT-IN PRESSURE FOR DELIVERABILITY CALCULATION PURPOSES WAS ABNORMALLY LOW IN ITS STATE NO. 6 WELL, UNIT L, SECTION 36, TOWNSHIP 31 NORTH, RANGE 9 WEST, NMPM, BLANCO MESA-VERDE POOL.

Case No. 3105

SUPPLEMENTARY STATEMENT SUBMITTED BY
PUBCO PETROLEUM CORPORATION

At the time this matter was heard before the Commission, permission was granted to interested parties to file within a two-week period following the hearing a statement of position of such party with relation to the matters considered at the hearing. Pubco Petroleum Coporation, through its counsel, assumes that such permission did not exclude the applicant from submitting such a statement. In brief form, the position of the applicant is restated as follows:

1. The provisions of Order R-333-F were not intended to and do not apply to situations where the shut-in pressure (P_c) for the purposes of deliverability calculation through the use of deliverability formula for Northwest New Mexico is conceded to be an accurate measured pressure not influenced or rendered inaccurate by the presence of liquids in the well or some other extraneous mechanical substances.

2. The substitution of an assumed pressure not representative of the accurate measured shut-in pressure

into the deliverability formula distorts the interdependency and relationship between the deliverability formula factors so that the deliverability, as calculated, is not representative of an individual well's deliverability and consequently denies to that well the use of the formula upon which allowable is based.

3. The use of an average shut-in pressure of the offsetting wells to the well in question is not justified, even under Order R-333-F, for the reason that the offset wells and the subject wells are not producing from the same zone, as required by the Order.

At the hearing, the point was made by the applicant that Order R-333-F has no application to an individual well whose shut-in pressure is measured accurately for the purposes of annual deliverability tests and when such measured pressure is conceded to be accurate. Reference was made to the testimony in Oil Conservation Commission Case 2695, in which hearing the provisions of Order R-333-F were considered and explained, following which the Order was adopted. The members of the Commission asked for specific reference to the testimony in Case 2695 supporting this contention. The following page references are to the transcript of the hearing:

Page 7. Questions by Mr. Durrett; Answers by Mr. Utz.

Q. Do your rules provide methods for taking shut-in pressure on wells which cannot have both casing and tubing measured and shut-in pressure which appear to be low due to liquids in the bore?

A. Yes. On page 6, down about the fourth paragraph, the latter part of that paragraph we have entered this wording, some of which I will recommend a deletion, the second word, beginning with "the high of such pressures," that should be "the higher of such pressures shall be used as P_c in the deliverability calculation. When any such shut-in pressure has been determined by the Commission to be abnormally low, the shut-in pressure to be used shall be determined by one of the following methods:," then we list three methods.

These three methods are as follows: "A Commission designated value." Well, first, I had better elaborate slightly on the portion that I would like deleted from this paragraph. After the words "abnormally low" I would suggest that we delete "or when only one pressure is available." In some instances it is not possible to get the second pressure or annular pressure normally on conventional wells, and even on dual completions where you can take but one pressure, if that pressure appears to be a normal shut-in pressure I doubt the feasibility of compelling the operator to prove that it is actually an accurate pressure by some other means.

The first method would be "A Commission designated value." This would be, it would have to be done only in instances where the shut-in pressure appeared to be abnormally low. The Commission may designate a value from its records. In other words, it is our intention to contour the previous year's pressures for each pool, which would give you a very good indication by location as to whether or not the pressure was abnormally low.

The second would be an average shut-in pressure of all offset wells completed in the same zone. Where this is possible the average shut-in pressure from all offset wells would be applicable pressure or acceptable pressure.

The third method would be the calculation of surface pressure based on a measured bottom hole pressure, and this calculation should be made in accordance with the Example No. 7 in the Commission Back Pressure Manual, which simply means that you would run a bomb and determine the bottom hole pressure and calculate back to the surface on a gas gradient.

Page 11. Mr. Durrett and Mr. Utz.

Q. Do your rules propose that a limiting multiplier be used concerning wells which report a very low shut-in pressure or that cannot achieve a 25% drawdown?

A. Yes, they do. Even though we propose a deliverability pressure determined as stated, we know that in some instances where we have liquid problems and known liquid problems, that we will have shut-in pressure, surface shut-in pressures that are abnormally low. These surface shut-in pressures we know are not accurate.

The deliverability formula itself presumes that the P_c in the formula be an accurate indication

> of the reservoir pressure, static reservoir pressure. Therefore, to take care of these instances where we have abnormally low shut-in pressures, and in order to control those exaggerated deliverabilities, we believe that the multiplier, which is the value inside the brackets of the deliverability formula, after it's been raised to the power, should be limited to some value to be determined by the Commission.
>
> To go a little farther with that, while the rule does not specifically state how that should be done, I believe that I will recommend that multiplier be, the maximum multiplier be determined in this manner, by the use of the lowest seven-day shut-in pressure in the pool which is determined to be accurate. In other words, no other reservoir conditions affecting that pressure. And the pool average working pressure be put in the deliverability formula to determine what the multiplier is under those conditions, and that no multiplier should be used higher than that.

It is conclusive that Order R-333-F has no application to Pubco State No. 6 Well, since the measured seven-day shut-in pressure is conceded to be accurate and that the test was not influenced by liquid problems, by variations in tubing casing pressure, or by the failure of the reservoir pressure from which this well is producing not having stabilized within the test period. This was demonstrated conclusively by the shut-in pressure test recently conducted by Pubco, the evidence of which is before the Commission, which indicated that the well stabilized in 55 hours and thereafter the pressure increased not one pound or fraction thereof during the remainder of the seven-day test period. The reservoir pressure was therefore conclusively established as the bottom hole pressure of the well after stabilization. This stabilized pressure is in line on a decline curve basis showing decreasing deliverabilities for this well for the years 1960, 1962, 1963, 1964 and the most recent test in 1964. Admittedly, the 1961 deliverability pattern of the decline sharply reversed, indicating the inaccuracy of the 1961 test. However, it is unusual engineering practice to assume that of five tests following the same curve, the sixth which seems not to follow the curve is the correct test. The decline curve demonstrated to the Commission at the hearing was prepared on the basis of decreasing deliverability vs. accumulated production, which is the usual basis in customary engineering practices.

The use of an average offset well shut-in surface pressure under Order R-333-F is qualified by the fact that an accurate pressure reading is not available, and when used, the Order specifically states, "an average shut-in pressure of all offset wells completed in the same zone." It was demonstrated at the time of the hearing of this matter that the various sections of the Mesaverde Formation, including the Menafee, the Point Lookout and the Cliff House, open in the State No. 6 Well, greatly exceeded by several times that of any of the offset wells with the exception of Pubco State No. 5 Well. The accurate pressure measured in the State No. 6 Well is a composite pressure of all the reservoirs in which the State No. 6 Well is open and its positive stabilization at 55 hours in a seven-day test is indicative that that pressure represents reservoir pressure and not simply well bore pressure. Such evidence of test accuracy is not available from the offset wells. It would therefore seem incongruous to use an average pressure when an accurate pressure is available. Order R-333-F was not intended to provide a means for the Commission to adjust allowables to conform to what the Commission staff thinks they should be, and while it might be convenient for the purpose of accomplishing that end to use an average shut-in pressure of offset wells, such use exceeds the authority granted by the Order to the

Commission staff. We therefore respectfully submit that the action resulting in the substitution of an unrepresentative pressure for an accurate pressure in the 1963 deliverability test for the Pubco State No. 6 Well results in discrimination in the use of the deliverability formula to which all operators are subject and not to be allowed legally, in equity or in good conscious. The deliverability for 1963 of the Pubco State No. 6 Well should be established on the basis as originally reported by the operator prior to change by the Commission.

Respectfully submitted,

MODRALL SEYMOUR SPERLING ROEHL & HARRIS

Original Signed by James E. Sperling

By______________________________

ON BEHALF OF PUBCO PETROLEUM CORPORATION

El Paso Natural Gas Company

El Paso, Texas 79999

September 29, 1964

MAIN OFFICE OCC
'64 OCT 1 AM 8 02

New Mexico Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico 87501

Gentlemen:

The following is El Paso's statement in Case No. 3105, Application of Pubco Petroleum Corporation for Recision of an Administrative Determination, under Order No. R-333F, San Juan County, New Mexico.

At the time of the call of the above mentioned Hearing on September 16, 1964, El Paso made a statement concurring with the application of Pubco and advised that El Paso was of the opinion that the Commission action was taken utilizing the rule which had been adopted to apply to conditions other than those existing for the Pubco State No. 6 well. El Paso owns a partial interest in the subject well and pointed out that there were numerous other wells in the pool, including other wells in which El Paso has an interest, to which this rule had been erroneously applied.

Prior to Case No. 2695, which resulted in Order R-333F, El Paso's representatives were invited by the Commission Staff to participate and did participate in meetings with the Commission discussing the problem conditions that needed to be cared for and aided in drafting the changes in the rules which were then recommended by the Commission Staff. It was our understanding that the purpose of the rule change was to assure accurate determination of the seven-day shut-in pressure of each well and to provide alternative means of determining such pressures when conditions were known or suspected which prevented accurate determination with normal wellhead pressure measurements. As a result of our understanding of the proposed intent of the rule change, we made a statement concurring with Mr. Utz's recommendations.

We believe that the Staff testimony in Case No. 2695 reasonably would be and was understood by the industry representatives to indicate a desire on the part of the Staff to establish a method for determining the seven-day shut-in pressure when an accurate seven-day shut-in pressure was not obtained during the annual deliverability test. The corrected pressure would then be applied in the formula to determine deliverability as prescribed by the rules. The several references in Staff testimony to liquid conditions which would prevent an accurate test indicate the conditions for which a cure was sought. We have excerpted several bits of testimony which support this conclusion. We do not find any testimony indicating that the determination of a "pressure sink" area would form the basis for determination by the Commission that the pressure in wells in the area was "abnormally low." On the contrary, we believe Mr. Durrett's question on page 8 of the transcript, which was: "Do your rules provide methods for taking shut-in pressure on wells which cannot have both casing and tubing measured and shut-in pressures which appear to be low due to liquids in the bore?" limits the answer to cures for inaccurate pressures. In reply to this question the witness did refer to the Commission's intention to make a pressure contour map and said, "In other words, it is our intention to contour the previous year's pressures for each pool, which would give you a very good indication by location as to whether or not the pressure was very low." If the Staff intended by this testimony to serve notice of their desire to establish the existence of "pressure sinks," the Staff's testimony certainly failed to impress the listeners with this purpose. At the least, the testimony is ambiguous since it could be understood as indicating the Staff's intention to compare the current tests with the pressure contours established from the previous year's tests and thereby determine whether or not the pressure was "abnormally low."

We would also point out that the transcript indicates on page 23 that Operators would be advised when the Commission had determined pressures to be abnormally low and that an opportunity would be given for correction. This was not done.

This discussion is not intended as a criticism of the witness or the Staff. The Commission Staff has always been frank and honest with the industry representatives. In this particular case, however, it seems there was a lack of understanding on the part of industry representatives and possibly a failure to clearly communicate the ultimate intention of the Staff. Certainly the concurrence of El Paso Natural Gas Company would not have been given had it then been understood that the purpose of the rule was to establish "pressure sink" areas as well as to provide a means of correcting inaccuracies resulting from liquids in the wellbore.

The following are excerpts from the transcript of the Hearing which we believe are pertinent to this matter. Mr. Durrett is questioning Mr. Utz:

(Page 7 of transcript)

Q Do your rules provide methods for taking shut-in pressure on wells which cannot have both casing and tubing measured and shut-in pressures which appear to be low due to liquids in the bore?

A Yes. On page 6, down about the fourth paragraph, the latter part of that paragraph we have entered this wording, some of which I will recommend a deletion, the second word, beginning with "the high of such pressures", that should be "the higher of such pressures shall be used as P_c in the deliverability calculation. When any such shut-in pressure has been determined by the Commission to be abnormally low, the shut-in pressure to be used shall be determined by one of the following methods:", then we list three methods.

These three methods are as follows: "A Commission designated value." Well, first, I had better elaborate slightly on the portion that I would like deleted from this paragraph. After the words "abnormally low" I would suggest that we delete "or when only one pressure is available". In some instances it is not possible to get the second pressure or annular pressure normally on conventional wells, and even on dual completions where you can take but one pressure, if that pressure appears to be a normal shut-in pressure I doubt the feasibility of compelling the operator to prove that it is actually an accurate pressure by some other means.

The first method would be "A Commission designated value." This would be, it would have to be done only in instances where the shut-in pressure appeared to be abnormally low. The Commission may designate a value from its records. In other words, it is our intention to contour the previous year's pressures for each pool, which would give you a very good indication by location as to whether or not the pressure was abnormally low.

The second would be an average shut-in pressure of all offset wells completed in the same zone. Where this is possible the average shut-in pressure from all offset wells would be applicable pressure or acceptable pressure. The third method would be the calculation of surface pressure based on a measured bottom hole pressure, and this calculation should be made in accordance with the Example No. 7 in the Commission Back Pressure Manual, which simply means that you would run a bomb and determine the bottom hole pressure and calculate back to the surface on a gas gradient.

<u>(Page 9 of transcript)</u>

Q Do your rules provide whether casing pressure or tubing pressure shall be used in the deliverability calculation?

A (The first portion of the answer is a historic discussion which is omitted, the following is the last paragraph of the answer on Page 10 of the transcript):

Since that time and since sand fracking has been in use for a number of years and shots are no longer used in the area, and since such a large number of these cased in wells have been, if not all, have been remedied where we have communication in most cases between the tubing and annulus, we now feel also because of liquid problems which we are now encountering, we again feel that the most equitable way and the most accurate way to calculate deliverabilities is by using the higher pressure. (Note: The word cased on the 3rd line above should be caved)

(Page 10 of transcript)

Q Under your rules, will a pool deliverability pressure be used in lieu of 50% of individual well seven-day shut-in pressure?

A Yes. Due to liquid problems and in particular some pools in which the shut-in pressures are now approaching closely to the pipeline pressures, we have found that 50% gives us such a high multiplier that in some cases we feel quite sure that this multiplier gives us an extremely exaggerated deliverability. Therefore, in order to relieve the need of having to have so much drawdown and/or using these high multipliers, we believe that on a pool basis that we should determine a deliverability pressure which would be applicable to all wells in that pool, and this would be based on previous years' shut-in pressure and static well head working pressure averages. This will cause the deliverability pressure to be closer to conditions under which the well is produced. In other words, the correction from actual test conditions to deliverability conditions will be much less and have a much less chance of error.

(Page 11 of transcript)

Q Do your rules propose that a limiting multiplier be used concerning wells which report a very low shut-in pressure or that cannot achieve a 25% drawdown?

A Yes, they do. Even though we propose a deliverability pressure determined as stated, we know that in some instances where we have liquid problems and known liquid problems, that we will have shut-in pressure, surface shut-in pressures that are abnormally low. These surface shut-in pressures we know are not accurate.

The deliverability formula itself presumes that the P_c in the formula may be an accurate indication of the reservoir pressure, static reservoir pressure. Therefore, to take care of these instances where we have abnormally low shut-in pressures, and in order to control those exaggerated deliverabilities, we believe that the multiplier, which is the value inside the brackets of the deliverability formula, after it's been raised to the power, should be limited to some value to be determined by the Commission. ......

(Page 23 of transcript - Mr. Nutter questioning Mr. Utz)

Q Over on page 6, when we say here that if the shut-in pressure is determined by the Commission to be abnormally low, then one of these three alternate methods may be used?

A Yes.

Q When and by what procedure will the Commission determine the pressure to be abnormally low?

A When a pressure in an area is lower than the contour pressure would show, or by experience he would know that it was substantially lower than the average pressures in the area.

Q How will the Commission notify the operators that the pressure there is abnormally low?

A If the operator sends the test in to the district office, his notification will be either by letter or note on the test returned to the operator.

Q Or possible retest?

A Yes, or use another pressure.

Q For the calculation of the test?

A Yes. The chances are pretty good that he'll already have that other pressure to use and won't have to retest.

There is an absence of information showing the effect on the wells in the Blanco Mesaverde Pool of the Commission's application of the rules which is being contested. Until a complete study has been made of the causes for and results of the application of the rules as the Commission proposes, El Paso is not willing to concede that the rules should be applied in any case other than to correct inaccurate pressures. El Paso has supported and will continue to support conservation measures aimed at protecting correlative rights, however, we question that the interpretation of the rule as advocated by the Commission Staff will aid in protecting correlative rights.

New Mexico Oil Conservation Commission
September 29, 1964
Page eight

El Paso believes that the Commission erred in applying the restrictions to well deliverabilities in order to correct so-called pressure sinks and recommends that the Commission rescind such action not only as to the Pubco well but to all other wells where such action was taken.

Yours very truly,

F. Norman Woodruff

F. NORMAN WOODRUFF, Manager
Gas Proration Operations

FNW:mgs

BEFORE THE NEW MEXICO
OIL CONSERVATION COMMISSION

IN RE APPLICATION

OF PUBCO PETROLEUM

CORPORATION.

Case No. 3105

STATEMENT BY TENNECO OIL COMPANY

Tenneco Oil Company wishes to advise the Commission that it concurs in and supports the application of Pubco Petroleum Corporation in the captioned matter.

Tenneco Oil Company is the owner and operator of numerous gas wells in the San Juan Basin, including the Delhi-Taylor No. 2 Pritchard, located H-1-30N-9W, which is one of the wells that the Commission used in making its determination in the captioned case. Tenneco's wells range from poor to excellent as to their deliverability characteristics. Tenneco has definite plans to conduct extensive reworking operations in order to attempt to make certain that its poor wells more nearly conform to actual reservoir conditions.

Recent action by the Oil Conservation Commission in adopting a method of regulation which penalizes a high productivity well on the arbitrary basis that such a well deviates from the average of certain other wells marks a departure from the Commission's orderly system of regulation. The Commission apparently has ignored the practical probability that a well may be more favorably situated structurally, has better reservoir conditions or a superior completion.

Further, the Commission has refused to accept an operator's well test, although such test was accurately taken in accordance with procedures prescribed by the Commission, solely on the premise that such test should not be considered valid because it is "abnormally low," when related to certain other wells, when no showing is made that the tests on the other wells are accurate.

The Commission purports to justify its action under its Order R-333-F, which order essentially provides that whenever the Commission determines a shut-in pressure test to be "abnormally low," it may choose another pressure by one of three alternative methods; to-wit

(1) The Commission may require a bottom hole pressure test to be taken in the Commission prescribed manner when there is reason to suspect that an inaccurate pressure is being obtained due to liquid in the hole or mechanical obstructions; or

(2) The pressures of offsetting wells, completed in the same zone, may be averaged with the pressure deemed to be "abnormally low" by the Commission; or

(3) The Commission may designate a value.

It appears obvious from consideration of the evidence from which said rule was promulgated, that these alternative procedures should be used only where a well test could not be accurately obtained in accordance with the Commission's prescribed well testing procedures. In the event physical

conditions should prevent an accurate test, then the pressure would be obtained by running a "pressure bomb"; if this procedure could not be employed, then, but only then, would the method of averaging pressures in offset wells completed in the same zone, be utilized; the third alternative would never be reached unless the first and second methods could not be used.

In the case of the Pubco State Well No. 6 and other wells affected by the Commission's action, calculated surface pressures based on measured bottom hole pressures were obtained in the manner prescribed by the Commission. In addition, evidence was adduced showing that the pressures were stabilized during the 7 day test period and no evidence was presented indicating that the pressures were not stabilized. The Commission, notwithstanding such showing or lack of showing, has nevertheless refused to recognize these true pressures and has resorted to the second alternative of using an average of pressures in offset wells as a substitute. This action has been based not upon any claim that the well tests were inaccurately taken, but upon the faulty premise that the test must be inaccurate when it deviates substantially from the "average" of certain wells in the pool.

The statutes under which the Commission operates require the Commission to afford to each operator the opportunity to produce its just and equitable share of recoverable gas reserves. The statutes further authorize the Commission to establish for each pool an allocation formula in order to effectuate this mandate. So long as the allocation formula is applied equally to all operators in the pool, no operator should be heard to object; except, perhaps, as to the formula itself.

In connection with the captioned matter, the Commission has not presented a case to change the allocation formula even though such is the result and effect of the Commission's action upon high deliverability wells. By its unilateral action, the Commission has simply decided that the formula does not work when applied to high deliverability wells. It is apparent in such cases that the operators of these wells are not being given the opportunity to produce the amount of gas which should be allocated to them under the existing allocation formula and, therefore, these operators are denied the opportunity to produce their equitable share of recoverable gas reserves; which action is in direct violation of the statutes governing the Commission's action.

The Commission in the captioned case appeared to say that it was protecting the interests of the offset operators. Yet not one of the affected offset operators appeared in support of the Commission's position. Conversely, most, if not all, of the offset operators are supporting Pubco's position. Each of these offset operators have knowledge of the capabilities of Pubco's wells and have had the same opportunity to attempt the same procedures as Pubco, but for some reason or reasons, or for no reason, have elected not to do so.

Tenneco Oil Company supports the application of Pubco Petroleum Corporation in this case and respectfully requests that the Commission review its action as to all wells affected by the averaging procedure and that the Commission rescind such action and restore each well to its proper position under the existing allocation formula.

Tenneco Oil Company further respectfully requests that this statement become a part of the record in the captioned case and made a part of the transcript of said case.

Respectfully submitted,

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CASE 3105 -- Pubco
State Well No. 6

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING
CALLED BY THE OIL CONSERVATION
COMMISSION OF THE STATE OF NEW
MEXICO FOR THE PURPOSE OF
CONSIDERING:

CASE No. 2695
Order No. R-333-F

THE APPLICATION OF THE OIL CONSERVATION
COMMISSION UPON ITS OWN MOTION FOR AN
ORDER REVISING, AMENDING, OR DELETING
CERTAIN PORTIONS OF ORDER R-333-C & D
AS AMENDED BY ORDER R-333-E PERTAINING
TO GAS WELL TESTING PROCEDURE APPLICABLE
TO GAS WELLS COMPLETED IN SAN JUAN, RIO
ARRIBA, McKINLEY, AND SANDOVAL COUNTIES,
NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on November 8, 1962, at Santa Fe, New Mexico, before Daniel S. Nutter, Examiner duly appointed by the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission," in accordance with Rule 1214 of the Commission Rules and Regulations.

NOW, on this 30th day of November, 1962, the Commission, a quorum being present, having considered the application, the evidence adduced, and the recommendations of the Examiner, Daniel S. Nutter, and being fully advised in the premises,

FINDS:

(1) That due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

(2) That there is need for a number of additions to and revisions of Order No. R-333-C & D as amended by Order No. R-333-E, heretofore entered by the Commission, said order outlining a testing procedure for gas wells completed in the Counties of San Juan, Rio Arriba, McKinley, and Sandoval, New Mexico.

(3) That the following rules and regulations should be adopted, and that said rules and regulations are in the interest of conservation.

IT IS THEREFORE ORDERED:

(1) That the following Special Rules and Regulations governing gas well testing in the San Juan Basin (Counties of San Juan, Rio Arriba, McKinley, and Sandoval, New Mexico), superseding the rules and regulations contained in Commission Order No. R-333-C & D, as amended by Order No. R-333-E, are hereby promulgated and adopted as an exception to Rules 401 and 402 of the general statewide rules and regulations of this Commission relating to gas well testing procedures.

GAS WELL TESTING RULES AND PROCEDURES
SAN JUAN BASIN, NEW MEXICO

CHAPTER I TYPE OF TESTS REQUIRED

Section 1: Initial Deliverability and Shut-In Pressure Tests for Newly Completed Wells

A. Immediately upon completion of each gas well in the San Juan Basin, a shut-in pressure test of at least seven days duration shall be made.

B. Within 60 days after a well is connected to a gas transportation facility, the well shall have been tested in accordance with Section 1 of Chapter II of these rules, "Initial Deliverability and Shut-In Pressure Test Procedures," and the results of the test filed with the Commission's Aztec office and with the gas transportation facility to which the well is connected. Failure to file said test within the above-prescribed 60-day period will subject the well to the loss of one day's allowable for each day the test is late.

C. The requirements for Initial Tests and Annual Deliverability and Shut-In Pressure Tests and the notification requirements and scheduling of such tests which apply to newly completed wells shall also apply to reworked or recompleted wells.

D. Any tests taken for informational purposes prior to pipeline connection shall not be recognized as official tests for the assignment of allowables.

Section 2: Annual Deliverability and Shut-In Pressure Tests

A. Annual Deliverability and Shut-In Pressure Tests shall be made on all gas wells during the period from January 1 through December 31 each year except as follows:

1. An Annual Deliverability and Shut-In Pressure Test will not be required during the current year for any well connected to a gas transportation facility after October 31. Such tests may be taken at the option of the operator of the well, however.

2. When the Initial Deliverability and Shut-In Pressure Test required by Section 1-B above has been taken in accordance with the annual testing procedure outlined in Section 2 of Chapter II of these rules, the initial test may be considered the annual test for the year in which the test was completed. Provided however, that if an operator intends to use such initial test as the first annual test, he must notify the Commission and the gas transportation facility to which the well is connected of his intent in writing prior to the conclusion of the 14-day conditioning period.

B. All Annual Deliverability and Shut-In Pressure Tests required by these rules must be filed with the Commission's Aztec office and with the appropriate gas transportation facility within 30 days after the end of the month during which the test is completed. Provided however, that any test completed between December 1 and December 31 must be filed not later than January 10. Failure to file any test within the above-prescribed times will subject the well to the loss of one day's allowable for each day the test is late. No extension of time for filing tests beyond January 10 will be granted except after notice and hearing.

Section 3: Scheduling of Tests

A. Annual Deliverability Tests

By December 1 of each year, each gas transportation facility shall, in cooperation with the operators involved, prepare and submit a schedule of the wells to which it is connected which are to be tested during the ensuing January and February. Said schedule shall be entitled, "Annual Deliverability and Shut-In Pressure Test Schedule," and shall be submitted in triplicate to the Commission's Aztec office. At least one copy shall also be furnished each operator concerned. The schedule shall indicate the date of tests, pool, operator, lease, well number, and location of each well. At least 30 days prior to the beginning of each succeeding 2-month testing interval, a similar schedule shall be prepared and filed in accordance with the above.

The gas transportation facility shall be notified immediately by any operator unable to conduct any test as scheduled. In the event a well is not tested in accordance with the test schedule, the well shall be re-scheduled by the gas transportation facility, and the Commission and the operator of the well so notified in writing. Notice to the Commission must be received prior to the conclusion of the 14-day conditioning period.

It shall be the responsibility of each operator to determine that all of its wells are properly scheduled for testing by the gas transportation facility to which they are connected, in order that all annual tests may be completed during the testing season.

B. <u>Deliverability Re-Tests</u>

An operator may, in cooperation with the gas transportation facility, schedule a well for a deliverability re-test upon notification to the Commission's Aztec office at least ten days before the test is to be commenced. Such re-test shall be for good and substantial reason and shall be subject to the approval of the Commission. Re-tests shall in all ways be conducted in conformance with the Annual Deliverability Test Procedures of these rules. The Commission, at its discretion, may require the re-testing of any well by notification to the operator to schedule such re-test.

Section 4: <u>Witnessing of Tests</u>

Any Initial or Annual Deliverability and Shut-In Pressure Test may be witnessed by any or all of the following: an agent of the Commission, an offset operator, a representative of the gas transportation facility connected to the well under test, or a representative of the gas transportation facility taking gas from an offset operator.

CHAPTER II <u>PROCEDURE FOR TESTING</u>

Section 1: <u>Initial Deliverability and Shut-In Pressure Test Procedure</u>

A. Within 60 days after a newly completed well is connected to a gas transportation facility, the operator shall complete a deliverability and shut-in pressure test of the well in conformance with the "Annual Deliverability and Shut-In Pressure Test Procedures" prescribed in Section 2 of this

When critical flow exists between the wellhead and orifice meter, the measured wellhead flowing pressure of the string through which the well flowed during test shall be used as P_t when calculating the static wellhead working pressure (P_w) using the method established below.

When critical flow does not exist at any restriction, P_t shall be the corrected average static pressure from the meter chart plus friction loss from the wellhead to the orifice meter.

The static wellhead working pressure (P_w) of any well under test shall be the calculated 7-day average static tubing pressure if the well is flowing through the casing; it shall be the calculated 7-day average static casing pressure if the well is flowing through the tubing. The static wellhead working pressure (P_w) shall be calculated by applying the tables and procedures set out in the New Mexico Oil Conservation Commission Manual entitled "Method of Calculating Pressure Loss Due to Friction in Gas Well Flow Strings for San Juan Basin."

To obtain the shut-in pressure of a well under test, the well shall be shut in immediately after the 7-day deliverability flow test for the full period of seven consecutive days. Such shut-in pressure shall be measured within the next succeeding twenty-four hours following the 7-day shut-in period. The 7-day shut-in pressure shall be measured on both the tubing and the casing when communication exists between the two strings. The higher of such pressures shall be used as P_c in the deliverability calculation. When any such shut-in pressure is determined by the Commission to be abnormally low, the shut-in pressure to be used shall be determined by one of the following methods:

1. A Commission-designated value.

2. An average shut-in pressure of all offset wells completed in the same zone.

3. A calculated surface pressure based on a measured bottom-hole pressure. Such calculation shall be made in accordance with the New Mexico Oil Conservation Commission "Back Pressure Mannual," Example No. 7.

All wellhead pressures as well as the flowing meter pressure tests which are to be taken during the 7-day deliverability test period as required hereinabove shall be taken with a deadweight gauge. The deadweight reading and the date and time according to the chart shall be recorded and maintained in the operator's records with the test information.

Orifice meter charts shall be changed and so arranged as to reflect upon a single chart the flow data for the gas from each well for the full 7-day deliverability test period; however, no tests shall be voided if satisfactory explanation is made as to the necessity for using test volumes through two chart periods. Corrections shall be made for pressure base, measured flowing temperature, specific gravity, and supercompressibility; provided however, if the specific gravity of the gas from any well under test is not available, an estimated specific gravity may be assumed therefor, based upon that of gas from near-by wells, the specific gravity of which has been actually determined by measurement.

The 7-day average flowing meter pressure shall be calculated by taking the average of all consecutive 2-hour flowing meter pressure readings as recorded on the 7-day flow period chart. The pressure so calculated shall be used in calculating the wellhead working pressure, determining supercompressibility factors, and calculating flow volumes.

The 7-day flow period volume shall be calculated from the integrated readings as determined from the flow period orifice meter chart. The volume so calculated shall be divided by the number of testing days on the chart to determine the average daily rate of flow during said flow period. The flow chart shall have a minimum of seven and a maximum of eight legibly recorded flowing days to be acceptable for test purposes. The volume used in this calculation shall be corrected to New Mexico Oil Conservation Commission standard conditions.

The average flowing meter pressure for the 7-day or 8-day flow period and the corrected integrated volume shall be determined by the purchasing company that integrates the flow charts and furnished to the operator or testing agency when such operator or testing agency requests such information.

The daily volume of flow as determined from the flow period chart integrator readings shall be calculated by applying the Basic Orific Meter Formula:

$$Q = C' \sqrt{h_w P_f}$$

Where:

Q = Metered volume of flow Mcfd @ 15.025, 60° F., and 0.60 specific gravity.

C' = The 24-hour basic orifice meter flow factor corrected for flowing temperature, gravity, and supercompressibility.

h_w = Daily average differential meter pressure from flow period chart.

P_f = Daily average flowing meter pressure from flow period chart.

The basic orifice meter flow factors, flowing temperature factor, and specific gravity factor shall be determined from the New Mexico Oil Conservation Commission "Back Pressure Test Manual."

The daily flow period average corrected flowing meter pressure, psig, shall be used to determine the supercompressibility factor. Supercompressibility Tables may be obtained from the New Mexico Oil Conservation Commission.

When supercompressibility correction is made for a gas containing either nitrogen or carbon dioxide in excess of two percent, the supercompressibility factors of such gas shall be determined by the use of Table V of the C.N.G.A. Bulletin TS-402 for pressures 100-500 psig, or Table II, TS-461 for pressures in excess of 500 psig.

The use of tables for calculating rates of flow from integrator readings which do not specifically conform to the New Mexico Oil Conservation Commission "Back Pressure Test Manual" may be approved for determining the daily flow period rates of flow upon a showing that such tables are appropriate and necessary.

The daily average integrated rate of flow for the 7-day flow period shall be corrected for meter error by multiplication by a correction factor. Said correction factor shall be determined by dividing the square root of the chart flowing meter pressure, psia, into the square root of the deadweight flowing meter pressure, psia.

Deliverability pressure, as used herein, is a defined pressure applied to each well and used in the process of comparing the abilities of wells in a pool to produce at static wellhead working pressures equal to a percentage of the 7-day shut-in pressure of the respective individual wells. Such percentage shall be determined and announced periodically by the Commission based on the relationship of the average static wellhead working pressures (P_w) divided by the average 7-day shut-in pressure (P_c) of the pool.

The deliverability of gas at the "deliverability pressure" of any well under test shall be calculated from the test data derived from the tests hereinabove required by use of the following deliverability formula:

$$D = Q \left[\frac{\left(P_c^2 - P_d^2\right)}{\left(P_c^2 - P_w^2\right)} \right]^n$$

Where:

D = Deliverability Mcfd at the deliverability pressure, (P_d), (at Standard Conditions of 15.025 psia and 60°F).

Q = Daily flow rate in Mcfd, at wellhead pressure (P_w).

P_c = 7-day shut-in wellhead pressure, psia, determined in accordance with Section 2 of Chapter II.

P_d = Deliverability pressure, psia, as defined above.

P_w = Average static wellhead working pressure, as determined from 7-day flow period, psia, and calculated from New Mexico Oil Conservation Commission "Pressure Loss Due to Friction" Tables for San Juan Basin.

n = Average pool slope of back pressure curves as follows:

Mesaverde Formation	0.75
Dakota Producing Interval	0.75
Fruitland Formation	0.85
Farmington Formation	0.85
Pictured Cliffs Formation	0.85
Other Formations	0.75

(Note: Special Rules for Any Specific Pool or Formation May Supersede The Above Values. Check Special Rules If In Doubt.)

The value of the multiplier in the above formula (ratio factor after the application of the pool slope) by which Q is multiplied shall not exceed a limiting value to be determined and announced periodically by the Commission. Such determination shall be made after a study of the test data of the pool obtained during the previous testing season. The limiting value of the multiplier may be exceeded only after the operator has conclusively shown to the Commission that the shut-in pressure (P_c) is accurate or that the static wellhead pressure (P_w) cannot be lowered due to existing producing conditions.

Any test prescribed herein will be considered unacceptable if the average flow rate for the final 7-day deliverability test is more than ten percent in excess of any consecutive 7-day average of the preceding two weeks. A deliverability test not meeting this requirement shall be invalid and the well shall be re-tested.

All charts relative to initial or annual deliverability tests or photostats thereof shall be made available to the Commission upon its request.

All testing agencies, whether individuals, companies, pipeline companies, or operators, shall maintain a log of all tests accomplished by them, including all field test data.

All forms heretofore mentioned are hereby adopted for use in the San Juan Basin Area in open form subject to such modification as experience may indicate desirable or necessary.

Initial and Annual Deliverability and Shut-In Pressure Tests for gas wells in all formations shall be conducted and reported in accordance with these rules and procedures. Provided however, these rules shall be subject to any specific modification or change contained in Special Pool Rules adopted for any pool after notice and hearing.

CHAPTER III <u>INFORMATIONAL TESTS</u>

A. A one-point back pressure test may be taken on newly completed wells before their connection or reconnection to a gas transportation facility. This test shall not be a required official test but may be taken for informational purposes at the option of the operator. When taken, this test must be taken and reported as prescribed below:

<u>ONE-POINT BACK PRESSURE POTENTIAL TEST PROCEDURE</u>

1. This test shall be accomplished after a minimum shut-in of seven days. The shut-in pressure shall be measured with a deadweight gauge.

2. The flow rate shall be measured by flowing the well three hours through a positive choke, which has a 3/4-inch orifice.

3. A 2-inch nipple which provides a mechanical means of accurately measuring the pressure and temperature

of the flowing gas shall be installed immediately upstream from the positive choke.

4. The absolute open flow shall be calculated using the conventional back pressure formula as shown in the New Mexico Oil Conservation Commission "Back Pressure Test Manual."

5. The observed data and flow calculations shall be reported in duplicate on Form C-122, "Multi-Point Back Pressure Test for Gas Wells."

6. Non-critical flow shall be considered to exist when the choke pressure is 13 psig or less. When this condition exists the flow rate shall be measured with a pitot tube and nipple as specified in the Commission's Manual of "Tables and Procedure for Pitot Tests." The pitot test nipple shall be installed immediately downstream from the 3/4-inch positive choke.

7. Any well completed with 2-inch nominal size tubing (1.995-inch ID) or larger shall be tested through the tubing.

B. Other tests for informational purposes may be conducted prior to obtaining a pipeline connection for a newly completed well upon receiving specific approval therefor from the Commission's Aztec office. Approval of these tests shall be based primarily upon the volume of gas to be vented.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

EDWIN L. MECHEM, Chairman

E. S. WALKER, Member

S E A L

A. L. PORTER, Jr., Member & Secretary

esr/

HEARING TESTIMONY OUTLINE

I. Brief background of events leading up to action which was taken.

1. Low shut-in pressure problem recognized some time ago.

2. October 1962 hearing dealt with the problem of high mutipliers in formula and low shut-in pressures. Provided that Commission could correct shut-in pressures when ~~when~~ pressures were abnormally low; also provided for variable deliverability pressures to be set by the Commission in each pool.

3. Upon receipt of 1963 tests study was conducted at direction of Mr. Porter to determine if shut-in pressure problem was affecting deliverability tests. This study was made and it was found that abnormally low shut-in pressures were causing high multiplier problem in numerous instances.

4. Based upon this study tests were recalculated and allowables revised on 57 wells effective August 1, 1964.

✓ II. Sheet explaining deliverability calculation and emphasizing importance of accurate pressures. Exhibit #1.

✓ III. Exhibit #2.

Shut-in pressure and production history of Pubco State #6 and its offsets.

1. Note pressure decline and production increase subsequent to workover in 1959 and 1963.

✓ IV. Exhibit #3.

Deliverability test history of Pubco #6 State well.

1. Relationship between deliverability and reserves as inferred by the allocation formula.

a. Higher the reserves, higher the deliverabillty and vice versa.

b Deliverability should decline as reserves are produced, if not tends to make a farce out of deliverability proration.

2. Review of deliverability test history on Pubco #6 State.

a. Had modest deliverability prior to workover in 1959. D

5800 to 7700 in years prior to workover.

b. Deliverability increased to 12,428 MCF in 1959 and to 38,347 MCF in 1960 after additional work.

(1) Indicate recoverable reserve increase of 5 to 6 times.

(2) Indicate more recoverable reserve present in 1960 than had ever contained previously, even though 8,630,724 MCF had been produced prior to January 1, 1960.

c. Explain change to Pd of 80% and show effect on graph.

d. Compare 1961 test with 1963 test - shows deliverability increase even though 5,531,988 MCF production in 1961 and 1962.

e. Q rate and Pw decrease between 1961 and 1963 test although deliverability increases. Indicates low Pc

3. Conclusions - Magnitude of problem in other reservoirs - inequities arising

Statement that average of offset pressures is fairest approach because those are wells which are in pressure communication with each other.

V. Exhibit #4.

Summary showing affect of using average offset pressures in lieu of actual measured pressure on deliverability calculation for Pubco #6 State well.

Also shows average offset conditions and effect on allowables.

VI. Exhibit #5.

Bar graph showing graphically the information contained in Exhibit #4.

6

Exhibit No. ~~8~~ 7 MULTIPLIER CURVE

Define

Change 25% to 24% Drawdown

25% - .8639	24% - .8870	Change - 2.67% increase

Change 6% to 5% Drawdown

6% - 2.3320	5% - 2.6635	Change - 14.22% increase

Cause of error

Test is a back-pressure test used as a reflection of reserves.

Exhibit 8

~~XXXXXXXXXXXX~~ PUBLICATIONS

Exhibit No. 10 ISOBARIC MAPS

Define

Show changes

Opinion - reason for lower pressures.

Introduce exhibits

Exhibit No. ~~8~~ 9 PRODUCTION GRAPH

Define

Show Change in rate of State #6 production during 1960

State #6 production during 1963 exceeded total production of the offset wells by over one billion feet

Opinion - created a pressure sink ~~XXXXX~~ by excessive production in relation to the well's reserve

Exhibit No. 6 ALLOWABLE GRAPH

Define

Factors: Acreage - 1732.13 A x D - 6.302097

Pool Formula 25 - 75

Show the per well allowables based on the AxD allocation factors

1000	AxD-6302.10	A-1732.13	Total- 8034	% by AxD- 78.44
5000	31510.49	1732.13	33243	94.79
10000	63020.97	1732.13	64753	97.33
30000	189062.91	1732.13	190795	99.09
8913	56170.59	1732.13	57903	97.01
16716	105345.85	1732.13	107078	98.38
28722	181008.83	1732.13	182741	99.05

DELIVERABILITY CALCULATION FORMULA

$$\text{Deliverability} = Q \times \left[\frac{(\text{Shut-in pressure})^2 - (\text{Deliverability Pressure})^2}{(\text{Shut-in pressure})^2 - (\text{Working Pressure})^2} \right]^N$$

1. Q is the average daily volume of gas that a well flowed during the test period.

2. Shut-in Pressure. This is a measured pressure at the wellhead after the well has been shut in seven days.

3. Working pressure is a pressure which is measured while the well is flowing. If the well is flowing through the tubing it is measured on the casing. If it is flowing through the casing it is measured on the tubing. The difference in pressure between the shut-in pressure and the working pressure is known as the draw down. A general statement which can be made is that "all other things being equal, the smaller the draw down the higher the deliverability. Also the smaller the draw down the greater the element of potential mathematical error in the deliverability calculation.

4. Deliverability pressure is not a measured pressure but is set by the Commission for each pool. In the Blanco Mesaverde Pool it is 80% of the Shut-in pressure (Pc). In the Basin Dakota Pool it is 50% of the Shut-in pressure.

5. N = average pool slope of the back pressure curve.

As may be seen from the formula it is very important that the shut-in pressure be an accurate pressure because it appears twice in the formula and the deliverability pressure is directly related to the shut-in pressure. If the shut-in pressure used is erroneously low the effect is always to increase the deliverability of a well. The reason for this is two fold. First, if the shut-in pressure of a well is lower than other wells in the pool then the deliverability pressure, being directly related to the shut-in pressure, is also low. Secondly, if the shut-in pressure is low it approaches a value nearer the value of the working pressure, making it appear that the well has drawn down less than it actually has. Mathematically the effect of this in the above mentioned formula is to make the denominator in the formula smaller and this causes the resulting multiplier to be larger, therefore the effect of using an erroneously low shut-in pressure is to give an erroneously high deliverability which does not truly reflect the ability of the well to produce gas. Theoretically, the shut-in pressure used in the deliverability calculation should be the reservoir pressure in the well's drainage area and this is not necessarily the pressure measured at the wellbore.

Exhibit 1

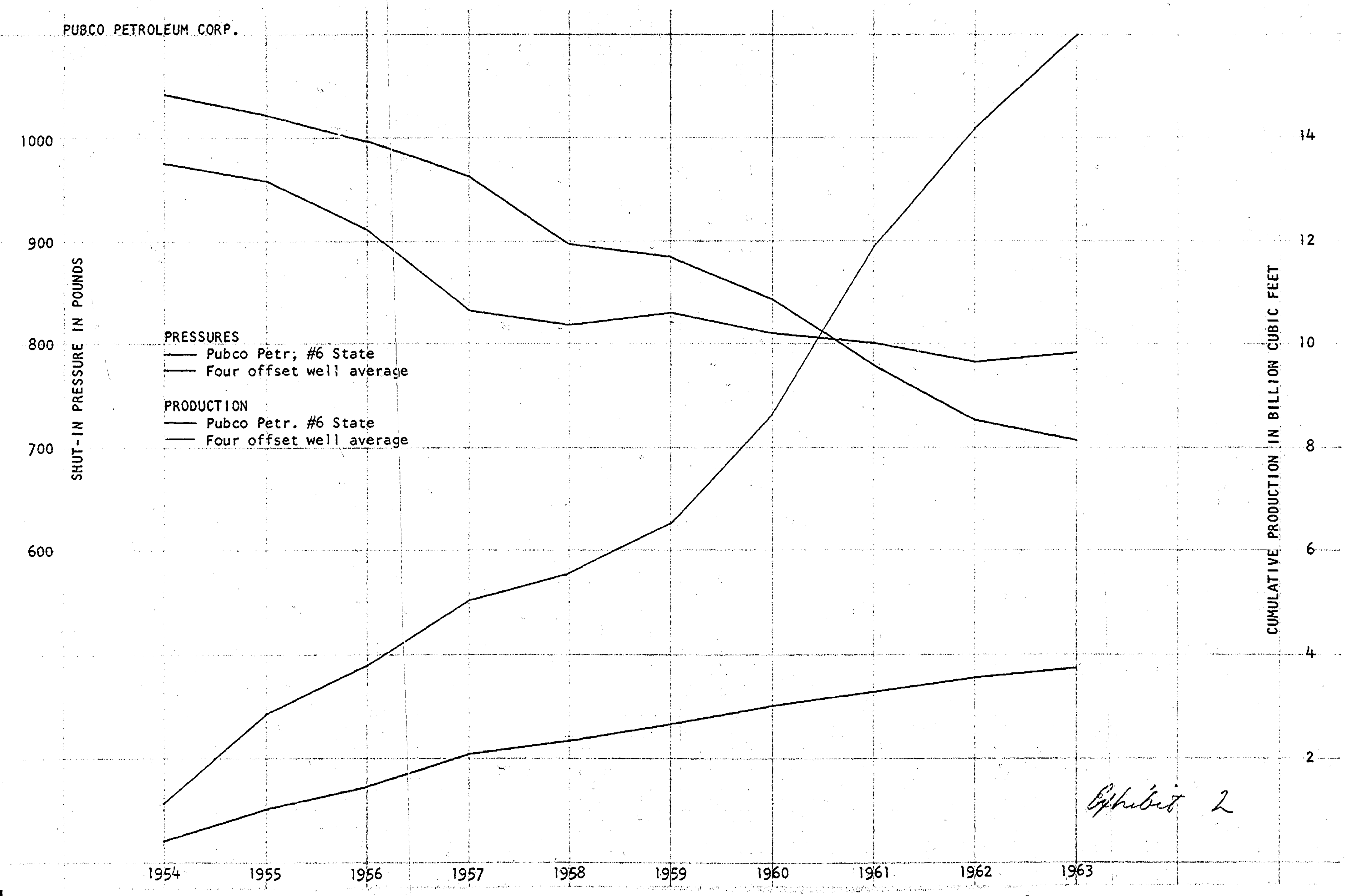
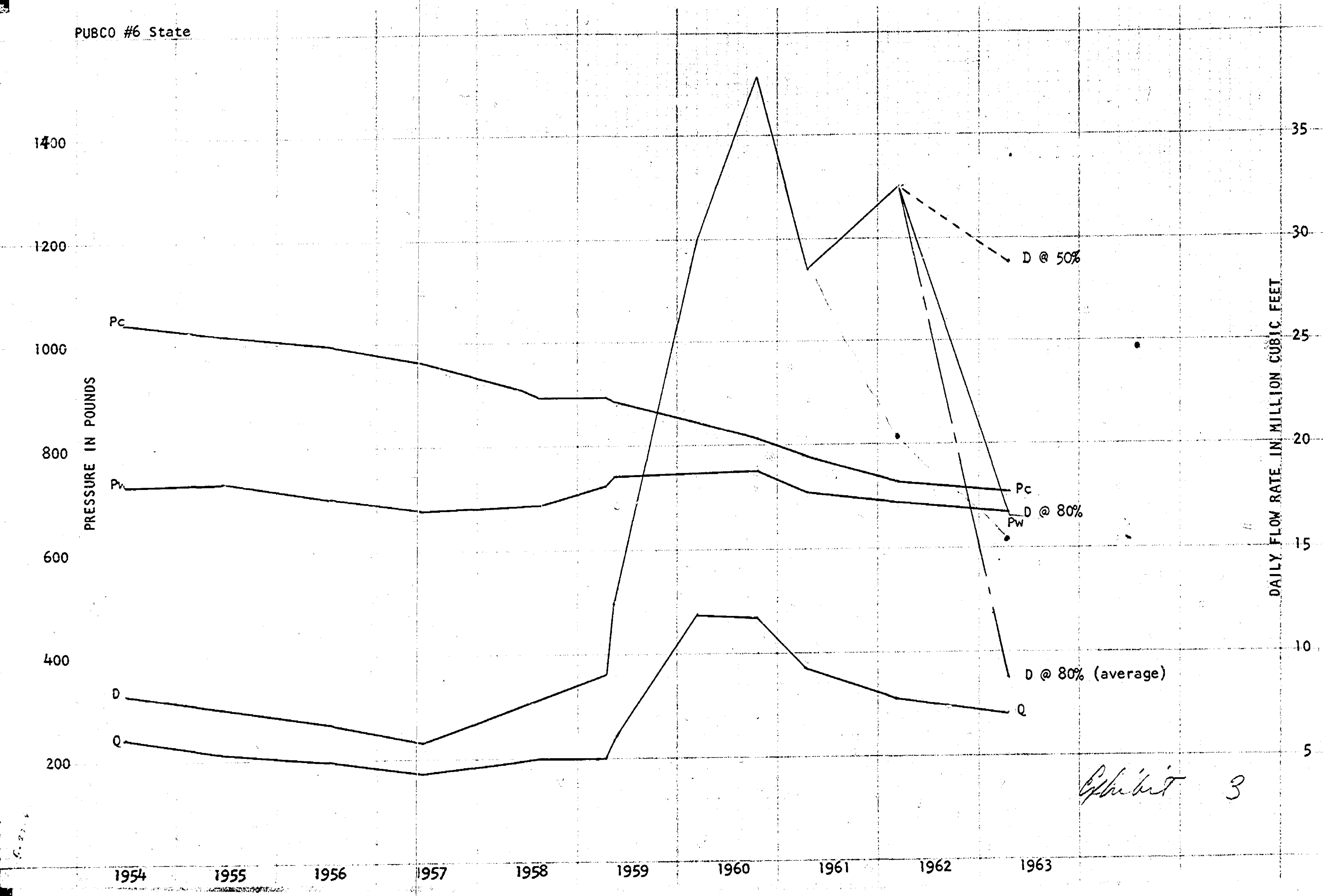

PUBCO PETROLEUM CORP.
SHUT-IN PRESSURE IN POUNDS
1000
900
800
700
600
PRESSURES
Pubco Petr; #6 State
Four offset well average
PRODUCTION
Pubco Petr. #6 State
Four offset well average
CUMULATIVE PRODUCTION IN BILLION CUBIC FEET
14
12
10
8
6
4
2
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963

Exhibit 2



PUBCO #6 State
PRESSURE IN POUNDS
1400
1200
1000
800
600
400
200
Pc
Pw
D
Q
D @ 50%
Pc
D @ 80%
Pw
D @ 80% (average)
Q
DAILY FLOW RATE IN MILLION CUBIC FEET
35
30
25
20
15
10
5
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963

Exhibit 3

EXHIBIT SHOWING EFFECT OF USING OFFSET AVERAGE PRESSURES IN DELIVERABILITY CALCULATION - WELL, PUBCO STATE #6

<u>Average Pressure of 5 Wells (Pubco State #6 and Its Offsets) Pressures</u>

Delhi-Taylor #2 Pritchard	H-1-30N-9W	873#
Pubco Petroleum #5 State	H-36-31N-9W	789#
El Paso Nat. Gas #2 Turner State	A-2-30N-9W	724#
Union Texas #9 Johnston	H-35-31N-9W	782#
Pubco #6 State	L-36-31N-9W	708#
	Total 5 wells	3826
	Average Pressure	775#

<u>Deliverability Calculation Comparison</u>

Q = 6968

	Press.	*Del.	*Allowable
Using Actual Measured Pressures on Pubco State #6	708	16,716	107,078
Using 5-well Average of 4 offset Wells & Pubco State #6	775	8,913	57,903

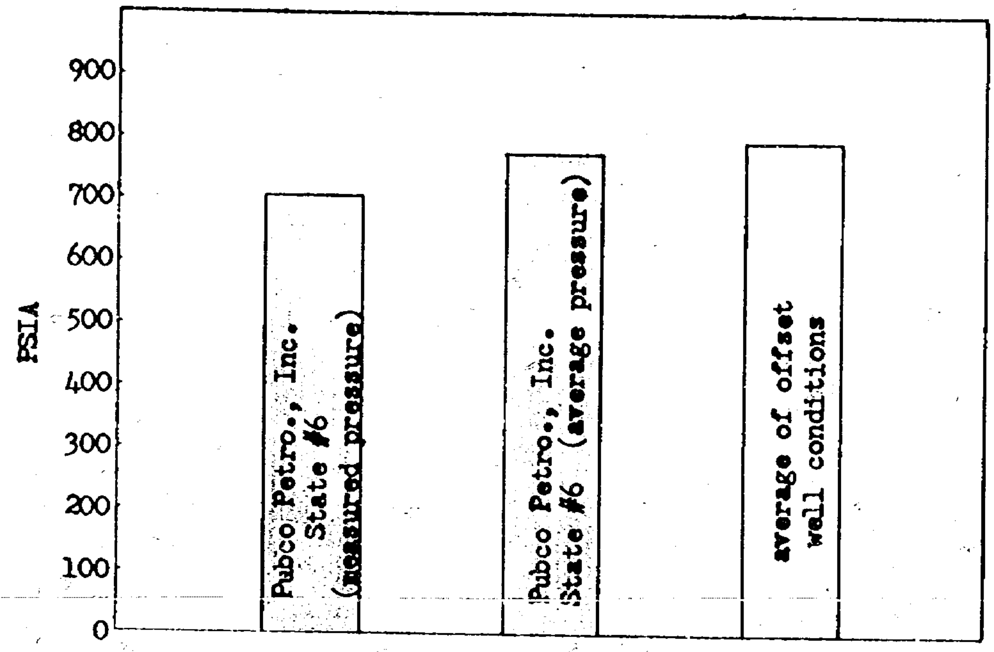
<u>Offset Deliverability Test & Allowable Comparison</u>

		Pc	Q.	*Del.	*Allowable
Delhi-Taylor #2 Pritchard	H-1-30N-9W	873	4549	3772	
EPNG #2 Turner State	A-2-30N-9W	724	528	518	
Pubco #5 State	H-36-31N-9W	789	1642	1543	
Union Texas #9 Johnston	H-35-31N-9W	782	853	692	
4 offset Wells, Average Values		792	1893	1631	12,011

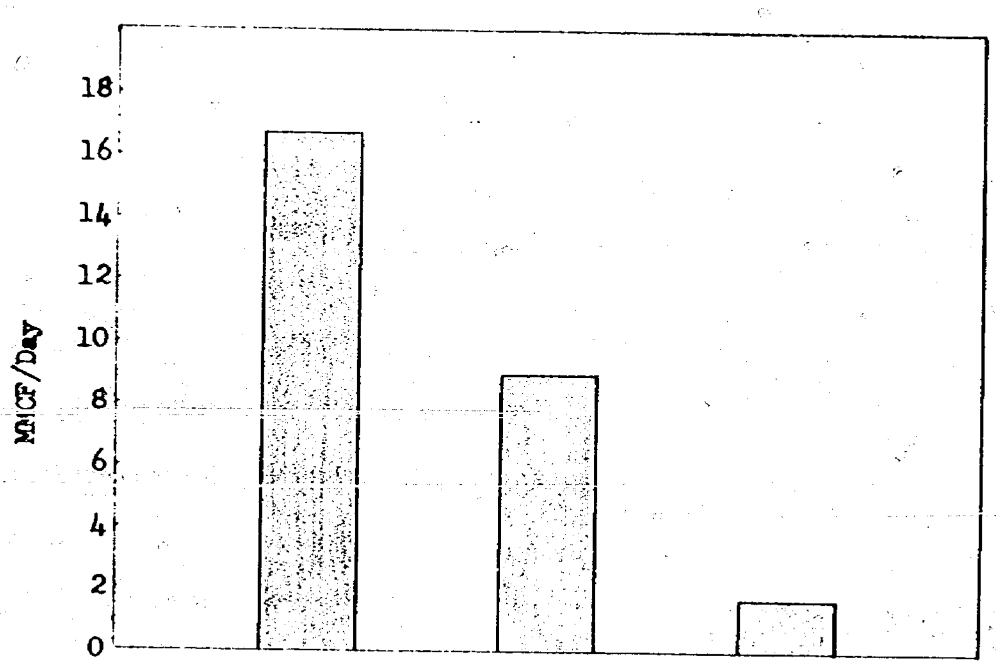
*Allowable based on average of allocation factors for 12 months period March 1, 1963 through February 29, 1964.

*All Deliverability date from 1963 Annual tests.

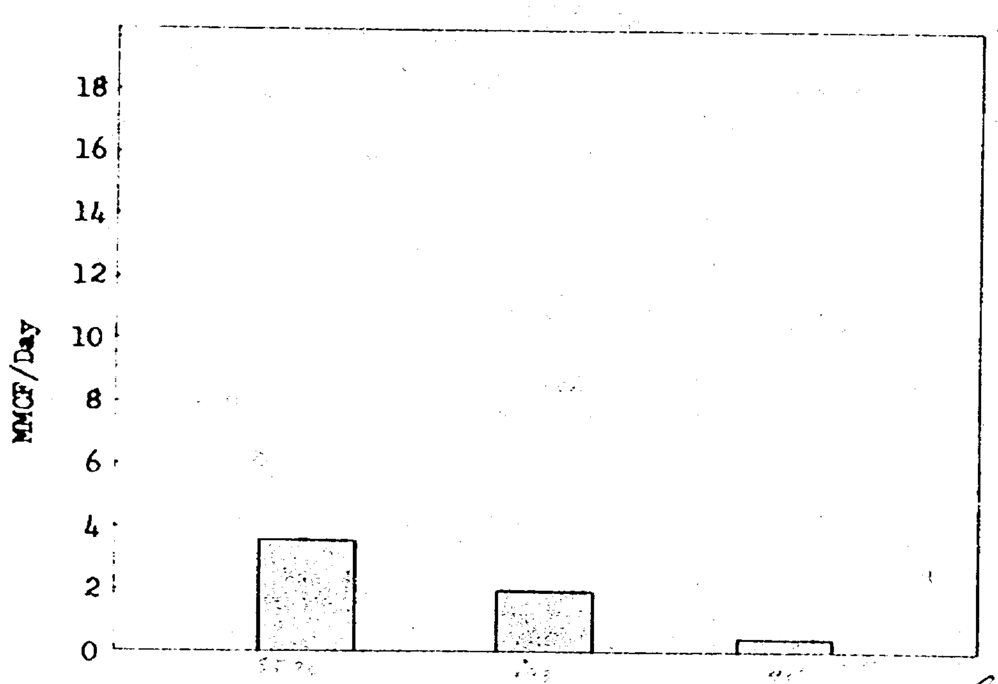
Exhibit 4



PRESSURE

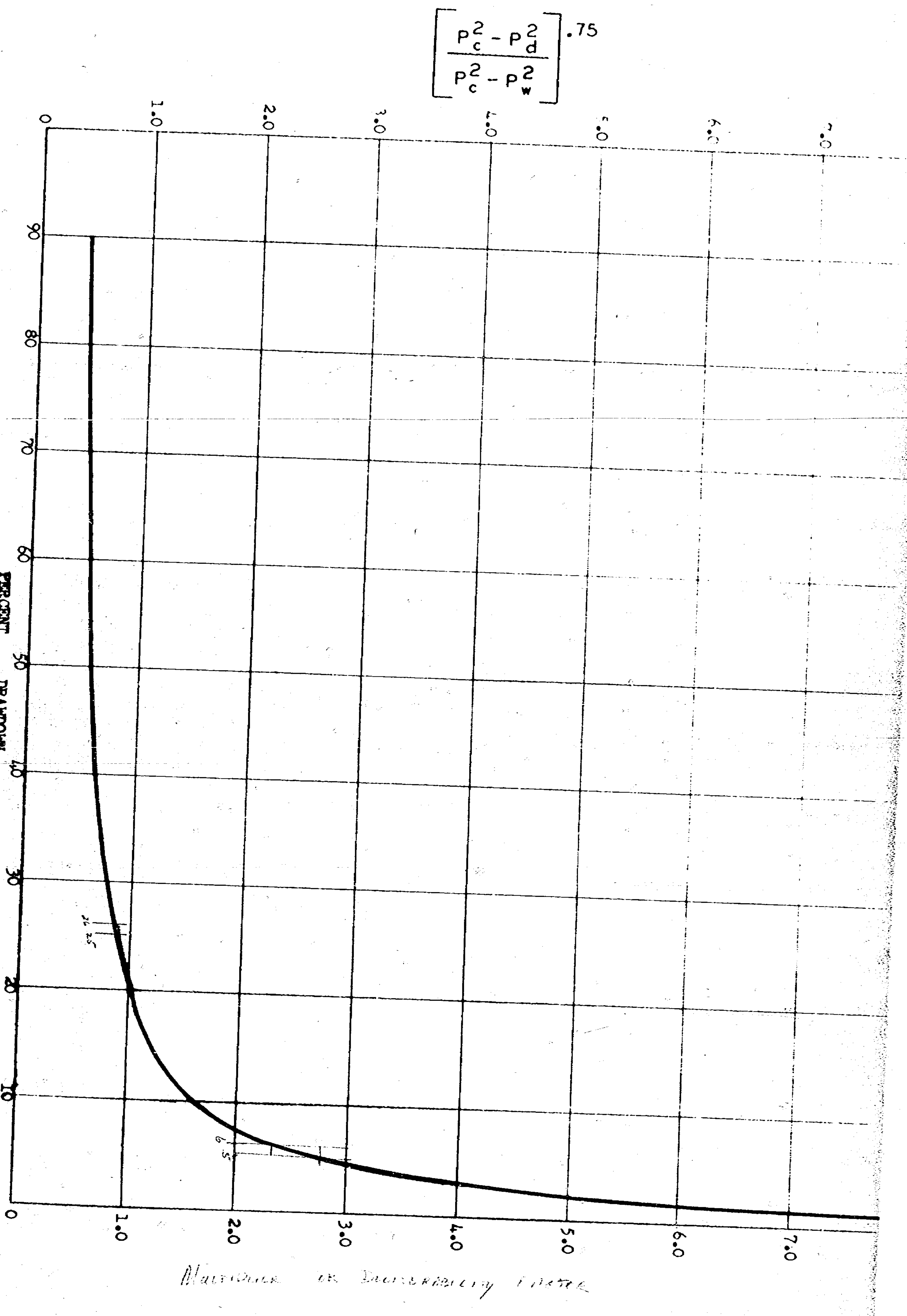


DELIVERABILITY



ALLOWABLES

Exhibit 5



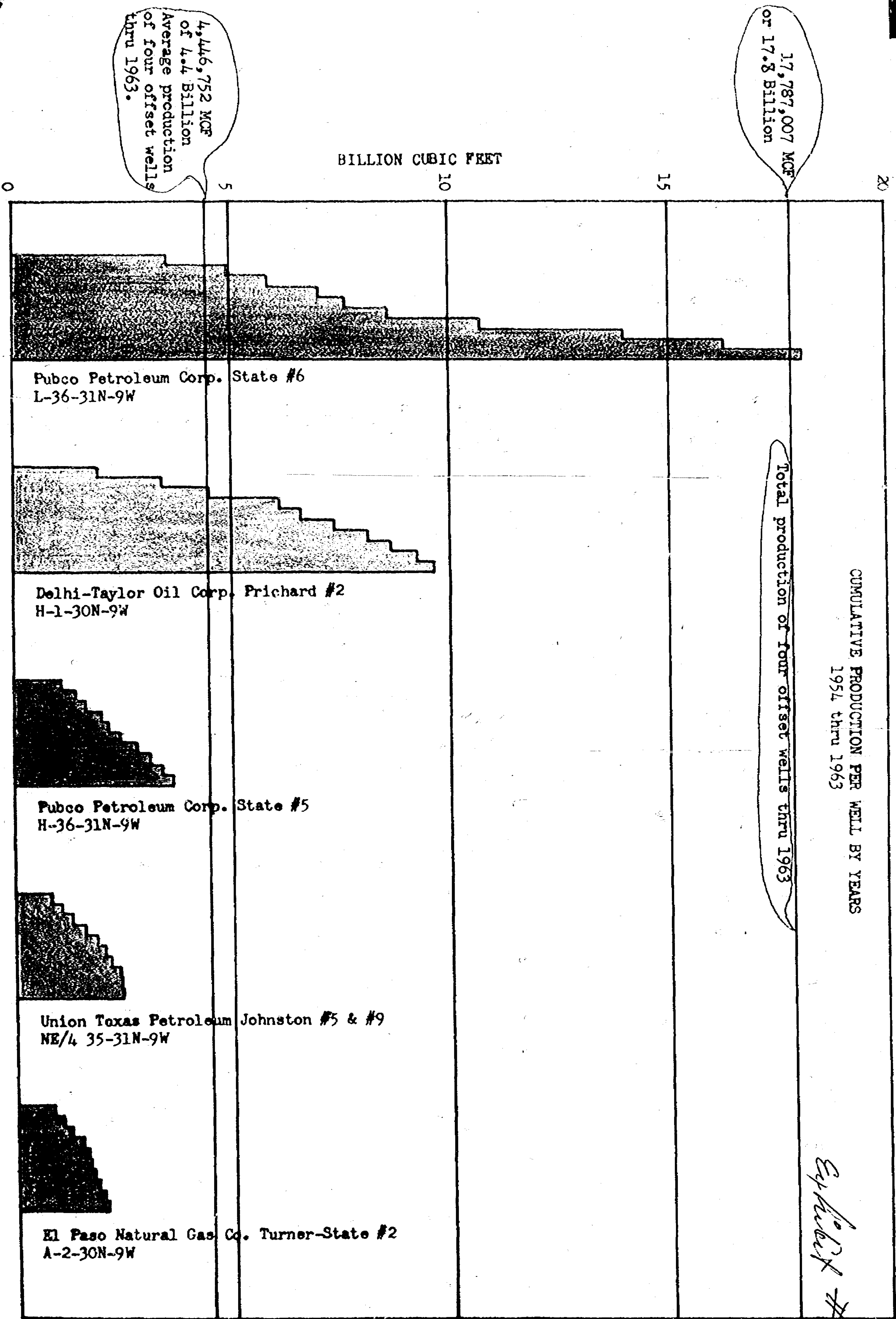
$\left[\frac{P_c^2 - P_d^2}{P_c^2 - P_w^2}\right]^{.75}$
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
90
80
70
60
50
40
30
20
10
PER CENT DRAWDOWN

Exhibit 7

AUTHORITIES

		Page
1.	E. R. Corliss, SOUTHWESTERN GAS MEASUREMENT SHORT COURSE, 1957	287
2.	Craft and Hawkins, APPLIED PETROLEUM RESERVOIR ENGINEERING	31
3.	John M. Campbell, OIL PROPERTY EVALUATION	146
4.	Katz, et al., HANDBOOK OF NATURAL GAS ENGINEERING	422, 436, 462
5.	Rawlins and Schellhardt, BACK-PRESSURE DATA ON NATURAL GAS WELLS AND THEIR APPLICATION TO PRODUCTION PRACTICES, MONOGRAPH 7 OF THE U. S. BUREAU OF MINES	12

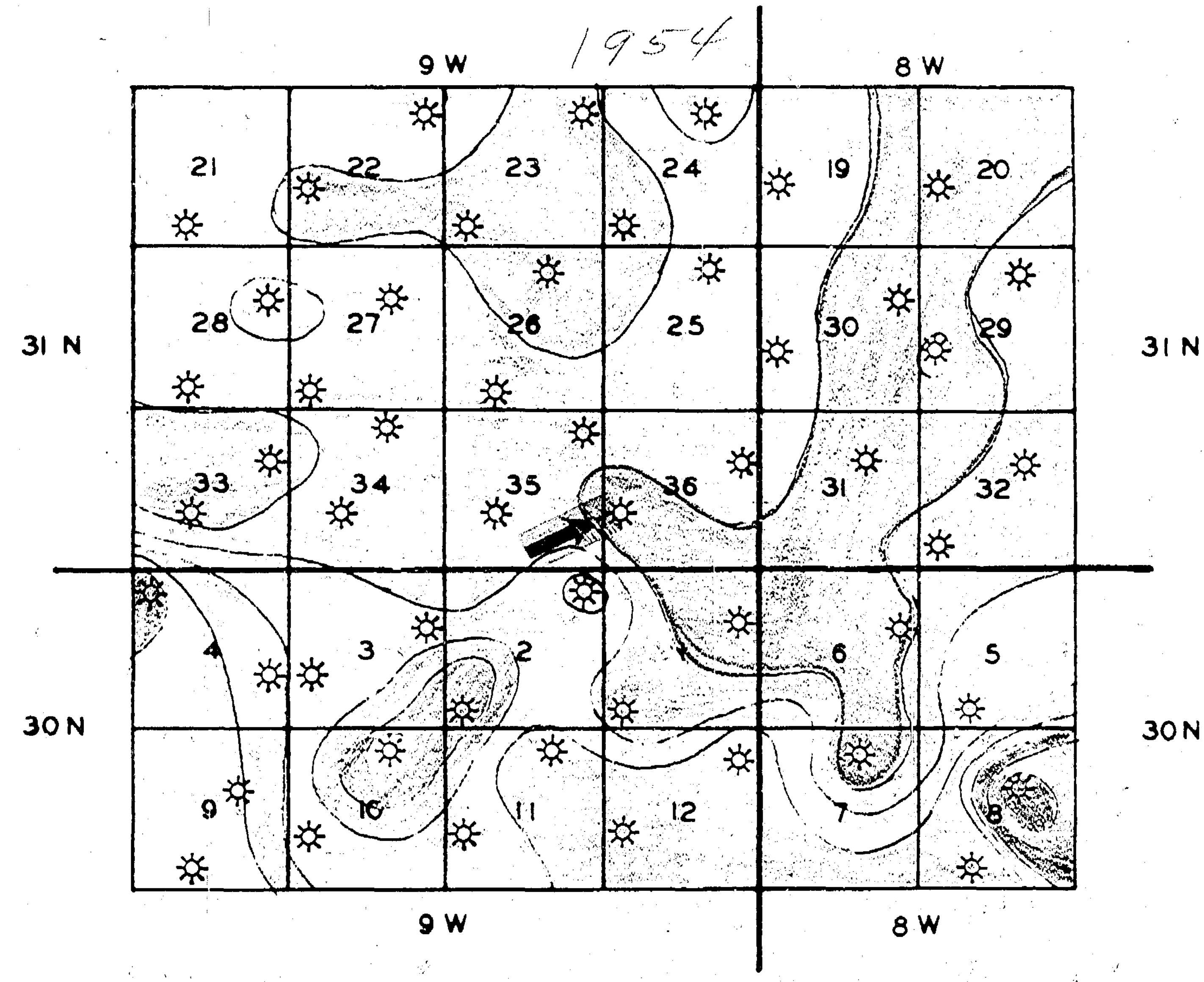
BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
OCC Exhibit No. 8
Case No. 3105



CUMULATIVE PRODUCTION PER WELL BY YEARS
1954 thru 1963
BILLION CUBIC FEET
0
5
10
15
20
4,446,752 MCF of 4.4 Billion Average production of four offset wells thru 1963.
17,787,007 MCF or 17.8 Billion
Total production of four offset wells thru 1963
Pubco Petroleum Corp. State #6
L-36-31N-9W
Delhi-Taylor Oil Corp. Prichard #2
H-1-30N-9W
Pubco Petroleum Corp. State #5
H-36-31N-9W
Union Texas Petroleum Johnston #5 & #9
NE/4 35-31N-9W
El Paso Natural Gas Co. Turner-State #2
A-2-30N-9W

Exhibit # 9

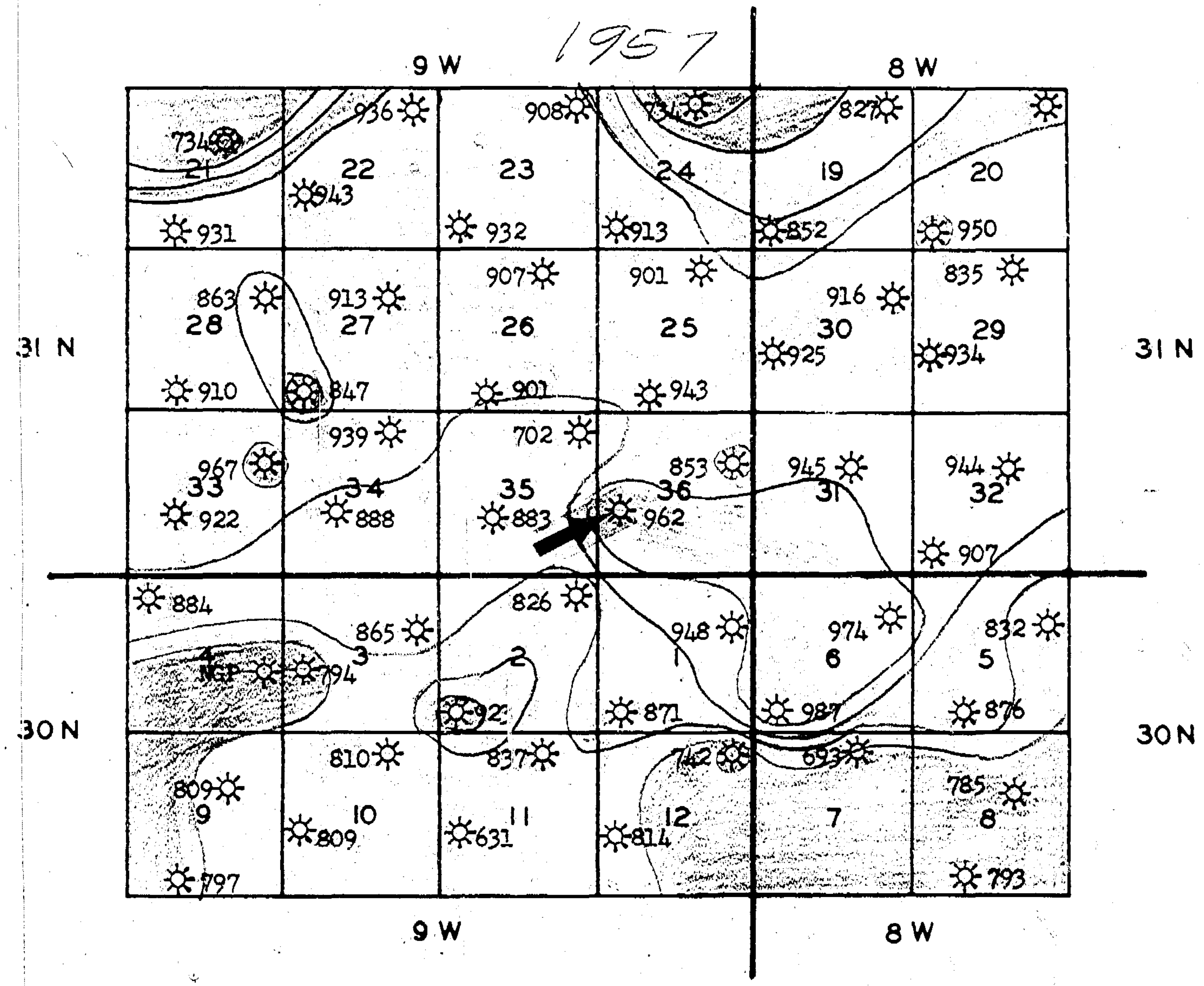
Exhibit 10



		1050 - 1100
743½		1000 - 1050
745		950 - 1000
755		900 - 950
735		[illegible] - 900
738½		800 - 850
739		750 - 800
737½		[illegible] - 750
740½		[illegible] 700
741		[illegible] - 650

574

1957


9 W
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31 N
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907
884
826
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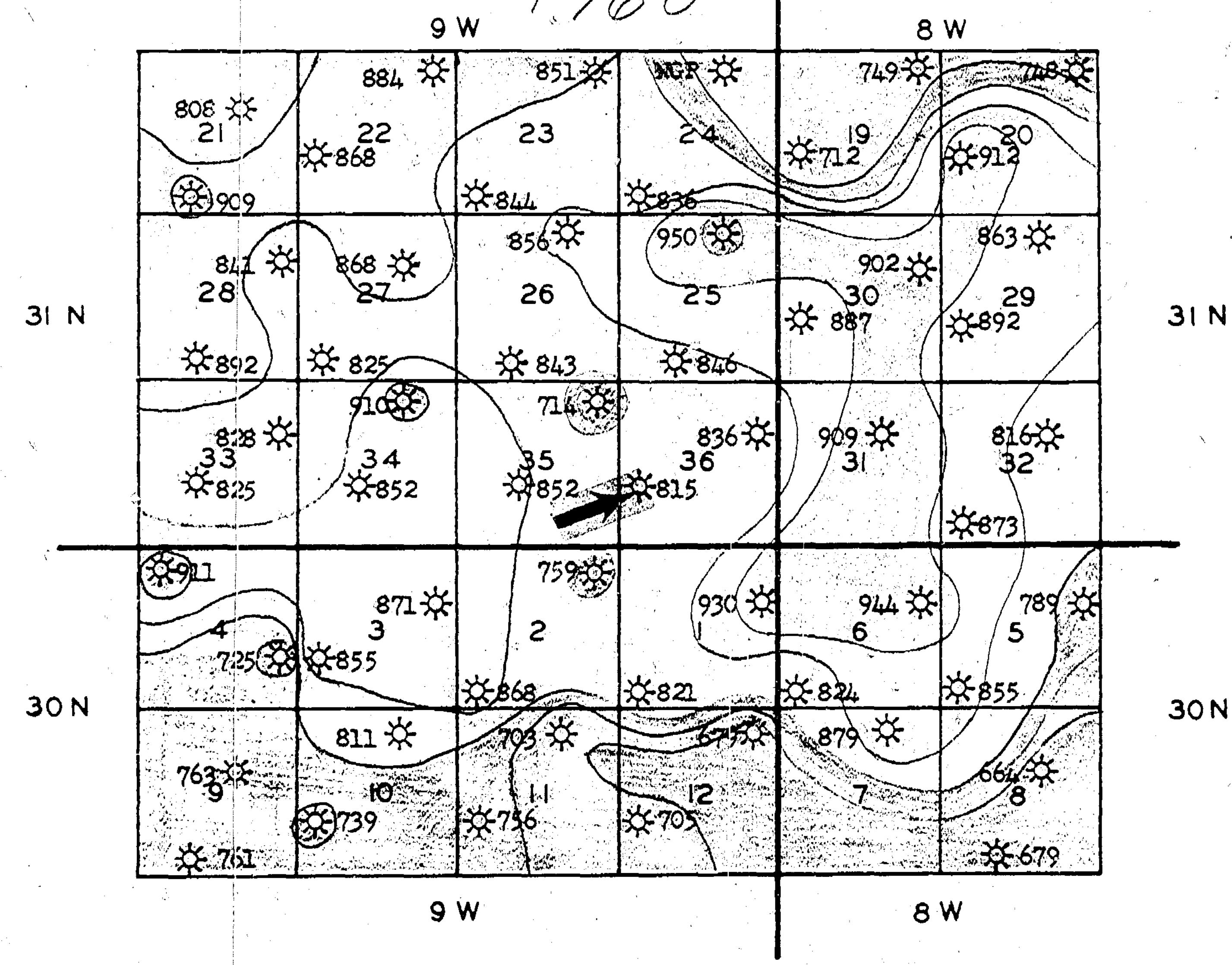
1960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851
NGP
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748
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712
912
909
844
836
856
950
902
863
841
868
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892
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910
714
836
909
816
828
825
852
852
815
873
911
759
871
930
944
789
725
855
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811
703
677
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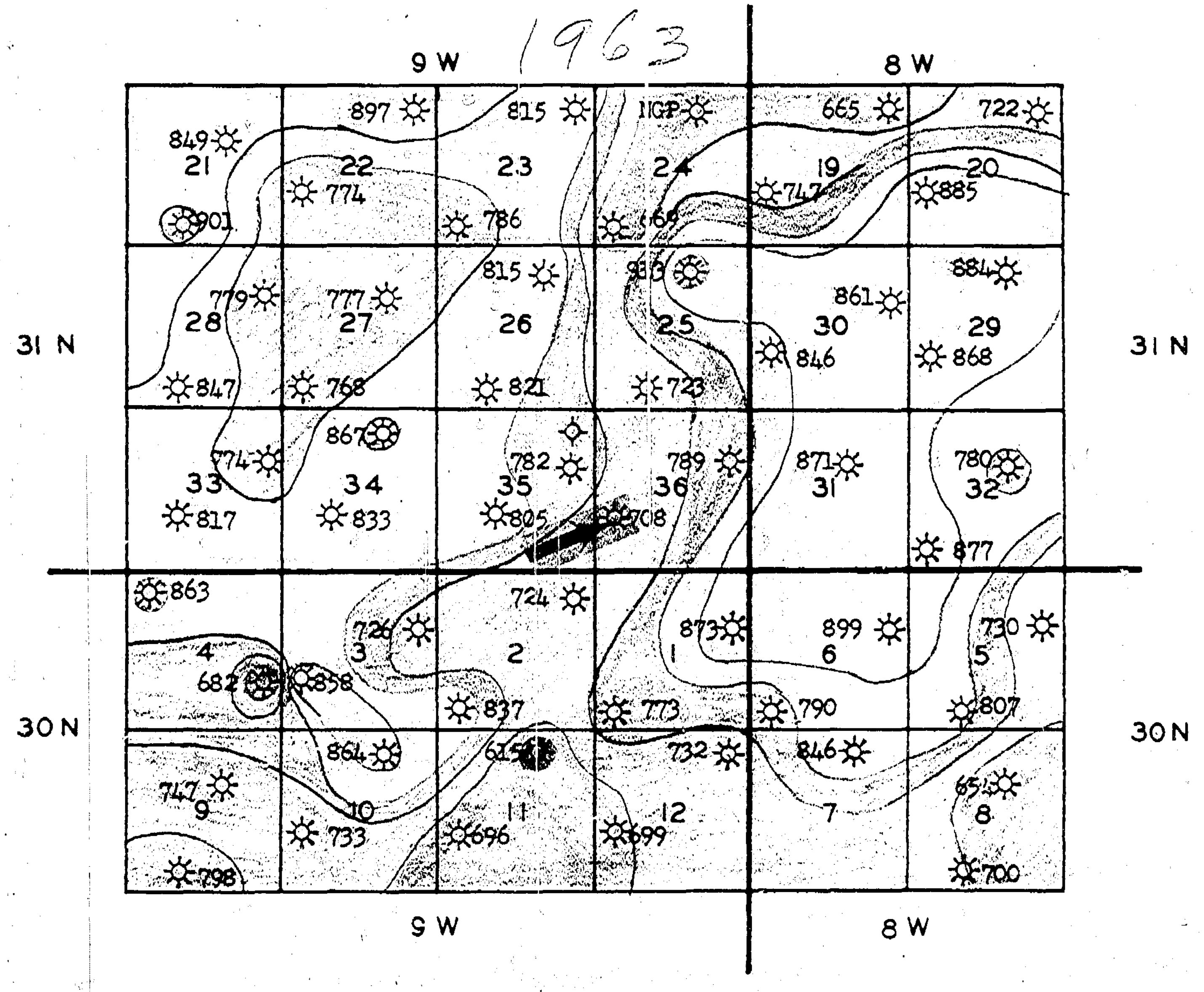
763
664
739
756
705
761
679

1963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774
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768
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871
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774
817
833
805
708
877
863
724
726
873
899
730
682
858
837
773
790
807
864
732
846
747
733
696
699
798
700

67

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It is granted that the call of this hearing does not include discussion of the allocation formula in use; however, I would like to refer to the proration order in the Blanco Mesaverde Pool, which allocates gas on the basis of 75% acreage times deliverability and 25% acreage. Before this order could be written a finding had to be made by the Oil Conservation Commission to the effect that deliverability and reserves in this pool were related in such a way that the employment of the 75-25 formula would result in the allocation of gas to all wells in the pool substantially in the proportion that the recoverable reserves under each tract bears to the total reserves in the pool. Using this basis, then, it may be said that the higher a given well's deliverability the higher the recoverable reserves under its tract and the higher the allowable assigned compared to wells of lower deliverability. We are not here to argue about whether or not the proration formula in use actually does properly allocate gas in the Blanco Mesaverde Pool. For purposes of argument in this case we grant that the 75% acreage times deliverability - 25% acreage formula does allocate gas in proportion to recoverable reserves; however, if there is a relationship between deliverability and reserves, then it logically must follow that after part of the reserves under a tract is produced then the deliverability of the well should decrease because there is no longer as large a reserve left as before production occurred. If this is not true it tends to make a farce out of the whole business of deliverability proration. Exhibit #3 is a chart graphically depicting values from deliverability tests which have been filed for the Pubco #6 State well beginning in 1954 and continuing through 1963. The green line, Pc, represents the 7-day Shut-in pressure used in the annual deliverability test for each year. The black line, Pw, represents the working pressure for each representative test. The working pressyre, very simply stated, is the casing pressure if the well is flowing on the tubing or the tubing pressure if the well is flowing on the casing. The black line on the graph, Q, represents the average daily volume of gas which the well flowed during the 7-day test period.

This volume is measured in MCF. The red line, D, represents the calculated deliverability for this well and this figure is the figure used in the allocation formula to determine the well's allowable for each year. You will note that this well had a modest, although above average for the pool, deliverability from 1954 through 1959 when the well was worked over. You will note that the deliverability in 1959 increased to 12,428 MCF and in 1960 after an additional workover the deliverability for that year eventually calculated at 38,347. Prior to the workover in 1959 as you can see the deliverability had ranged from 5800 to 7700 in the years immediately prior to the workover. Agan, using the premise that deliverability and reserves are directly related, then we must accept the fact that the recoverable reserves in communication with the wellbore of the Pubco #6 State and lying beneath its 320-acre tract increased from 5-6 times when this well was worked over. This is extremely unlikely but as I said we are accepting the proration formula to be the proper formula and therefore for purposes of this discussion are granting that the recoverable reserves attributable to this well did increase in this amount. In order to do this we are actually saying that at the time of the 1960 deliverability test the drill block contained more recoverable reserves than it had ever contained previously, notwithstanding the fact that 8,630,724 MCF of gas had been produced from this well by January 1, 1960. No additional remedial work has been done on this well since that time. In 1960 this well produced 2,100,907 MCF of gas. In 1961 it produced 3,230,559 MCF; in 1962 it produced 2,301,429 MCF of gas; yet the calculated deliverability as plotted indicates that at the time of the 1962 annual deliverability test the well had more recoverable reserves yet to be recovered than had been present at the time the 1961 deliverability test was conducted. You will note that insofar as the 1963 test is concerned we have drawn 3 red lines on the graph, representing the deliverability for this well. I will try to explain why this was done. In October 1962 a hearing was held and Order R-333-F was amended in several respects.

One change made was that the deliverability pressure to be used in the deliverability calculation formula which previously had been a flat 50% of the shut-in-pressure for all wells was changed to a pressure which would be determined and specified by the Commission periodically. The determination of this deliverability pressure would be based upon the relation between the average static wellhead working pressure, Pw, divided by the average 7-day shut-in-pressure, Pc. In the Blanco Mesaverde Pool it was determined prior to the 1963 annual testing season that a deliverability pressure equal to 80% of the shut-in-pressure most closely met the proper requirement for the pool. Therefore all wells in the Blanco Mesaverde Pool have used a deliverability pressure equal to 80% of their shut-in-pressure for the 1963 annual test. You will note that the use of a deliverability pressure of 80% drastically reduces the calculated deliverability and this item applies to all wells in the Blanco Mesaverde Pool. For the purposes of comparison of the 1961 or 1962 deliverability test with the 1963 deliverability test we have shown with a dotted red line the location of the well's calculated deliverability at a deliverability pressure equal to 50% of the shut-in-pressure. This is the only fair comparison between the 1961 or 1962 annual test and the 1963 annual test because in order to be compared they must be calculated at the same deliverability base. Therefore the 1963 annual deliverability again indicates that the recoverable reserves under this tract have increased when compared with the 1961 annual test, even though 5,531,988 MCF of gas was produced during 1961 and 1962. This amount of gas is slightly larger than the total reserve of an average Blanco Mesaverde proration unit according to testimony from previous hearings in this pool. The 1962 test did show a larger deliverability than the comparable 1963 test. Obviously the 1962 test was also an unrealistic test due to low shut-in-pressure. It is obvious that if we are to continue using a deliverability factor in the allocation formula and by so doing accept the relationship between deliverability and reserves then we must question deliverability tests which yearly show an increase even after heavy production from the well.

For example, the slope of the line between the 1961 and 1963 tests shows that the daily rate of flow decreased from 9166 MCF to 6968 MCF or 2188 MCF. The working pressure decreased by 45# yet the calculated deliverability when compared on the same deliverability pressure basis increased from 28,393 to 28,916. In regard to deliverability tests the following general statements can be made: Normally, all other things being equal, if the daily rate of flow that a well is flowing during a test decreases, then the calculated deliverability decreases. Also, if the working pressure decreases this also indicates a lower calculated deliverability. The only factor in the deliverability calculation which by showing a decrease will increase the calculated deliverability is the shut-in-pressure; therefore it is obvious that the abnormally low shut-in-pressure measured on the Pubco #6 State well for the 1963 deliverability test is abnormally low and is causing a mathematical error in the deliverability test. This error is magnified as the shut-in-pressure approaches the working pressure, and as the well is produced longer the problem may become even more magnified. Therefore it became apparent to us that it was absolutely necessary that some correction be made for the deliverability test for this well and for various other wells in the San Juan Basin which exhibit the same problems. It seemed to us that if something were not immediately done to insure that comparative representative tests were being secured for all wells in the pool serious inequities were going to be aggravated. We feel that the use of average shut-in-pressures from the direct offset wells to the well in question can, better than any other information, be said to represent the reservoir pressures in this portion of the reservoir. Also, as it has been demonstrated that the shut-in pressure, particularly on very large wells such as the Pubco State 6, is such a critical factor in the deliverability calculation, every effort should be made to prevent this type of well from receiving an unfair advantage because of low shut-in pressure. Actually it is our contention that the shut-in pressure on this well is low for the reason that it has received excessive production in relation to the offset wells, thereby creating a pressure sink in the vicinity of the wellbore.

If proper corrections are not made we maintain that deliverability proration in the San Juan Basin will become a farce as we have already noted that the problem is going to be more pronounced in the Basin Dakota Pool, due to extremely acute stabilization problems.

Exhibit 2 is a graph depicting pressure history of the Pubco State #6 well and its offsets. Also shown is the cumulative yearly production since 1954 of the State #6 and the average production of its 4 offsets. The Pubco #6 State well was worked over in 1959 and its deliverability was greatly increased. This accounts for the very steep production increase during and after 1959 and this greatly increased production is undoubtedly related to the steep pressure decline on the #6 State well after 1959.

Exhibit No. 4 is a summary showing the effect of using average offset pressures in lieu of the actual measured pressures in the deliverability calculation for the Pubco State #6 well for the 1963 annual deliverability test. All pressures listed are taken from 1963 annual deliverability tests. When the presure from the Pubco State #6 well is averaged with the pressures from the 4 direct offset wells the resulting pressure is 775 p.s.i.g. The measured surface pressure on the Pubco State #6 is 708 p.s.i.g. Next the exhibit shows the effect of substituting the average offset pressure for the actual measured pressure in the 1963 annual deliverability test for the #6 State well. As may be seen, the deliverability and resulting allowable are nearly cut in half. The third part of the exhibit shows the deliverability and allowable comparison for the 4 offset wells calculated individually and averaged - all the above information is shown graphically on Exhibit No. 5

A well which has a lower than average shut-in-pressure gains in two ways in the deliverability calculation. First, because the deliverability pressure is a fixed percentage of the shut-in-pressure, the percentage being 80% in the Blanco Mesaverde Pool, it gains the advantage of being calculated to a lower deliverability base. Secondly, it makes the well appear to have a lower draw-down (i.e. difference between Pc and Pw) than it actually has. The effect of this in the deliverability calculation is to exaggerate the calculated deliverability when compared with other offset wells with higher pressures. In the case of very large wells such as the Pubco State #6 this inaccuracy becomes very large.

5 bar graphs

Exhibit 5 is a bar graph showing the effect of using the average shut-in pressures from the 4 direct offset wells to the Puboo State with the pressure from the State 6 in the deliverability calculation for the 1963 annual test. Also shown is the effect on allowable caused by this deliverability difference.

The red bars represent the actual measured shut-in pressure from the 1963 annual test, the actual calculated deliverability as submitted and the resulting allowable for the State 6 well for the 12-month period March 1, 1963 through February 29, 1964.

The blue bars show the effect of using an average pressure arrived at by averaging the pressures from the 4 direct offset wells with the pressure from the State 6 and substituting this pressure in the deliverability calculation on the 1963 annual test for this well. All other values from the test are unchanged. You will note that the deliverability is reduced from 16,716 MCFPD to 8,913 MCFPD, almost a 50% reduction, although the only substitution made in the deliverability calculation is to use the offset pressure of 775 pounds instead of the single pressure of 708 pounds measured on the State 6. By making this correction the average allowable for the period March 1, 1963 to February 29, 1964 is reduced from 182,741 MCF per month or 3470 MCFPD to 106,454 MCF per month or 1930 MCFPD

The green bar shows the average offset well conditions. The average pressure for the 4 offset wells is 792 pounds. The average deliverability from the tests on the offset wells as submitted is 1631 MCFPD. The average allowable for the 4 offset wells for the period March 1, 1963 to February 29, 1964 is 12,011 MCF per month or 400 MCFPD.

MULTIPLIER CURVE

This curve identifies what we term the "multiplier" for various pressure drawdown percentages. The term drawdown here represents the percent of pressure drop from the shut-in pressure, Pc, to the working pressure, Pw. The deliverability pressure, Pd, used here is 80% of the shut in pressure. The value of this multiplier is a factor in the deliverability test calculation for the Blanco-Mesaverde Pool as used in 1963. The corrected average daily flow rate of the well is multiplied by ~~thx~~ this factor to determine the deliverability of the well.

The multiplier value approaches infinity as the drawdown approaches zero.

A one percent change, from ~~24%~~ 25% to ~~15%~~ 24% drawdown, causes a multiplier increase of 2.61 percent. This is the approximate point where accuracy of pressure measurement in field operations begins to give close results by allowing for minor deviations in the data without causing greatly exagerated deviations in the calculations.

A one percent change, from 6% to %5 drawdown, causes a multiplier increase of 12.45 percent. Minor errors in field data are greatly amplified because of this position on the curve.

The Pubco well test falls in this drawdown range.

An error in the pressure data can be slow stabilization, liquid in the well bore, wellhead leaks or guaging errors. We do not accuse Pubco of submitting errors in guaging. We believe the error is due to slow stabilization.

~~The deliverability calculation as used in the proration formula is used to represent reserves.~~

~~The deliverability test as required by order R-333-F is a back pressure test.~~

~~The following exhibit refers to the calculation of reserves and back-pressure tests and stresses the importance of accurate pressures.~~

The deliverability test is a back-pressure test and the results are used as a reflection of reserves in gas allocation?

Nav Ex

PUBLICATIONS

A. Mr. E. R. Corliss presented a paper at the Southwestern Gas Measurement Short Course in 1957 entitled "Deliverability Method of Rating Gas Wells" in which the following paragraph appeared:

Under "Conditions affecting Deliverability Test" item 2, "Stabilization of Test Pressures -

> Stabilized values of both working and shut-in pressures are essential to good deliverability data. In reservoirs of extremely low permeability, stabilized shut-in and flowing conditions may have to be approximated, as demonstrated in the testing method promulgated by the New Mexico Oil Conservation Commission."

B. Craft and Hawkins, APPLIED PETROLEUM RESERVOIR ENGINEERING, copyright 1959, by permission of Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Beginning on page 31, they discussed pressure in relation to reserve calculations as follows:

> "Another problem in any volumetric or material balance calculation is that of obtaining the average reservoir pressure at any time after initial production. Figure 1.7 is a static reservoir pressure survey of the Jones sand in the Schuler Field. Because of the large reservoir gradient from east to west, some averaging technique must be used to obtain an average reservoir pressure. This can be calculated either as an average pressure, average area pressure or average volumetric pressure as follows:"

Then they offer three formulae to show the procedure. Figure 1.7 is an isobaric map of the pool.

We are interested in this approach because the term deliverability in the proration formula is used as a reflection of reserves under the proration unit.

C. John M. Campbell, OIL PROPERTY EVALUATION, copyright 1959, by permission of Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

Beginning on page 146 in the section "Material Balances for Free Gas" the paragraph entitled "Average Reservoir Pressure" reads in part:

> "The oil and gas balances both contain terms which depend on the reservoir pressure. In view of the fact that pressure varies throughout a field, it is necessary to find a proper average. The pressure history for a field is essential for sound evaluation work."

D. Katz, Cornell, Kobayashi, Poettmann, Vary, Elenbaas and Weinaug, HANDBOOK OF NATURAL GAS ENGINEERING, copyright 1959, by permission of McGraw-Hill Book Company, Inc., New York, New York.

pressure-decline method, the following paragraph appears:

"In computing gas reserves from reservoir pressure, it must by assumed that well pressures reflect the equalized reservoir pressures. For low-permeability reservoirs, pressure build-up data on wells may be used to estimate equalized pressures, as discussed in Chapter 10."

This again identifies the need for accurate reservoir pressures.

In Chapter 10, on page 422, we find a section entitled "Determination of Equalized Reservoir Pressures" which reads in part:

"Periodic measurements of the shut-in or formation reservoir pressure must be made in order to calculate gas reserves and to correct the back-pressure curve as the field is depleted. In low-permeability formations apprecialbe pressure differences may exist between various points even after long shut-in times. These differences are due to the low rates at which gas can flow through the low-permeability formations to reach the depleted zones. Such pressure differences should be recognized and taken into account by the calculation and use of an "equalized reservoir pressure". The equalized reservoir pressure is the uniform pressure that would exist in the reservoir after such a long time had passed that the flow of gas to the depleted areas had ceased add that, for practical purposes, no pressure gradients existed in the reservoir."

Again, here is strong emphasis for accurate reservoir pressures for calculations of reserves or tests.

On page 436, under the title "Bask Pressure Tests" reference is made to the next text:

E. Rawlins and Schellhardt, BACK-PRESSURE DATA ON NATURAL GAS WELLS AND ~~THIER~~ THEIR APPLICATION TO PRODUCTION PRACTICES, 1935, Monograph 7 of the U.S. Bureau of Mines.

On page 12 the following paragraph appears:

"Pressures

The degree of accuracy of the wellhead pressure determinations is a most important factor in a back-pressure test. Errors in wellhead pressures are reflected directly in the calculated values of pressures in reservoir, which are used as the basis for determining the capacity of a well to deliver gas at different back pressures. For instance, a small error in one of the pressures in the factor $P_f^2 - P_s^2$ is reflected as a large percentage error in the difference of the squares of the two pressures. The effect of errors in pressure measurement on the interpretation of data from back-pressure tests of gas wells is discussed in detail in appendix 7."

Actually, appendix 8 is entitled "Cause and Effect of Errors in ~~Bas~~ Gas-Pressure Data". The importance of correct data is emphasized by the fact that an

No Ex

article was appended to the text.

All of the texts referred to have stressed accuracy of reservoir pressures for calculating both reserves and back-pressure tests. The deliverability test is a back-pressure test and the results are used by this Commission as a reflection of reserves.

I would like to offer the identity of the authors of the publications quoted here.

E. R. Corliss is an engineer for Southern Union Gas Company, Dallas, Texas.

B. C. Craft, Professor and Head of/The Petroleum Engineering Department of Louisiana State University.

M. F. Hawkins, Jr., Professor of Petroleum Engineering at Louisiana State University.

John M. Campbell, PhD., Chairman of the School of Petroleum Engineering at the University of Oklahoma.

Donald L. Katz, Professor of Chemical Engineering and Chairman, the Department of Chemical and Metallurgical Engineering at the University of Michigan.

David Cornell, Associate Professor of Petroleum Engineering at Oklahoma State University.

Riki Kobayashi, Associate Professor of Chemical Engineering at The Rice Institute.

Fred K. Poettmann, Supervisor, ~~of the~~ Engineering Department, Research ~~XXX~~ Organization, The Ohio Oil Company.

John A Vary, Chief Reservoir Engineer, Michigan Consolidated Gas Company.

Jack T. Elenbaas, District Engineer, Production and Pipe Line District, Michigan Consolidated Gas Company.

Charles F. Weinaug, Professor and Chairman of the Department of Petroleum Engineering, University of Kansas.

E. L. Rawlins, Senior Petroleum Engineer, Petroleum Experiment Station, U.S. Bureau of Mines, Bartlesville, Oklahoma.

M. A. Schellhardt, Associate Natural Gas Engineer, Petroleum Experiment Station, U.S. Bureau of Mines, Bartlesville, Oklahoma.

These people represent all phases of the industry—research, education and application. The emphasis placed on the accuracy of reservoir pressures is impressive to me.

Ex 7

ISOBARIC MAPS

The four plats are of the same area of the Blanco-Mesaverde Pool. The lines and colors reflect pressure contours. The contour interval is 50 pounds. All pressures were taken from the annual deliverability tests for the years indicated. The black arrow near the center of each plat identifies the Pubco Petroleum Corporation State #6 well located in the southwest quarter of Section 36, Township 31 North, Range 9 West.

The production-reserve ratio of the wells has not been uniform. Any well which has produced a higher percent of its reserves over a given period of time shows a faster rate of depletion and; therefore, a faster pressure decline.

The plats reflect that the State #6 well was in an area of higher pressure during 1954 and in 1957. In 1960 the pressure had been reduced in the immediate area and by 1963 the pressure was much further reduced and over a wider area.

In 1954 the State #6 well had a pressure of 1042 pounds which is in the pink contour for pressures between 1000 and 1050 pounds.

In 1957 the State #6 was still in the higher pressure contour of the area.

Remedial action was performed in 1959 and 1960 which resulted in higher production rates. Reconnection after the 1960 remedial action was May 27, 1960. The October 14, 1960 pressure of the State #6 well was more than 50 pounds below the then existing high pressure contour in the area.

The 1963 pressure for the well was 142 pounds below the high pressure contour.

In my opinion, the high rate of withdrawal of gas by the State #6 well in relation to that of the offset wells contributed much to the cause of the low pressure pattern.

PRODUCTION GRAPH EXHIBIT No. 8

This bar-graph shows the cumulative production dor each of the wells identified on the exhibit. The first step of each bar shows the cumulative volume produced thru 1954.~~XXXXXXX~~ The last step or the top of each bar shows the cumulative ~~XXXXXXXXXX~~ volume produced by each well thru 1963

The Pubco State #6 well was reworked in 1960 - ~~XXXXXXX~~ the graphic position is where the production line crosses the 10 billion line. The rate of increase in cumulative production ~~XXXXXXXXX~~ is much higher from that time on.

Each of the four offset wells production history shows the annual rate to be relatively constant since that time.

The horizontal line at 4.4 Billion Cubic Feet represents the average of the total~~X~~ production for the four offset wells.

The horizontal line at 17.8 Billion Cubic Feet is the total cumulative production for the four offset wells at the end of 1963 at which time the Pubco State #6 well had produced 18.1 Billion Cubic Feet.

The Pubco State #6 well has produced more gas each year since 1959 than the sum of the four offset wells. In 1963, the State #6 produced more than one Billion Cubic Feet more than the four offset wells.

In my opinion, based on the pressure and production history, the Pubco State #6 well has created a low-pressure area around the wellbore. This pressure-sink causes the deliverability and, thus, the allowable to be too high to accurately represent the reserves under the drill tract.

The portions ~~of~~ outlined by ball point pen are not identified on the exhibit. We can do that Tuesday in Santa Fe if you desire.

Ex 9

ALLOWABLE CURVE

This chart shows the allowable assignment as would occur using an acreage allocation factor of 1732.13 and and A x D allocation factor of 6.302097. These factors are the averages of the factors used for actual allocations from March 1963, through February 1964. This selection was made early in the year to apply average monthly allowable comparisons.

Specifically, this chart shows the relationship of the allowable assignment due to acreage and that due to deliverability. The horizontal scale is per well deliverability and plotted in million cubic feet per day. The vertical scale is the monthly allowable as would be assigned by the ~~average~~ allowable factors. The lower line represents the allowable due to deliverability of the well and the space between the lines represents the allowable assigned for acreage.

The proration formula is designed to allocate 25% of the allowable by acreage and 75% by acreage times deliverability. This occurs on a pool basis, not on a per well basis. Examples of the percent of allowable based on deliverability are as follows: at a deliverability of 100 MCF, 26.7% of the allowable is assigned by deliverability; at 500 MCF, 64.5% of the allowable; at 1000 MCF, 78.4%; at 5000 MCF, 94.8%; at 10,000 MCF, 97.3% and at 30,000 MCF, 99.1%.

The problem here concerns only a few wells. Of the 1901 wells tested in the Blanco-Mesaverde Pool in 1963, only 189 wells had a deliverability higher than one million cubic feet per day. Of the 189 wells, only 29 wells had a deliverability in excess of two million feet per day and 8 of these had a deliverability over three million feet.

This chart is presented to show the ~~need for tests as accurate~~ necessity for accurate deliverability tests; as possible. Specifically, for the higher deliverability wells where the deliverability affects the allowable to such a high degree.

	Acreage	AxD	Total	AxD ÷ total
[illegible]	1732.13	56,176.59	57908	97.00%
[illegible]	1732.13	105,[illegible]	[illegible]	98.38%
[illegible]	1732.13	[illegible]	[illegible]	99.05%

DELIVERABILITY CALCULATION FORMULA

$$\text{Deliverability} = Q \times \left(\frac{(\text{Shut in pressure})^2 - (\text{Deliverability Pressure})^2}{(\text{Shut in pressure})^2 - (\text{Working Pressure})^2} \right)^N$$

1. Q is the average daily volume of gas that a well flowed during the test period.

2. Shut-in pressure. This is a measured pressure at the wellhead after the well has been shut-in seven daysl.

3. Working pressure is a pressure which is measured while the well is flowing. If the well is flowing through the tubing it is measured on the casing. If it is flowing through the casing, it is measured on the tubing. The difference in pressure between the shut-in pressure and the working pressure is known as the draw down. A general statement which can be made is that "all other things being equal, the smaller the draw down the higher the deliverability". Also the smaller the draw down the greater the element of potential mathematical error in the deliverability calculation.

4. Deliverability pressure is not a measured pressure but is set by the Commission for each pool. In the Blanco Mesaverde Pool it is 80% of the Shut-in pressure (P_c). In the Basin Dakota Pool it is 50% of the Shut-in pressure.

5. N = Average pool slope of the back pressure curve.

As may be seen from the formula, it is very important that the shut-in pressure be an accurate pressure because it appears twice in the formula and the deliverability pressure is directly related to the shut-in pressure. If the shut-in pressure used is erroneously low the effect is always to increase the deliverability of a well. The reason for this is two fold. First, if the shut-in pressure of a well is lower than other wells in the pool then the deliverability pressure, being directly related to the shut-in pressure, is also low. Secondly, if the shut-in pressure is low it approaches a value nearer the value of the working pressure making it appear that the well has drawn down less than it actually has. Mathematically the effect of this in the above mentioned formula is to make the denominator in the formula smaller and this causes the resulting multiplier to be larger, therefore the effect of using an erroneously low shut-in pressure is to give an erroneously high deliverability which does not truly reflect the ability of the well to produce gas. Theoretically, the shut-in pressure used in the deliverability calculation should be the reservoir pressure in the well's drainage area and this is not necessarily the pressure measured at the wellbore.

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
September 16, 1964

REGULAR HEARING

IN THE MATTER OF: Application of Pubco Petroleum Corporation for recision of an administrative determination under Order No. R-333-F, San Juan County, New Mexico.

Case No. 3105

BEFORE: Elvis A. Utz, Examiner

TRANSCRIPT OF HEARING

MR. PORTER: The Commission will take up the next case, 3105. This is an application of Pubco Petroleum Corporation for recision of administrative determination under Order No. R-333-F, San Juan County, New Mexico.

MR. SPERLING: If the Commission please, I am James E. Sperling of Modrall, Seymour, Sperling, Roehl and Harris, Albuquerque, appearing for the applicant, Pubco Petroleum Corporation. Associated with me in this matter are Mr. W. A. Keleher, Mr. John B. Tittman of the firm of Keleher and McLeod, Albuquerque, New Mexico.

MR. PORTER: I would like to ask for other appearances in the case at this time please, Mr. Morris.

MR. MORRIS: If the Commission please, I am Richard Morris of Seth, Montgomery, Federici and Andrews, Santa Fe. I wish to enter my appearance for El Paso Natural Gas Company. Associated with me in the case will be Mr. Ben Howell of the Texas Bar who will handle the case for El Paso Natural Gas Company.

I also wish to enter an appearance for Southern Union Gas Company and Southern Union Production Company and also for Tenneco Oil Company. Associated with me for Tenneco Oil Company will be Mr. J. D. Moon of the Texas Bar Association. At this time if I'm not out of order I would ask that the Commission give consideration to allowing all interested parties in the case a reasonable period of time following the termination of this hearing within which to submit their written statements of position. We feel that this matter is of great importance to the industry and to the whole system of prorating gas in the San Juan Basin and we wish to make our positions known with some precision.

It would perhaps simplify the position of the other interested parties in this case if we could know at the outset whether we would be allowed a reasonable period of time following the expiration of this hearing within which to submit such written statements.

GOVERNOR CAMPBELL: Mr. Sperling, does Pubco have any objection to this procedure of permitting a reasonable period of time for the submission of statements of position by other parties appearing in the case?

MR. SPERLING: No, we do not.

GOVERNOR CAMPBELL: They must be on your side. Mr. Morris, how long a period of time are you thinking about?

MR. MORRIS: We would request two weeks to submit the printed statements, but if the Commission would desire more speed I am sure that it could be done in a shorter period of time.

MR. PORTER: The Commission will grant a two week's period of time, two weeks from today as a deadline in which the interested parties may file a statement of position.

MR. MORRIS: Thank you.

MR. PORTER: Any other appearances?

MR. DURRETT: If the Commission please, my name is Jim Durrett. I am appearing on behalf of the staff of the Oil Conservation Commission of the State of New Mexico.

MR. PORTER: Any other appearances?

MR. SPERLING: If the Commission please, I would ask leave to make an opening statement in this matter. I think it will lay the groundwork and clear the air for what we expect to present in the way of testimony and evidence.

This matter is before the Commission on the application of Pubco for review of the action taken by the Commission through the Aztec District Office to the effect that a determination had been made by that office that the shut-in pressure measured as a part of the annual deliverability test for 1963, for Pubco's State #6 well which of course will be identified specifically in the testimony and is identified in the application.

Anyway, a determination was apparently made by the Commission staff that the shut-in pressure for the State #6 well as a part of the deliverability formula was an abnormally low pressure in their opinion.

The authority under which the Commission acted was stated to be Order No. R-333-F, which was adopted by the Commission at a hearing held in 1962 in Case Number 2695.

Now, generally this order relates to the taking of annual deliverability tests in northwest New Mexico and as the Commission knows, the provision for the conducting of annual tests on each well is for the purpose of determining the deliverability to be assigned to each well. This, of course, is in direct relationship to the allocation of the allowable for an individual well.

Now, it is our position that a reading of the testimony which was taken in Case No. 2695 makes abundantly clear that the reason for the adoption of that rule from which I will quote at a later point was that it was believed that certain inaccurate pressure readings were being taken in connection with annual deliverability tests.

Those inaccurate readings being largely caused by the presence or suspected presence of liquids in the hole or by virtue of restrictions which existed between casing tubing measureabilities which resulted in an unrealistic picture insofar as shut-in pressure was concerned.

I think that the sense or the entire sense of that earlier hearing is quite evident from the testimony as reported and we will be referring to that testimony, specific parts of it that relate to the action taken in this case will be pointed up in some detail.

Now, there was very little controversy insofar as this initial hearing was concerned. The sense of it being as I have stated that problems did exist where inaccurate pressures were being reported and which needed correction obviously because of the distortion of the deliverability formula as a result of their introduction therein.

As I say, recognizing that the Commission adopted Order No. R-333-F and provided that when it was determined an abnormally low pressure existed, then one of three methods could be employed for the correction of that abnormally low pressure which we take to mean inaccurate pressure and those three methods are as follows: 1 - A Commission designated value for the shut-in pressure. 2 - An average shut-in pressure value on offset wells completed in the same zone and, 3 - a calculated surface pressure based on a measured bottom hole pressure and such calculation to be made in accordance with the Oil Conservation Commission Back Pressure Manual #7.

It is quite apparent from the reading of the rule that there is no criteria or guide rule set up in the rule itself upon which a determination is to be based as to what constitutes abnormally low.

Obviously it has to be measured against something and the suggestion is that in the reporting of a particular shut-in pressure for a particular well an obvious discrepancy must apparently exist between the shut-in pressure for that well and we'll say some other selected shut-in pressure.

Now, without a criteria there is a wide latitude of discretion which may be employed in making the determination as to what constitutes abnormally low. In this particular instance of the three methods for correcting the shut-in pressure reported, the Commission has chosen to use an average shut-in pressure value on offset wells completed in the same zone.

We will show that the State #6 well does not A, have an abnormally low shut-in pressure and B, that the pressure reported was a measured pressure determined to be accurate by a variety of tests and therefore not subject to influence by liquids or by any other mechanical interference and that the pressure so reported and used in the calculation of deliverability as an integral part of the formula itself and the other factors in the formula being dependent and related thereto. We will show that that pressure is the only pressure which is representative of this particular well.

Now, as you know, we have been operating in the northwest New Mexico area for a number of years under a deliverability formula which is the rule of the game, at least at this point. We object strenuously to a departure from those rules for any reason other than the failure to obtain an accurate pressure reading insofar as a given well is concerned.

If you start fooling around with that formula by the introduction of inaccurate shut-in pressures in the formula then you have destroyed the value of the formula itself insofar as an individual well is concerned and you have robbed the particular well against which this action is taken of it's true share of the market as recommended on the basis of deliverability which as I say is a rule of the game.

Now, we're in a little peculiar position in this kind of a matter. Ordinarily before action is taken it is set for a hearing, and the pros and cons are investigated. In this particular instance the action has been taken and we are here in the position of going first and trying to show what we assume to have been the reason for the taking of the action and why those reasons are invalid reasons.

We necessarily are anticipating what the staff has in mind so far as their evidence is concerned because being the applicant we show our cards first. With that in mind we may be required to use considerable rebuttal testimony. We expect to present our case in chief along the line that I have indicated and at this time we have one witness, Mr. Charles Ramsey who should be sworn.

MR. PORTER: Mr. Ramsey, would you stand, please?

(Witness sworn.)

CHARLES RAMSEY

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

(Whereupon, Applicant's Exhibits No. 1 through 7 were marked for identification.)

MR. SPERLING: For the Commission's information, Mr. Durrett has made available to me a number of copies of Order R-333-F which will be of interest to the Commission I'm sure and I'll make those available at this time.

DIRECT EXAMINATION

BY MR. SPERLING:

Q State your name, address, by whom you are employed and in what capacity?

A I'm Charles Ramsey, Junior. I reside at 2905 Cagua Drive, Northeast, Albuquerque, New Mexico. I am presently employed by Pubco Petroleum as a reservoir engineer.

Q You have not previously testified before the Commission?

A No, sir, I have not.

Q Would you give us a brief resume of your background educationally and experience-wise?

A I attended the Colorado School of Mines from 1954 through 1958 and received a degree of Petroleum Engineer in 1958. Since graduation I have spent a total of six and a half years as an active reservoir and operations engineer. I was employed by Tenneco Oil Company for five years in Oklahoma and Louisiana as a reservoir engineer and operations engineer and for the past one and a half years I have been with Pubco as a reservoir engineer dealing with reservoir studies in the San Juan Basin and elsewhere.

Q In the course of the performance of your duties as an engineer you have had occasion have you not to make a study regionally as well as locally of reservoir conditions in the San Juan Basin and particularly in the immediate area of this well in question?

A That is correct.

Q We have referred to Pubco's well, State #6. Would you identify for the record the exact location of this well?

A Yes, the State #6 well is located in Unit L of Section 36, Township 31 North, Range 9 West in San Juan County, New Mexico. It is in the Blanco-Mesaverde Pool.

Q If you will, Mr. Ramsey, give us a resume of the history of this well.

A The State #6 well was completed initially on July 23, 1952, as an open hole completion with casing set above the Mesaverde Section. We worked this well over on two occasions in 1958 and in 1959, by perforating the tubing to allow the tubing and casing to be in communication due to casing problems in the open hole. In 1960 we evidenced a serious casing leak in this well, as shown by gas escaping from the well around the well bore. We located this casing leak at 640 feet and repaired it. We redrilled the well and set casing through the entire Mesaverde Section at that time and completed the well through a total of 395 feet of perforations in the Cliffhouse, Menefee and Point Lookout Sections of the Mesaverde. So essentially, since May of 1960, the State #6 well has been a new well relative to it's earlier completion.

Q One of the matters which is at issue in this proceeding is the conducting of the 1963 deliverability test for this particular well. Would you explain to us and refer to what exhibits you have there with reference to the conducting of this test, the results obtained and so forth?

A The 1963 annual deliverability test on the State #6 well was conducted according to the regular test schedule from March 30, 1963, through April 14, 1963. The test was conducted in strict accordance with the rules as outlined in Order R-333-F and it was filed on the standard form, C-122A. The significant results of this test were that we measured a shut-in surface pressure of 708 pounds per square inch absolute and using this pressure and the other measured factors we calculated a deliverability of 16,716 Mcf per day.

Q You state that this was a measured shut-in pressure; in what fashion was it measured?

A This shut-in pressure was measured in accordance with the testing rules of Order R-333-F by a dead weight test gauge at the surface at the end of the seven day shut-in pressure.

Q Were there other tests conducted, not as a material or required portion of the deliverability test, but in any other test for your own information at that time?

A Yes. For our own reservoir purposes we conducted a bottom hole pressure static flowing survey in this well during the annual 1963 test. The results of this survey are shown on, I believe this is Exhibit 1.

Q Now, you have referred to what has been marked as Exhibit Number 1 Pubco and have stated that this recounts results of a flowing pressure survey made at the same time that the annual 1963 deliverability test was being conducted. Would you summarize briefly for us and tell us the significant information that's contained on this report?

A Yes. Let me describe first the mechanics of taking the test. The test was run by the B & R Service Company, Incorporated. It is a bottom hole static measurement of the flowing pressure in this well during the annual deliverability test of 1963. It was measured by a mechanically recording pressure gauge run to the bottom of the tubing.

Now, if you'll refer to the figures on the left-hand column in the lower portion of Exhibit 1, you'll see that this is a multi-point test in which we measured pressures from the surface as indicated by the lubricator measurement there at 1,000 foot intervals to the bottom of the tubing at 4,949 feet. The pressure measurement gauge at the surface at 659 pounds, as shown in the middle figures at the top, was checked very closely within three pounds by the deadweight test measurement of 662 pounds at the surface, so that we have an accurate bottom hole pressure measurement here.

Now, I might point out at this point that the tubing depth of 4,949 feet is some 153 feet below the mid-point of the perforations of the Mesaverde Reservoir. The mid-point of the perforations being the normal point at which reservoir pressures are measured. The significant result of this test, as shown in the right-hand column of figures, is that a gas gradient was determined from the surface to T.D. proving that there were absolutely no liquids in the hole during the flow period of the 1963 deliverability test.

Q Do you consider the results of this test, as reflected by the exhibit, are accurate tests?

A Yes, sir. I think that the confirmation of the deadweight test gauge and the pressure gauge show that this is an accurate measurement of the bottom hole pressure and that the absence of liquid in the hole at this time would indicate that the surface pressure measurement is an accurate reflection of the bottom hole pressure measurement.

Q As I understand it then, the information which was gained from the running of this extra or additional test at this time coincidentally confirmed test results which are a part of the deliverability test itself, is that correct?

A Yes, sir, that is correct.

Q When were you first aware that there might be some question so far as the Commission was concerned as to the 1963 deliverability test?

A We were not specifically notified by the Commission of any irregularity of the 1963 test until our Notification of Change of Deliverability later this year. However, in 1964, we received a letter dated March 19, 1964, from Mr. Arnold of the Commission"s District 3, and this is Exhibit 2. This letter essentially was a request that we measure by a bottom hole pressure device the shut-in pressure at the end of the 7 day shut-in period during the 1964 deliverability test.

Q Was such a bottom hole pressure test, which in effect was a shut-in test, run at the request of the Commission?

A Yes, it was. The results of this test are shown on Exhibit 3. This again was a mechanically recording bottom hole pressure gauge which was run by the B & R Service Company.

In this case we again ran the pressure gauge and measured the pressure at 1,000 foot intervals to the bottom of the tubing at 4,494 feet. This test was run at the end of the 7-day shut-in period of the 1964 deliverability test so we are measuring in this case the bottom hole pressure at the end of the 7-day shut-in period.

The gauge again was, it's accuracy was confirmed by the deadweight test measurement at the surface of 685 pounds compared to 687, a small two-pound difference there, and the significance of this test is that again we proved that there were absolutely no liquids in the hole to a depth of 4,494 feet, which is 153 feet below the mid-point of the Mesaverde perforations.

Q Now, the two tests to which you have referred as shown in Exhibits 1 and 3 were taken approximately a year apart. What is the relationship between the two of them, what do they show, what do they prove insofar as accuracy of measurement is concerned and absence of interference of some sort from extraneous matters that would affect the accuracy of the pressure?

A I believe we have shown conclusively with these tests that in the 1963 deliverability test and the 1964 deliverability test specifically that there was no liquid interference with the surface shut-in pressure measurement and this of course would follow that the surface shut-in pressure measurements is therefore an accurate reflection of the bottom hole pressure.

Q You stated in response to an earlier question of mine that the notice of the question insofar as the 1963 test was concerned was communicated to you or to your company in March of 1964. What subsequent action was taken or what was the next development insofar as this matter was concerned?

A On August 19, we received a letter dated August 17, 1964, again from Mr. Arnold of District 3. This letter is Exhibit 4. I'd like to just read this letter if I may.

"Effective August 1, 1964, the calculated deliverability for your State #6 well, located L-36-31N-9W, Blanco Mesaverde Pool is being corrected pursuant to Chapter II, Section II, Paragraph 9 of Order R-333-F of the New Mexico Oil Conservation Commission. It is the Commission's position that the shut-in pressure previously measured and used for the 1963 annual deliverability test was abnormally low and does not accurately reflect the average reservoir pressure. We have therefore corrected the shut-in pressure used in the deliverability calculation by averaging its pressure with the deadweight pressures measured on the offset wells listed below."

And they have listed here a total of five wells, which are four wells surrounding the State #6 well and including the State #6 well with their locations and corresponding pressures.

"Gas supplement number NW 8492 is being issued this date correcting your gas allowable effective August 1, 1964. The corrected deliverability for your well as recalculated is 8913 MCFPD. Revised Form C-122-A is attached.

If you have any questions regarding the above action or find errors in the deliverability recalculation please contact this office".

This was the letter which we received and attached to it, which I believe we have marked Exhibit 4A, is the corrected form C-122-A which was referred to. If you'll note in the lower left-hand portion of this form C-122-A, there is a summary of the pertinent data concerned with this deliverability test.

The values for P_c, the shut-in pressure, Q, the flow rate, P_t, the working pressure, P_c, the deliverability pressure and D, the deliverability, are listed here. The column on the left is the original measured values measured by us in our 1963 test and the column on the right are the values, adjusted values, proposed by the Commission.

You'll note here that the significant changes are in P_c which was originally measured at 708 and has been proposed to be adjusted to 775 pounds per square inch absolute. The flow rate they have held constant in both cases.

The working pressure has been held constant in both cases. The deliverability pressure which is a function of the shut-in pressure has been changed slightly and the result is a deliverability change from 16,716 Mcf to 8,913 Mcf which is approximately a 30% reduction in the well's deliverability.

Q Now, Mr. Ramsey, do you consider that the 1963 shut-in pressure, as measured at the time of the conducting of the 1963 deliverability test, was accurate and truly reflects the stabilized bottom hole pressure as of that time for the reservoir from which the State #6 well is producing?

A Yes, I certainly do. There is no doubt in my mind by the way that this 1963 deliverability pressure, as measured, of 708 pounds accurately reflects the bottom hole pressure and is a reflection of the true pressure within the entire reservoir from which State #6 is draining.

Q What do you base that conclusion and that opinion on? What data, what information do you have, what studies have you made?

A Well, let me say to start with that it's my understanding that there are three reasons why a shut-in pressure might be questioned.

These would be as we have discussed, liquids in the hole which would cause the shut-in pressure to be a low reflection of the true bottom hole pressure. Also there could be a problem of restrictions in either the casing or the tubing which would eliminate the possibility of reading the surface shut-in pressure on both the casing and the tubing.

There would also be some question that the reservoir pressure had stabilized or built up to a constant steady value within the 7-day period. Now, in order to show that there is no problem or question about our 1963 pressure measurement of 708 pounds I think I would like to put up here Exhibit Number 5 if I could.

This exhibit is what we might call a pressure history of the State #6 well. It is a plot of the 7-day shut-in surface pressure or the P_c factor that is used in the deliverability calculation versus the cumulative gas produced from the well.

All of these plots of 7-day surface shut-in pressures were measured with a deadweight pressure gauge. They were confirmed by both tubing and casing measurements and they are the exact values that are recorded on the Commission forms C-122-A.

We have plotted the 7-day shut-in surface pressure in pounds per square inch absolute on the vertical scale increasing from 200 Psi up to 11 pounds per square inch.

We have plotted on the horizontal axis the cumulative gas produced as measured and sold into the pipe line from this well.

A little background on this curve. Theoretically according to reservoir engineer equations this curve should show a straight line decline relationship between the shut-in pressure and the cumulative gas produced. In other words, we should be seeing a straight line decline.

Actually this well was completed at 1102 pounds in 1952. It declined rather steadily to 1,061 in '53, 1,042 in '54, 1,021 in '55, and 997 in '56 as reported during the annual deliverability test. So you can see that this is a rather straight line and what I would call certainly a normal decline.

Initially on this particular well in the time period of 1956 to 1959, which would be somewhere here in the gas production range between 5,000 and 8,500, we experienced this very severe casing leak. This casing leak was evidenced by gas escaping all around the well at the surface and we actually found a hole in the casing at 640 feet. This casing leak has been the cause for this sharp downward change in pressure decline in this short interval of production. The reason being that since we were actually losing gas out to the ground that we were not measuring at the surface, we had more cumulative gas produced in this particular interval than would be indicated by this curve.

In May of 1960, we re-completed this well, squeezed off the casing leak, set casing through the Mesaverde and perforated a total of 395 feet. So at this time we have essentially a new well which is completed through casing and it is this decline from 1960 through 1964 that I would like to draw particular attention to.

You'll note that this is almost a straight line. A very steady constant decline of pressure with cumulative production. This indicates to me that these pressures are accurate and accurately measured and that they represent the normal decline for this well. Now, the pressure in question is the 708 pounds recorded in 1963. You can see quite obviously that this pressure is right in line and very normal with reference to the well's constant steady decline. Now, we'll show in a few moments, as we have already started to with our bottom hole pressure measurements, that the 1964 pressure and the 1963, were accurately measured and since this is a very steady constant decline, that infers to me that we are actually measuring reservoir pressure throughout the years 1960 through 1964, and that the well is declining normally, that the 1963 that since we were actually losing gas out to the ground that we were not measuring at the surface, we had more cumulative gas produced in this particular interval than would be indicated by this curve.

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Now, I've plotted here the proposed adjusted pressure of 775 pounds per square inch which the Commission has proposed. It's also quite obvious in this case that this pressure is considerably out of line with the normal constant steady decline of this well. I would say that the 1963 pressure as measured would certainly be a much more normal pressure than the 775 pounds as proposed.

Q You have shown us that the pressure decline in this well has been consistent and almost classic with the cumulative gas production as a point of evidence upon which you base your opinion that the reported pressures are accurate pressures in all instances, including 1963. I think you mentioned a factor previously as one of those which could increase the accuracy of a shut-in pressure reading. You have to my mind eliminated the liquids, you have shown the pressure history of the well; another factor that you mentioned was the stabilization of a pressure as being one which affected the true representation of the pressure which is being used in a particular instance. What evidence do you have of stabilization of this pressure?

A In order to see this clearly, let's refer to, I believe this is Exhibit Number 6.

Q Yes, 6 is the B & R Service Report and in conjunction with that is 6-A which I suggest that you put up there at this time.

A All right.

Q Let's refer here for the moment to 6-A which is the data to Exhibit 6 from which we have plotted 6-A.

A This is a report again from the B & R Service Company, Incorporated, as a bottom hole pressure buildup survey. This survey was initiated September 4, 1964. What we are doing mechanically here is running a mechanical recording pressure gauge to the bottom of the well to record the reservoir pressure buildup after the well has been shut-in. We shut the well in September 4, 1964, ran the pressure bomb to the bottom of the hole and left the well shut-in for 7 days. During this time we recorded the pressure change, the pressure increase at the bottom of the hole in the State #6 well. They recorded the data in the first two columns with their bottom hole pressure measuring device. I have calculated the corresponding surface pressures so that we can continue to refer to surface pressure in pounds per square inch absolute. This is merely a transfer of this bottom hole pressure to the surface by means of the recognized formula. The results of this test are shown on Exhibit 6-A here. We have called this a reservoir pressure buildup. It is shut-in surface pressure versus shut-in time.

We have shown on the horizontal scale that the well was shut-in for 7 days, the time increasing from zero at the left to 7 days at the right. We have plotted on the vertical axis the shut-in surface pressure, which is the pressure actually measured at the bottom of the hole and corrected routinely to the surface pressure from 500 pounds up to 680 pounds on the scale. The average August line pressure for this well was 516 pounds per square inch absolute. After this well had been shut-in for 30 minutes, the pressure had increased to 646 pounds per square inch absolute. From the shut-in time of 30 minutes it gradually, the pressure gradually increased to a pressure of 658 pounds per square inch absolute at approximately a little less than two and a half days.

From this period of two and a half days the pressure as measured by the B & R Service people with a magnifying mechanical recording reader from their charts did not change at all, not one pound, from the 658 through the 7-day period, at which it was still 658 pounds per square inch absolute. Now, the significance of this test is that we have a condition in the State #6 well in which the reservoir pressure will stabilize or become absolutely constant without change in slightly over two days. This is proof that the entire reservoir pressure from which State #6 is draining is reflected accurately and absolutely at the bottom of the hole in the State #6 well in 7 days.

Now, I might point out here also on this particular test that this was not taken in connection with an annual deliverability test. However, the well was producing for 127 consecutive days prior to this test into the pipeline with no choke so that we certainly had a very stabilized pressure drawdown condition in the well as compared with the 21 days required by the Commission under a standard test, we had 127 days or a much more severe flow period which would make this information very much more valid.

Q Was the Commission advised that this latest test that you have been talking about was to be conducted?

A Yes, sir, we notified them by telephone and also by letter of the test.

Q Was an invitation extended to witness the test?

A Yes, sir, it certainly was.

GOVERNOR CAMPBELL: Was it witnessed?

A Frankly I am not sure.

MR. KENDRICKS: No.

Q We have been talking a good deal about the deliverability formula, Mr. Ramsey, and how these factors, shut-in pressures and flowing pressures and so forth are all related. I wish you would explain to us now how these factors are related in the deliverability formula itself by illustrating the formula, the values which are contained therein and anything you want to say about the formula with reference to it's application to this particular well as well as all other wells subject to the rules of this Commission.

A Let's refer here to Exhibit Number 7. I have a large copy of it here I'll put up. This is merely a display of the deliverability formula as used standardly in the Mesaverde pool which we're all familiar with. To just refresh everybody with these terms, we were calculating deliverability D as equal to the flow rate, measured flow rate, at the well Q, which is a function of the shut-in pressure squared, less the deliverability pressure squared B_d, divided by the shut-in pressure squared, less the working well pressure squared, which is essentially the flowing pressure of the well corrected for friction. These powers raised to the slope of the particular pool and this area within here, within the brackets, raised to the power N is what is commonly called the multiplier. Now, in essence what we're talking about here is a deliverability which is directly related to the flow rate and the pressure drawdown which is represented by P_c minus P_w. It is very significant that the pressure drawdown and the flow rate are immediately related to one another. Now, in the case of State #6 we have measured an accurate representative reservoir pressure of 708 pounds per square inch which is a value of P_C. We measured a corresponding flowing pressure P_W and a corresponding flowing rate of Q. If these factors are used in this equation, and they are the only factors that should be used in any equation, we will come out with the correct deliverability for the well. The Commission has proposed that we adjust the P_c value and only the P_c value. In my opinion this would destroy the validity of the entire formula because the flow rate and the flowing pressure are also dependent upon the true P_c value. So that in the case of the adjusted pressure, which is a higher pressure, the State #6 well would be forced to use this pressure alone in the formula and it would not receive the actual benefit of having that pressure to give it a larger Q rate at that particular drawdown. So if the true pressure was 775 pounds, as proposed, then the flow rate would be higher and the deliverability would actually be the same.

Q You are saying then that if you fiddled around with one of the factors in that formula you have to fiddle around with all of them in order for them to be accurate?

A That's correct. Since they're all inter-related. I don't think it's mathematically correct to change one pressure and one value, specifically the P_c value, and leave the rest of the factors alone.

Q The rule that we talked about earlier says that if there is a determination that an abnormal shut-in pressure exists that one of these three methods may be used to adjust that pressure. In this instance the Commission has chosen to use, even though a bottom hole pressure was available, an average shut-in pressure of all offset wells and the significant part of this is completed in the same zone. Now, I want you to demonstrate, Mr. Ramsey, the zones from which the State #6 well is producing with relation to the zones from which the offset wells are producing. I think you have a cross section which is Exhibit Number 8.

(Whereupon, applicant's Exhibit 8 marked for identification.)

A This is what we might call a sub-surface comparison of the Blanco-Mesaverde completion data surrounding the Pubco State #6 well referring now to Exhibit Number 8. We are in the particular area of Sections 35 and 36 of 31 North, 9 West, and Sections 1 and 2 of 30 North, 9 West. The State #6 well we have shown with the green arrow here and the four surrounding wells which have been averaged pressure-wise with State #6 to come up with this reservoir pressure average are shown in red. Now, we have taken actual photographic copies of the electric logs of the surrounding wells and just adjoin them one next to the other on this exhibit. With the exception of the Delhi #2 Prichard Well which is located, I believe, in unit H of Section 1, 30 North, 9 West, which blew out before they were able to log the well and there is no log on this well. We have spotted on these individual logs the perforated intervals as reported on the Commission forms and we have colored these in inside the well bore in red. That's what these red areas denote, with the case of this open hole completion we have colored the entire well bore red. We have also shaded in in yellow the individual reservoirs or zones which have been open to the well bore as the result of each one of these perforated intervals in each individual well. Now, just take a look at these wells, we have them numbered 1 through 6. We have located them here as #1 to the southwest of State #6, #2 which I believe is an abandoned hole and has been replaced by this hole and we have not colored it in, and #3 which are to the northwest of State #6, #4 which is State #6, and #5 to the northeast of State #6 and #6 to the southeast. Now, I might just briefly run through these wells to illustrate numerically the differences in perforated intervals and the differences in zones open. In the Turner State #2, which is well #1 located in unit A of Section 2, 30 North, 9 West, we have zero feet open in what is commonly called the Lewis 6. We have two feet open in the Cliff House section of the Mesaverde, none of the Menefee Sands are open, 32 feet of the Point Lookout has been perforated and we have a total of 34 feet perforated in that particular well. In the Johnson #9, which is located to the northwest of State #6, they have a total of 5 feet perforated in the Lewis interval, 25 feet in the Cliff House, none of the Menefee is open, 27 feet perforated in the Point Lookout, for a total of 55 feet. State #6 well has 20 feet open in the Lewis interval, 78 feet open in the Cliff House, the entire Cliff House interval in this case, 122 feet in the, perforated in the Menefee, 219 feet perforated at Point Lookout, for a total of 439 feet perforated in the State #6 well. The State #5 has none of the Lewis open, 46 open in the Cliff House, 167 feet in the Menefee and 105 feet open in the Point Lookout. A total of 318 feet in State #5. The Delhi-Prichard #2 is an open hole with 165 feet total open. Now, the significance of this is that it's quite obvious that the wells surrounding State #6, the four wells which we have colored and shaded in in red in this exhibit have considerably different separate reservoir sections or zones open than does the State #6 well. We are talking here about shut-in surface pressure which is a composite pressure from all of the reservoirs that are open in any particular well and we are speaking of averaging these pressures to represent a pressure to be used with an individual well. In this case we have accurately measured the pressure of this individual well and it would be my opinion that since these wells are in completely different reservoirs that the averaging method in this particular case would be far secondary to the accurate pressure that was measured.

Q What you are saying, Mr. Ramsey, is that the measured accurate pressure for State #6 is the only pressure which can be used in connection with the computation of the deliverability applicable to this well, that is if a fair application of the formula principles is to be retained, is that right?

A Yes, sir, because we have accurately measured our pressure in this case, that is the only pressure that should be used.

Q Now, we're getting into the anticipation portion of the presentation of the direct on this.

GOVERNOR CAMPBELL: You are out of the fiddling around portion?

MR. SPERLING: Yes, sir.

Q You may have heard or will hear a suggestion that in view of the differential in pressures as between the State #6 well and the surrounding wells that this suggests the presence of a local situation which is sometimes referred to as a pressure sink. I believe you have prepared some exhibits which show that on a reginal basis throughout the Blanco-Mesaverde Pool that these areas have varying pressures as between different wells and different areas is actually the rule rather than the exception. Would you produce those exhibits at this time?

(Whereupon, applicant's exhibits 9, 10 and 11 marked for identification.)

A Now, we're calling these the 1963 iso-pressure map we have marked as Exhibit 9, the 1962 iso-pressure map we have marked as Exhibit 10 and the 1955 iso-pressure map we have marked as Exhibit 11. These are iso-pressure maps of the major portion of the Blanco-Mesaverde Pool. They were drawn from 7-day shut-in surface pressures reported to the Commission for each well on these maps taken during the respective annual deliverability tests of each year as indicated on the maps. These maps are drawn on a contour interval of 100 pounds per square inch. We have colored in in the various colors, generally with the low colors, the dark colors being the lower pressures, the areas in between the 100 pound contour intervals so that in the case for instance of the 1963 map a purple color would represent an area where all the pressures were below 600 pounds. A red color would represent an area where the 7-day shut-in pressures were between 600 and 700 pounds. A brown color would represent an area of between 700 and 800 pounds. A yellow color between 800 and 900. A pink color between 900 and 1,000 and a light tan color between 1,000 and 1,100 pounds, a light green color between 1,100 and 1,200 pounds. First let me call your attention to these maps in general. It's obvious from the, shall we call it a hodgepodge of colors representing various pressures, that there is no average pressure for the Blanco-Mesaverde Pool, in 1963, or in 1955, 1962. So we have here a wide pressure variation between wells throughout the field between wells adjacent to one another which has existed historically from 1955 early in the pool life up until 1962 and 1963. Now, just to emphasize some of these variations let me read a pressure here of 1,043 pounds per square inch on the 1963 iso-pressure map which I believe that is in Section 21 of 28 North, 6 West. This pressure of 1,043 pounds is offset by pressures of 669, 667, 739, 705, 700. As an example that is a rather severe pressure variance. As seen by these colors, this type of pressure variance is occurring throughout the field and has occurred. We have located on these maps the State #6 location in 1963, '62, and '55. I think that, well, I believe that it is quite obvious that the '63 pressure, and for that matter even the earlier pressures of the State #6 well are certainly not abnormal from the total trend of the Blanco-Mesaverde Pool.

Q Now, Mr. Ramsey, you have shown us that there is a pattern of variance in pressures throughout the field. Now, you showed us earlier that with reference to the area within which State #6 is located, that there are a variety of completion methods, a variety of open sections, a variety of perforated intervals. Do any of the conditions which exist locally in that area contribute to, or explain at least to some degree the variation that you find throughout the field itself?

A Yes. I think that we might use these different completion intervals as we have shown on these particular four wells surrounding State #6 as an example of the varying types of completions that are present and the varying amounts of different zones and completely different reservoirs that are open throughout the field and that would probably be one of the predominant causes of this wide pressure variance throughout the entire pool.

Q You've contoured these maps on 100 pound intervals. Why did you select that interval?

A Well, the 100 pound interval is in this case a broad contour interval. It's quite obvious here that on the 100 pound interval we have a large number of pressure variances, of course it could have been contoured on any multitude of pressure intervals but the effect of those, particularly with smaller intervals of 50 pounds, 25, 10, 5, or 1, would have been an extreme situation of the pressure variances that we have. In fact with very much smaller contour intervals it would have been rather impractical to contour these maps and they would have been very difficult to interpret.

GOVERNOR CAMPBELL: Might have run out of colors.

A Might have had a big black smear.

Q Is there anything else you want to add with reference to these exhibits?

A No, sir.

Q You have mentioned earlier in connection with other portions of the direct testimony that the effect of the introduction of what we consider to be the artificial shut-in pressure into the deliverability formula for this particular well has resulted in a decrease of deliverability calculation assignment to this particular well of approximately 50 percent from 16,000 Mcf to 8,000 Mcf. Let's talk about that a little bit with relation to volumes and full dollars.

A The effect of this proposed adjustment, as you say, has been a decrease in our deliverability from 16,716 to 8,913 or approximately cut our deliverability in half. Based on the last year's pool production and the most recent allocation factors, this would cause a reduction in our yearly gas production from the State #6 well of some 990,000 Mcf per year. This would be the reduction caused by such a deliverability adjustment. I believe to Pubco this is obviously a very serious reduction in that it represents a reduction in our income to this well of $138,600.00 per year. That is the reduction in the income to the whole well. Of this,$17,300.00 will be lost to the State of New Mexico in the form of royalty and $1,000.00 or $121,300.00 will be lost to the working interest owners of the well. So that this adjustment would quite obviously affect our well quite seriously.

Q Do you have anything else you would like to add as a part of the direct presentation of this case?

A No, sir, I don't believe so.

MR. SPERLING: At this time I would like to offer Exhibits 1 through 11 in evidence in this hearing.

MR. PORTER: Any objection to the admission of these exhibits? The exhibits will be admitted.

(Whereupon, Exhibits 1 through 11 offered and admitted in evidence.)

MR. SPERLING: That concludes our direct presentation.

MR. PORTER: Does anyone have a question of Mr. Ramsey? Mr. Durrett.

MR. DURRETT: If the Commission please, I have one or two questions of Mr. Ramsey.

CROSS EXAMINATION

BY MR. DURRETT:

Q Mr. Ramsey, concerning your statement that the area surrounding the Pubco State #6 was stabilized, how large an area are you speaking of?

A I have no idea what the size of that area would be.

Q Well, at least it's a drilling block in your opinion that the State #6 is on, is that correct?

A Yes, sir.

Q Do you think that the area stabilizes any further than that drilling block?

A Frankly we have no information that would indicate that it is.

Q Then this area would stabilize and the area outside the drilling block would not in your opinion?

A I have no build-up pressure curves on those wells outside there, I don't know whether they would stabilize or not.

Q Do you feel that Pubco State #6 is in communication with it's offset wells, Mr. Ramsey?

A I don't have anything that would lead me to believe that, no, sir.

Q Would you have anything to lead you to believe, as a reservoir engineer, that the Pubco State #6 is producing from a completely separate area and not in communication with any offset wells?

A Well now, let me refer back to this cross section. To indicate that many of the zones which are open in State #6 for instance, let's consider the Cliff House zone, are also open in some portion in all of the offset wells. However, we have other reservoirs open in State #6 which are not open in the offset wells, so it's producing from different reservoirs, some of which are the same and some are not.

Q Let's speak for just a moment about the reservoirs, if you want to call them that, or the zones, whatever you want to call them that are open in the offset wells; do you feel there's communication between those wells and Pubco State #6?

A Communication between these wells within the reservoirs that are within the zones that are open?

Q Yes, sir.

A I imagine that there probably is. Now, I don't know what your definition of communication is. They're the same reservoirs.

Q Drainage would occur and counter drainage between the wells, is that correct?

A It does occur or it could possibly occur.

Q It could occur if there is communication, couldn't it, Mr. Ramsey?

A I would say that the reservoirs are all interconnected, the ones that are open.

Q Are you familiar with the shut-in pressures on the offset wells surrounding Pubco State #6?

A Yes, I am.

Q Are those pressures the same pressures that State #6, so-to-speak, stabilized at in your opinion?

A Now, I believe you are referring for instance to the 1963 pressures as reported to the Commission on those wells.

Q Yes, I am.

A They are not the same as the 708 pounds reported on the State #6 well.

Q If that area was stabilized it would be the same, wouldn't it, Mr. Ramsey, or very nearly the same?

A Now, you are talking about this total area in here.

Q I am talking about the area of the Pubco State #6 and it's surrounding offset wells.

A I wouldn't know if that area is stabilized or not. I would say the reservoir area, particularly the 320 acres on which the State #6 is located, was stabilized as indicated by the exhibit.

Q You don't think the pressure of any offset well would have any bearing in your opinion as to whether or not that area was stabilized?

A Let me just refer to this Exhibit 6-A which is the stabilization performance that we are talking of and emphasize one fact again which I think will answer your particular question. The fact that this pressure as measured in State #6 has not changed in five days is indicative that the reservoir pressure within the reservoir which State #6 is producing from has held constant and has not received or lost any gas within this five-day period.

Q As a reservoir engineer you don't feel that pressure on any offsetting well would have anything to do with your opinion, would not influence you?

A I think this stabilization, or this constant, steady, unchanging reservoir pressure proves that.

Q It's not common practice to consider pressure of offset wells?

A I would say it probably would be if the offset wells that we're talking about were entirely completed in the same zones. However, in this case they're not and I would say that the offset well or the average pressure that you are speaking of is not directly concerned with State #6 as is this stabilized reservoir pressure that we've measured.

Q Moving on, Mr. Ramsey, this refers to your Exhibit Number 5.

A Now, I believe this is Exhibit 5.

Q I have just one question concerning that exhibit. I'm referring now to your dot above the 708 where you say "Adjusted P_c."

A That's this pressure here.

Q Yes. If it's established at this hearing today that there is an abnormally low pressure since 1960 or there has been in this well, then as a reservoir engineer would it be your opinion that that curve would move substantially up since 1960?

A I don't believe that with continued production from this well that this curve will move up at all, if that's an answer to your question.

Q Well, remember now, I say if it's established here today that there has been an abnormally low pressure in that the pressures would all move up, then wouldn't they, the whole line would not?

A No, sir, they would not.

Q Even if it's been established that it's abnormally low?

A This is the pressure performance of this well and this pressure performance is not going to be altered by arbitrarily assigning a pressure of 775, the pressures that we measured, regardless of what the outcome of this hearing is going to be, are going to continue to decline along this line.

Q It's not a matter of plotting on a graph then, is it, Mr. Ramsey, in your opinion? In other words, if you established that there has been an abnormally low pressure and you depict it, then you just move the line up, don't you?

MR. SPERLING: I would like to object to the question. He's assuming something certainly not in evidence in this case to date as a predicate upon which to ask the question.

MR. DURRETT: If the Commission please, I believe this man has been qualified as an expert witness and I am attempting to ask him a hypothetical question concerning his exhibit.

MR. SPERLING: It's also my understanding that we proceed in these matters in accordance with the Rules of Civil Procedure which is supposed to confine cross examination to the matter of the direct testimony presented in connection with the so-called plaintiff's case. This represents a departure from that.

MR. DURRETT: If the Commission please, I don't feel it is important enough to stand on the issues.

GOVERNOR CAMPBELL: I don't either.

Q (By Mr. Durrett) I don't think we even need to necessarily look at it, but referring to your exhibit which shows the various zones, Mr. Ramsey, which you are speaking about --

A Yes.

Q -- I believe that you stated in your opinion that these were completely different zones, so-to-speak, and not in communication, is that correct?

A I think if you'll recall that exhibit there is considerable amount of shale section separating the individual zones that were shown on those electric logs and those logs would indicate to me that particularly in the four or five-well areas that we were looking at there, that there appeared to be very little or no communication between each of the separate zones on the electric logs.

Q Do you feel that each zone depicted on your exhibit is a separate reservoir not in communication?

A It would appear that way.

Q Are all these zones within the Blanco-Mesaverde Pool as designated by the Commission?

A Yes, it's my understanding that they are.

Q I want to read to you, Mr. Ramsey, a portion of Section 65-3-29 of the New Mexico Statutes, and ask you for your opinion concerning these zones in light of this definition. This section of the Statute, Section (b) of 65-3-29, "Pool" means an underground reservoir containing a common accumulation of crude petroleum oil or natural gas or both. Each zone of a general structure, which zone is completely separated from any other zone in the structure, is covered by the word "pool" as used herein. "Pool" is synonymous with "common source of supply" and with Common Reservoir."

Considering this definition of a pool and zones, do you feel that these are separate pools?

MR. SPERLING: If the Commission please -- have you finished your question?

MR. DURRETT: Yes.

MR. SPERLING: I want to object to that. We have not qualified Mr. Ramsey as capable of interpreting the New Mexico Statutes. He has qualified as a reservoir engineer.

MR. DURRETT: I would like to suggest that as a reservoir engineer he is bound by what the law says. I am not asking him to interpret the law, I am sure he can understand the law. I am asking him in light of the law does he feel that these are separate pools.

GOVERNOR CAMPBELL: Have you objected to the question?

MR. SPERLING: Yes, I did.

GOVERNOR CAMPBELL: It seems to me that this witness has testified as to his interpretation, his factual interpretation. The law is there and I believe it's the responsibility of the Commission to determine whether or not the two are consistent. I think the objection should be sustained.

MR. PORTER: Objection sustained.

Q (By Mr. Durrett) Mr. Ramsey, moving on to the proper situation of the Mcf that would be lost by Pubco in the dollar amount of money, did you say it was in the neighborhood of $138,000.00 a year?

A The $138,600.00 would be the total revenue lost to the well. That would include both royalty and working interest income.

Q What year was this well drilled, Mr. Ramsey?

A It was completed in 1952.

Q When was the well paid out?

A Well --

MR. SPERLING: I object to that.

A I am not really sure about it.

MR. SPERLING: I don't think that's material as to when the well paid out. As far as I know it isn't a crime to have a well pay out in the San Juan Basin. We ought to have more of them.

MR. DURRETT: We will certainly agree with the proposition that we like to have more wells pay out in the San Juan Basin. This question is relevant. The proposition has been opened on direct examination concerning the amount of money that will or will not be lost by Pubco. We feel that it would be relevant concerning whether the money that they invested in this well has been recovered by them or re-couped so-to-speak.

MR. SPERLING: We'll be the first to concede that this is a fine well and that is why we are here. If it were not a fine well, we would not be here. We will certainly say that this well has long ago paid out and we hope will continue to pay to take care of some of those who do not pay which are owned by the same operator.

MR. DURRETT: I think that will answer my question, thank you. That's all I have.

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

Q (By Governor Campbell) I wish you would clarify for me your testimony relative to the fiddling around with the individual factors in this formula?

A Yes, sir.

Q As I understood you, if you treat with only one of these factors such as the P_c factor --

A Yes?

Q -- without adjusting to the P_w factor, the Q factor, then you are totally distorting the formula. Is that because there's a direct relationship between the P_c and the P_w?

A Yes, sir. For a gas well to produce at any flow rate which is the measured Q value --

Q Yes?

A -- it must have a pressure drawdown or a driving pressure force from the reservoir into the well bore and that drawdown is P_c minus P_w. Both of those factors being measured at the time of the test. So the theory of the deliverability equation, as I understand it, and I believe this is something that the staff engineers have quoted, is that this formula presumes that we have correctly measured flow rates, correctly measured flow pressures and correctly measured P_c or shut-in pressure which reflects the true reservoir pressure. Now, in the instance of this adjustment, we have measured a pressure of 708 pounds which I feel beyond any question is absolutely the true reservoir pressure. This pressure has been proposed that this be adjusted to 775, that would be a higher shut-in pressure which would result in a higher drawdown pressure at P_c minus P_w. If this well actually had the benefit of the 775 or higher shut-in pressure, to draw down from it would give it more pressure force to produce a higher flow rate and it would result in a higher deliverability, so in adjusting this P_c value and assumes that the flow rate and the flow pressure values are the same, then we have just picked out one factor and not adjusted the other factors, and the other factors are dependent upon the shut-in pressure.

GOVERNOR CAMPBELL: Thank you.

Q (By Mr. Porter) Mr. Ramsey, I believe you testified that you think there's very little or no communication between the various perforated zones in your well?

A You are talking about the individual zones that we have colored in yellow on our log.

Q Right.

A Well, it's obvious to me that there's considerable shale separation between those zones and I don't know why they would be in communication with one another.

Q Then this pressure that you are talking about here would just be a composite pressure of all these zones?

A Yes, sir, that's correct.

MR. DURRETT: If the Commission please I would like to ask one additional question.

Q (By Mr. Durrett) Mr. Ramsey, the question I would like to ask you, have you calculated reserves or made any reserve calculation for the various zones in your State #6?

A For each of the separate yellow-colored zones?

Q Yes.

A No, I haven't done that.

Q Would you have any idea, not necessarily in Mcf figures, but as to which are the better zones?

A Well, I've been told by the -- I did not sit on this well when it was drilled, it was drilled in 1952. It was reported to me by the geologist that sat on the well that they experienced a continued increase in the natural flow rate as they drilled through the sections it was drilled with gas. It was a continuous increase so they might be all similar.

Q Am I correct that the Menefee zone is not usually open in the Blanco-Mesaverde Pool as far as in general?

A It has been Pubco's practice to open it quite frequently I am sure. As to the other operators, those particular four were not open.

Q You don't consider the Menefee zone to be one of the better zones in this well, do you?

A In the State #6, I don't know how we would tell one from the other since we had a consistent gas increase all the way down.

Q I thought there was no communication?

A No, sir, there isn't any communication.

Q You don't think you could tell one from the other?

A Well, you asked me if the Menefee was better than the other zones, is that correct?

Q Better or worse. Do you feel it's one of the best zones in the well or one of the worse, or how do you feel about it?

A I feel that it is contributing to the production from the well. As to relative production per foot of sand with the other reservoirs, I don't have any factors to know one way or another whether it's really better per foot of sand for instance.

Q Is it considered a good zone in the Blanco-Mesaverde Pool as a rule?

A Well, we consider it a zone adequate enough to perforate.

MR. DURRETT: Thank you.

MR. PORTER: Mr. Ramsey, then you contend that the pressure which you submitted of 708 more nearly represents the reservoir condition than the average of the offsets?

A Yes, sir. That's the point of the entire discussion. Yes, sir.

MR. PORTER: Anyone else have a question?

GOVERNOR CAMPBELL: Does this conclusion necessarily indicate that the tests reported on the offsetting wells are in error or, you are not saying that are you?

A No, sir.

GOVERNOR CAMPBELL: You are saying that there are peculiar conditions here, such as you've mentioned, that make apparent to you the reason for the difference in pressure?

A Yes, sir, I am saying that we have measured our pressure accurately and that it represents the reservoir pressure of our well, having little or nothing to do with the pressures of the offset wells.

BY MR. UTZ:

Q I believe it's your contention that all the data plugged into the deliverability formula must be accurate data in order to calculate an accurate deliverability, is that your contention?

A Yes, sir.

Q It's also your contention that your P_C measured on this well is a stabilized pressure I believe?

A That's correct. The 708 pounds that you are referring to as we measured.

Q Is this the case in all of your wells that you have stabilized pressures?

A Frankly, I don't, I don't think we have any build-up pressure surveys on our other wells that I'm familiar with so that would be the only way that I would have any positive proof one way or another. I really wouldn't know.

Q Let's say if the pressure was not stabilized would that be an accurate pressure to plug into the deliverability formula?

A The fact that that pressure is stabilized?

Q Was not stabilized.

A Was not stabilized?

Q Yes, sir.

A Well, we are dealing here with a situation in which the Commission has said that the pressure at the end of 7 days is the pressure that will be used for everybody.

Q I understand that.

A I would say unless there is a very abnormal condition that a well had, let's say only one-tenth of it's build-up in 7 days, I would say that the 7-day pressure would be the one to use.

Q Would you say that it would be accurate pressure to plug into a deliverability formula to obtain an accurate deliverability?

A Unless it was disturbed by liquids or some other error of that nature.

Q Do you know whether all pressures stabilized in 7 days in that area?

A I have no idea.

Q Are you familiar with the number of build-up pressures that natural gas has run over the past several years?

A No.

Q You have no idea what they show?

A No.

Q Would you believe it if took some of those wells as long as two, two and a half weeks to stabilize?

A If that's what the curves show I guess I would have to believe it wouldn't I.

Q What I'm asking you is that if these shut-in pressures are not stabilized by plugging that unstabilized pressure into your deliverability formula, will that give you an accurate deliverability?

A Now, this is a theoretical question you are asking me, if that on a particular well we knew we had a pressure that was not stabilized and far below the stabilized rate, is that correct?

Q Yes.

A Then that would probably give you an inaccurate deliverability.

Q And you agree then that the pressure used, if you can get it, would be a stabilized pressure which I believe in quoting you, the force behind the drive to force gas to the well bore and cause Q?

A Yes, sir.

MR. UTZ: That's all I have.

MR. PORTER: Anyone else have a question? The witness may be excused.

MR. SPERLING: Mr. Porter, could I ask one more question on re-direct?

MR. PORTER: Surely.

RE-DIRECT EXAMINATION

BY MR. SPERLING:

Q Mr. Utz has asked you about whether or not the P_c pressure is not supposed to be representative of an accurate stabilized pressure. To your knowledge is it not the case that the rules of this Commission provide that the 7-day shut-in pressure should be considered to be the stabilized pressure insofar as this formula is concerned, isn't that the rules that we're operating under?

A Those are the general rules, yes, sir.

Q Those are not set by Pubco?

A No, sir.

MR. PORTER: Any further questions? The witness may be excused.

(Witness excused.

MR. PORTER: We will take a very short five-minute break.

(Whereupon, a recess was taken.)

MR. PORTER: The hearing will come to order. Mr. Durrett.

MR. DURRETT: Are you ready for the Commission case now?

MR. PORTER: Yes, sir.

MR. DURRETT: I have two witnesses. I would like to request they be sworn at this time.

(Witnesses sworn.)

EMERY ARNOLD

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

DIRECT EXAMINATION

BY MR. DURRETT:

Q Will you please state your name and position for the record?

A Emery Arnold, Supervisor District 3 of the New Mexico Oil Conservation Commission.

Q Mr. Arnold, would you please give the Commission a very brief background of the events leading up to the action that the Commission took with regard to the Pubco State Well #6?

A Yes, we've known for a period of years in the San

Juan Basin that we had pressure problems are directly related to the type of gas reservoirs we have up there and come from a variety of reasons. We, in some wells there's a, as Mr. Ramsey pointed out, have liquids problems. We have slow stabilization problems and the problem has been discussed, oh, generally by industry committees and by the Commission staff for sometime. In October, 1962, a hearing was called which amended Order 333-F, and among other things the order was amended to provide that the Commission could correct shut-in pressures when the pressures were abnormally low.

The order also provided for variable deliverability pressures to be set by the Commission in each pool. Upon receipt of the 1963 annual deliverability test, a study was conducted at the direction of Mr. Porter to determine if shut-in pressure problem was affecting deliverability tests.

This study was made and it was found that abnormally low shut-in pressures were causing high multiplier problems in numerous instances. Based upon this study tests were re-calculated and allowables revised on 57 wells effective August 1st, 1964.

Q I believe we have covered this somewhat so I'll ask you to be very brief. Do you have an exhibit explaining the formula and how it is calculated, the mechanics of this deliverability formula?

A Yes, I do.

Q Is that marked as Exhibit Number 1?

A Yes, it is.

(Whereupon, applicant's Exhibit No. 1 marked for identification.)

Q Will you please refer now to Exhibit No. 1 and explain what that is?

A Exhibit No. 1 is a sheet which explains the deliverability calculation formula which we are using. This explanation is given for the purpose of showing how deliverability is calculated and how each of the factors used in the deliverability formula does affect the calculated deliverability.

Q is the average daily volume of gas a well flowed during a test period. The shut-in pressure is the measured pressure at the wellhead after the well has been shut-in 7 days. The working pressure is a pressure which is measured while a well is flowing.

If the well is flowing through the tubing, it is measured through the casing. If it is flowing through the casing it's measured through the tubing. The difference between the shut-in pressure and the working pressure is known as the drawdown on a well. The general statement which can be made is that all other things being equal, the smaller the drawdown, the higher the calculated deliverability.

Also the smaller the drawdown the greater the element of potential mathematical error in the deliverability calculation. The deliverability pressure is not a measured pressure but is set by the Commission for each pool. In the Blanco-Mesaverde Pool it is 80% of the shut-in pressure, in the Basin-Dakota it is 50% of the shut-in pressure. N is the pool slope of the back pool of the pressure curve and is constant for each pool. As may be seen for the formula it is important that the shut-in pressure be an accurate pressure because it appears twice in the formula and the deliverability pressure is directly related to the shut-in pressure.

If the shut-in pressure is erroneously low the effect is always to increase the deliverability of the well. The reason for this is two-fold. First, that the shut-in pressure of a well is lower than other wells in the pool and the deliverability pressure being directly related to the shut-in pressure is also low. Secondly, if the shut-in pressure is low, it approaches a value nearer the value of the working pressure, making it appear that the well has drawn down less than it actually has. Mathematically the effect of this in the above mentioned formula is to make the denominator in the formula smaller and this causes the resulting multiplier to be larger, therefore the effect of using an erroneously low shut-in pressure is to give an erroneously high deliverability which does not truly reflect the ability of the well to produce gas. Theoretically, the shut-in pressure used in the deliverability calculation should be the reservoir pressure in the well's drainage area and this is not necessarily the pressure measured at the wellbore.

Q Now, Mr. Arnold, is this theory expressed on your Exhibit 1 and your determination that the Pubco State #6 has an abnormally low shut-in pressure the basis for the action you took which gave rise to this hearing?

A Yes, that's right.

Q Moving on to the next exhibit, Exhibit No. 2, would you please refer to that exhibit and explain what it represents?

(Whereupon, applicant's exhibit No. 2 marked for identification)

A Exhibit No. 2 is a pressure and production history graph of the Pubco #6 State well and of it's four offset wells. You'll note that during the years 1954 through 1960, this well actually had a higher shut-in pressure than the offset average pressures. Undoubtedly this is due to the fact that the Pubco State #6 does have good permeability and did stabilize better within it's drill block in the offset wells.

The well was worked over in 1959, and you will note that after 1959 there's a sharp increase in the production on the Pubco State #6 well and also a rather rapid decline on the measured shut-in pressure.

The green line at the bottom shows the average production in the offset wells. The blue line shows the Pubco State #6 production. The red line is the Pubco State #6 measured shut-in pressure, the black line is the averaged shut-in pressure of the four offset wells.

Q Anything else you feel is pertinent about this exhibit, Mr. Arnold?

A No, I don't believe so.

(Whereupon, applicant's exhibit No. 3 marked for identification)

Q Will you please move then to Exhibit No. 3 and identify that and explain what it is?

A Exhibit No. 3 is a graph depicting the deliverability test history on the Pubco State #6 well from 1954 through 1963. I think at this time it might be well to review the proration formula in use in this pool, which is a 75% deliverability, 25% acreage formula, and this formula infers that deliverability and reserves are related in such a way that the utilization of this formula allocates to each well allowable which is proportionate to it's reserves.

Therefore, in other words what we are doing is actually measuring reserves with deliverability when we use a proration formula. It follows therefore that as reserves are produced, then deliverability should decline.

If this relationship doesn't exist then it tends to make a farce of deliverability proration. You will note that from 1954 through 1959 this well had a modest, although above average for the pool, deliverability. The well was worked over, as has been testified to, in 1959, and again in 1960, and the deliverability increased to 38,330 Mcf on the 1960 deliverability test.

Actually what this says in the light of the proration formula is that when this well was worked over it was put in communication with an additional reserve equal to five or six times the reserve that was present prior to the work-over, even though 8,630,724,000 cubic feet of gas had been produced up to that time.

MR. PORTER: Up until what time, Mr. Arnold, 1960?

A January 1, 1960, yes. Now, the 1962 deliverability test shows an increase over the 1961 deliverability test. This in itself indicates to me that there is very likely something the matter with the '62 deliverability test also because it showed a deliverability increase, a considerable increase even though an additional 3,230,559 Mcf of gas was produced during 1961. Insofar as the 1963 deliverability test, I would like to explain the three red lines on the deliverability curve, which I don't believe I mentioned, as the red curve. I presume everybody is following that.

Q (By Mr. Durrett) The three lines you are speaking of now are to the far right of the exhibit where the curve tails off there and there's a solid line and two broken lines?

A Yes, the red line only at the moment I'm speaking of, which is the deliverability curve on this well. The solid red line is the deliverability at a deliverability pressure of 80% of a shut-in pressure. Using the actual measured pressure on the Pubco State #6 well for the test of 708 pounds, the 80% corrected curve, the lowest curve is the value as we have corrected it using the average pressure of offset wells to correct this deliverability at a deliverability pressure of 708 pounds.

The dashed line at the top of the curve is the calculated deliverability using the pressure as measured and using a deliverability pressure of 50% of shut-in pressure.

The reason I have done this is because if we're going to compare the 1961, two and three tests, it's necessary that we do compare them to the same deliverability base. At the present time all wells in the pool have been changed to a deliverability pressure of 80%. However, this deliverability calculated at a deliverability pressure of 50% using the actual measured pressure does show that the well has shown an increase in deliverability from 1961 to 1963, and thereby indicates that the recoverable reserve is larger at the time of the 1963 test than at the time of the 1961 test. This is true even though 5,331,988 Mcf of gas was produced during the years 1961 and 1962.

This amount is just about equal to an average Mesaverde reserve in the Blanco-Mesaverde Pool, according to the reserve estimates which have been testified to in previous hearings before the Commission. The Blanco Mesaverde Pool is not the only reservoir in which we have this same kind of a problem. We do have the problem worse, I believe, in the Basin-Dakota Pool which is even slower to stabilize and pressure variations are even greater.

I maintain that if we except without question deliverability tests which show an increasing deliverability from year to year, even after the production of substantial reserves, that it will eventually make a farce of the whole business of deliverability proration. I believe that's all unless you have a further question.

Q Am I correct now, Mr. Arnold, that you have no quarrel with the measured bottom hole pressures as such or the measured surface pressures? In other words, you are not saying that there was an error in measuring these pressures?

A No, sir, we think that we used accurate measured pressures but we believe the problem has come from a pressure stabilization problem, not necessarily in the drill block of the State #6 well only, but in the entire area. I do believe that the entire area is in pressure communication in that if you do have a pressure differential between the two areas which is communication within the same pool and something is not done to correct it you will have a movement of gas from the high pressure area to the low pressure area.

Q Would it be your opinion that pressure as measured was abnormally low, caused by this low pressure area, only the pressure that they measured was accurate in measuring it, is that correct?

A Yes, sir. I think the pressure is very possibly low because of disproportionate withdrawals in the area and possibly part of these disproportionate withdrawals may be due to inaccurate deliverability tests we've had previously due to the same problem. I would like to emphasize that I know their field data was correct.

Q Will you please turn to your Exhibit --

A One other point I wanted to make on this exhibit.

Q Go ahead.

A I would like to point out the green line on this exhibit as the shut-in pressure marked P_c. The blue line is Pw. The working pressure, the red line, is the deliverability line. The black line is the Q or average rate of flow during the test period. Between 1961 and 1963, you will note that the flow rate decreased on this well, the working pressure also decreased on the well, and still the calculated deliverability increased. This points up the fact that the drawdown, or the difference between the shut-in pressure and the working pressure, is the problem which is entering a mathematical error into the calculation.

Q What happens, Mr. Arnold, if you don't get a proper drawdown between the working pressure and the shut-in pressure?

A You mean by reason of a low shut-in pressure?

Q Yes.

A If you have a low shut-in pressure it makes it appear that the well is drawing down less than it actually is and this causes an increase in the calculated deliverability.

Q Anything further on Exhibit 3, Mr. Arnold?

A No, I don't believe so.

(Whereupon, applicant's exhibit No. 4 marked for identification)

Q Let's move on then to Exhibit No. 4. I don't think it will be necessary to read all the figures on there, but if you will just briefly explain what that represents to the Commission.

A Exhibit No. 4 is an exhibit showing the effect of using the average offset pressures in the deliverability calculation on the Pubco State #6 well on the 1963 annual deliverability test.

The first portion of this exhibit shows the offset wells and the State #6 well with their measured surface pressures and shows that the average was 775 pounds. The second section shows the effect on the deliverability calculation on this well of substituting a shut-in pressure of 775 pounds, the average pressure for the actual measured pressure of 708 pounds on the deliverability test calculation.

As you can see, it reduces the calculated deliverability from 16,716 Mcf to 8,913 Mcf and reduces the allowable from 107,078 Mcf per month to 57,903 Mcf per month. The third section shows the offset deliverability test and allowable comparison. In other words, the individual calculated deliverabilities on the offset wells and the resulting deliverability and average monthly allowable in all these allowances we have used is March 1, 1963, through February 29, 1964.

Q Anything else pertinent concerning this exhibit, Mr. Arnold?

A There is one point I would like to make on the Delhi #2 Prichard Well which is one of the offsets, the Q rate was 4,549 Mcf per day, or the average daily flow during the test period.

The Q rate on the Pubco #6 State well was 6,968 Mcf per day which is slightly in excess of two million bigger. However, even when we used the average offset pressure we ended up with a multiplier on the Pubco #6 State well which gave us

8,913, which is approximately two million in excess of the flow rate, whereas on this Delhi #2 Prichard well, the calculated deliverability is actually 3,772, which shows that that well had a multiplier of less than 1.

This demonstrates that the problem is coming from lack of drawdown and that when you do have an extremely small drawdown or difference between the shut-in pressure and a working pressure, it throws a large mathematical error into the deliverability calculation.

(Whereupon, applicant's exhibit No. 5 marked for identification)

Q Will you please refer now to Exhibit No. 5, Mr. Arnold, and identify it?

A Exhibit No. 5 is a graph showing the same information as contained on Exhibit No. 4. The red, there are three boxes on the exhibits, each containing three bars. The bar to the left, the one colored red on most of the exhibits, represents the actual measured shut-in pressure on the Pubco #6 State on the 1963 deliverability test, the resulting deliverability as calculated and the resulting daily allowable as assigned.

The blue bar or center bar shows the average shut-in pressure from the offset, the resulting calculated deliverability on this particular well and the resulting allowable using those pressures.

The green bar shows the average offset well conditions. The average pressure of the four wells, their average deliverability and their daily allowable average.

Q Is this just a graphic representation of your Exhibit No. 4, Mr. Arnold?

A Yes.

Q Do you have anything else pertinent to this Exhibit No. 5?

A No, sir.

Q Mr. Arnold, are you of the opinion that the various so-called zones in the Blanco-Mesaverde Pool are in communication with each other?

A The primary producing zones in the Blanco-Mesaverde Pool are two sandstones, the Cliff House sandstone at the top of the section, the Point Lookout sandstone at the bottom. The Menefee zone is primarily shale, coal, section which is not generally considered to be a good gas reservoir. I do, however, realize that it does have sandstone developments at times and some reserves have been developed there and I'm sure, referring to Pubco's testimony, that they have found some gas present.

However, the main Mesaverde gas reservoir is in the Cliff House and Point Lookout sandstones and they are in communication. I would like to say further on that, that I don't know necessarily the Blanco-Mesaverde Pool is 70 miles long by 40 miles wide. I don't think that you have good pressure communication throughout the length and width of this pool. However, within segments or small producing areas I believe that you do have pressure communication.

Q In this connection, Mr. Arnold, do you feel that there is pressure communication with the Pubco State Well #6 and it's surrounding offset wells?

A Yes, I do.

Q Would the various shut-in pressures on the offset wells influence this determination as calculated on your deliverability test and reported to the Commission?

A Do those influence my determination?

Q Yes, do they go into your determination? Do you consider them offsets?

A Yes, you certainly consider the offsets. The fact that there's a pressure difference between all of them doesn't necessarily influence the fact that you think they're connected.

Q Is it your opinion that the area surrounding the Pubco State Well #6 was stabilized when the 1963 deliverability test was taken?

A It may have been stabilized within an area of permeability, obviously as I said before, this well in the early days did stabilize very well which indicated that it was in communication with a segment of sandstone which had better than average permeability. It may be near stabilization within this better sandstone. However, if it is in pressure communication with the offset drill blocks and there is a pressure differential, then certainly gas would be being contributed to this drill block from the offset drill blocks, therefore the area is not stabilized in my opinion.

Q Is it your opinion, Mr. Arnold, that the action that the Commission took in averaging the shut-in pressure of the Pubco State #6 with it's offset well will afford to the operator of each well in the Blanco-Mesaverde Pool opportunity to produce his just and equitable share of oil and gas or gas underlying his property?

A Yes, I believe so.

MR. DURRETT: I believe that's all I have for Mr. Arnold on direct examination.

MR. PORTER: Any questions?

MR. SPERLING: Yes, sir.

CROSS EXAMINATION

BY MR. SPERLING:

Q Mr. Arnold, do you believe that the present proration formula under which we are operating in New Mexico, that is, 75% deliverability, 25% acreage, is a good, workable, equitable formula?

A I don't believe the discussion of the equity of the proration formula is under the call of the hearing.

Q You did mention this was the proration formula under

Northwest New Mexico is operating, did you not?

A Yes.

Q I believe I understood you to concede that the pressures which is reported for the State #6 well were accurate measured pressures?

A Yes, sir.

Q What justification do you have for substituting a different pressure from wells producing from different zones in that formula, for an accurate measured formula taken and introduced in the formula, in accordance with the rule in effect?

A Well, I don't believe that the wells, that well and it's offset wells are completed in different zones. In fact, I believe that the Pubco witness has testified that the same zones are open in several of the offset wells. I look upon the Blanco-Mesaverde reservoir as being a single reservoir, at least within small areas. I believe that the deliverability test formula, calculation formula, anticipates that you use a correct reservoir pressure, at least insofar as it is practicable to determine a reservoir pressure.

Insofar as the way that we have done it, I feel that it is fair because insofar as the equities are concerned, those five wells are in pressure communication with each other. I feel that an average pressure which you arrive at by averaging all the five pressures together does better than any one measured pressure to represent a fair representation of the reservoir pressure in that area which I think is anticipated by the deliverability calculation formula.

Q Do you think that was within the intention of the adoption of Rule R-333-F?

MR. DURRETT: If the Commission please, I would have to object to that question on the ground that Mr. Arnold is not qualified to discuss or comment on what the Commission's intention was. That's known by the Commission only. He has no way of knowing what the Commission's intention was.

Q (By Mr. Sperling) You were present at the hearing in Case 2695 were you not?

A I believe that I was, yes, sir.

Q I want to refer you to some of the testimony which was given by Mr. Utz at the time of the hearing which resulted in the adoption of Rule R-333-F. This is on page 7 of the transcript and the question was asked of Mr. Utz on direct examination from Mr. Durrett as follows: "Do your rules provide methods for taking shut-in pressure on wells which cannot have both casing and tubing measured and shut-in pressures which appear to be low due to liquids in the bore?"

The answer to that question was: "Yes. On page 6, down about the fourth paragraph, the latter part of the paragraph we have entered this wording, some of which I will recommend a deletion, the second word, beginning with 'the high of such pressures', that should be 'the higher of such pressures shall be used as P_c in the deliverability calculation. When any such shut-in pressure has been determined by the Commission to be abnormally low, the shut-in pressure to be used shall be determined by one of the following methods:', then we list three methods.

These three methods are as follows: 'A Commission designated value.' Well, first, I had better elaborate slightly on the portion that I would like deleted from this paragraph. After the words 'abnormally low' I would suggest that we delete 'or when only one pressure is available'.

In some instances it is not possible to get the second pressure or annular pressure normally on conventional wells, and even on dual completions where you can take but one pressure, if that pressure appears to be a normal shut-in pressure I doubt the feasibility of compelling the operator to prove that it is actually an accurate pressure by some other means.

The first method would be 'A Commission designated value.' This would be, it would have to be done only in instances where the shut-in pressure appeared to be abnormally low. The Commission may designate a value from its records. In other words, it is our intention to contour the previous year's pressures for each pool, which would give you a very good indication by location as to whether or not the pressure was abnormally low.

The second would be an average shut-in pressure of all offset wells completed in the same zone. Where this is possible the average shut-in pressure from all offset wells would be applicable pressure or acceptable pressure. The third method would be the calculation of surface pressure based on a measured bottom hole pressure, and this calculation should be made in accordance with the Example No. 7 in the Commission Back Pressure Manual, which simply means that you would run a bomb and determine the bottom hole pressure and calculate back to the surface on a gas gradient."

Which of those three methods do you consider as the most accurate for determining the shut-in pressure of the well for the purpose of use in a deliverability formula?

A I think that entirely depends upon the circumstances. I think, as I said before, that what you need to do is to determine the most accurate reservoir pressure for at least that portion of the reservoir you are looking at, so far as measuring it. As determining what the pressure is at the well bore, then I think a measured bottom hole pressure is the best method. Although actually, if you don't have liquid problems you can probably get just about as accurate a pressure by measuring a dead weight pressure at the surface of the hole.

Q Do I understand then that you feel that you are, within the rules under which we are operating, authorized to make a selection on an individual basis of a particular well which is to have a pressure substituted for it other than it's accurate measured pressure, is that the sense of what you are saying?

A Yes, sir. In the light of what we have done that would have to be my conclusion.

Q Does that change the rule or doesn't it?

A No, sir, I don't believe that it does and there is other language in that transcript which discusses the stabilization problem and the problem in general of contouring pressures in several of these reservoirs in order to come up with a more accurate reservoir pressure which would result in more accurate deliverability tests.

This isn't a new idea at all. We have been discussing it inside the industry for some time. We realize that if you have wide pressure variations between wells in the same gas reservoir that it does then enter into the deliverability calculation and greatly affects calculated deliverabilities.

On larger wells where you have drawdown problems to begin with, it immediately accentuates the problem so that you get into very bad calculated deliverabilities.

Q In making your determination that you don't agree with a particular pressure for a particular well, do you ever take into consideration any of the factors that were illustrated by the exhibit, the cross section that was put on as a part of the Pubco case? Do you ever consider the completion methods, the perforation intervals, sand open, have anything to do with the pressures?

A Have anything to do?

Q In an individual well or a comparison of individual wells?

A Of course the amount of gas present in a particular drill block certainly has something to do with the pressure. You would normally think that you would have a smaller pressure decline per Mcf of gas produced for instance. Then, of course the allocation formula in effect in this pool takes this very definitely into account that there are differences between reserves under various proration units.

Q Are we talking about reserves in this hearing as distinguished from whether or not pressures are accurately measured for the purpose of taking into consideration the computation of deliverability of a well?

Are we discussing reserves, is that your conception of this hearing?

A Well, it's a little bit hard to discuss the problem at all without the problem of reserves coming into it. I don't think primarily we are discussing reserves.

Q We are discussing reserves as a basis for your imposition of Rule R-333-F if you say that the production, the cumulative production or the deliverability of a given well should be adjusted, is your testimony that it should be adjusted? Aren't we talking about -- you are making a subconscious or otherwise determination what reserves are a factor in your imposition of the effect of this rule?

A I think that's right. I believe I testified on direct that when we set up that deliverability formula in any pool we immediately infer that deliverability and reserves are related in a specific relationship.

The only point that I was attempting to make there, that if this is true, then as reserves are produced, deliverability should decrease rather than increase.

Q Let's get to that now. Let's look at your Exhibit, which I believe is Exhibit No. 3. I believe that you have available to you the 1964 deliverability as calculated and measured for this well, do you not?

A Yes, sir.

Q Do you have that information?

A I believe I do.

Q I wish you would plot the 1964 deliverability on your chart.

GOVERNOR CAMPBELL: On the original exhibit.

A I read that deliverability to be 15,103 Mcf per day.

Q Plot that on the 80% line, that's what we are using now.

A All right, I have it plotted.

Q Would you connect that point with previous points by a straight line?

A All right.

GOVERNOR CAMPBELL: Where is it? May we see it before he goes on with the questions so we can understand it better?

Q (By Mr. Sperling) Now, would you connect --

GOVERNOR CAMPBELL: Wait a minute. What you've done from this point, deliverability point, over here to this point.

A Yes.

MR. PORTER: That's from 16 down to 15.

Q (By Mr. Sperling) Refer again to your exhibit and on the 50% factor which was introduced, I believe in 1963, in memo 1-63, where for this pool the P_d figure was changed from 50% to 80%, is that when that occurred?

A Yes, sir. October, 1962. '63 tests were the first tests.

Q If the 50% one which you have shown by the red line up here were corrected to the 80%, that is from 1960 through 1964, where would that fall?

A I don't have the '64 test corrected to the 50% deliverability.

MR. KENDRICK: I believe it's been entered on C-122-A. Maybe I looked at the wrong one in the file.

A Is that the 14,393 figure?

MR. KENDRICK: I think that's the corrected figure.

A Here it is, it's 24,957. You want me to plot that also?

MR. SPERLING: Yes, please.

MR. KENDRICK: 24 what?

A 24,957. Almost 25. You can connect that with the dotted line above it.

MR. KENDRICK: Yes.

Q (By Mr. Sperling) If you extend the dotted line to the peak which is shown as the 1960 deliverability test, you have a straight line haven't you?

A Yes, that's right.

Q And it shows that the 1961 one was out of line for some reason?

A It shows something was out of line. It certainly doesn't prove that the '62 test was a correct test.

Q Well, it certainly proves that it was when taken in consideration with the 1960, 1962, and 1963 and 1964, they're all on the same curve.

A Well, I would also like to demonstrate one other thing that can be done. You'll notice on this graph there are two penciled dots.

Q I hadn't discerned those. Oh, yes.

A If we had corrected -- do you find the two dots?

Q One just above 800 and one to the right?

A Yes, just about 20 and in the 1962 slot, and the other one just above 15 and in the 1963 slot. Now, we decided to go back and check what would have happened if we had used average pressures in calculating the deliverability test on the Pubco State #6 well for those two years. Yes, using average pressures and calculating to a 50% deliverability base. You will notice that if you construct a line from the point where the 1961 test is through those two points that you also get a pretty good curve there.

Q What does that indicate?

A That indicates to me that we may have been in error on the 1962 test by some 12 or 13 thousand Mcf per day. And on the 1963 test also by a considerable amount. Well, actually the 1963 test is now corrected to a different deliverability base anyhow. The only reason I put that point on there was to show what the history would have been if we had used the average of the offset pressures and calculated the '62 and '63 test to a 50% deliverability base. So that you can compare the points actually.

Q We presented evidence that the State #6 well at a very recent test, or on a very recent test, stabilized flat. The constant pressure at the end of, I think some 55 hours. Do you suggest the possibility of the movement of gas or the communication as between these offset wells and this one? If that were actually the case, would you not have expected the State #6 stabilization curve to have continued to increase?

A I think that it would, given time. We're talking about very large withdrawal rates and possibly very large drainage areas and that being the case it may take considerably longer. Well, I am firmly of the opinion that it would take longer to get the pressure stabilization actually in the area.

Q How much longer?

A Well, I haven't any idea how much longer.

Q Well, I was --

A The conclusion that you have to reach if you say that the Pubco State #6 is draining an area which is not in communication with anything else --

Q Well, to follow the sense of the question which was asked of our witness by Mr. Utz, I believe he mentioned some about two and a half years. Would you agree that in order to accomplish complete stabilization throughout the Blanco-Mesaverde field that all these wells be shut-in for two and a half years?

A No, I sure wouldn't recommend that.

Q Then conversely you are saying that you don't think the 7 day period is a sufficient stabilization period?

A Well, we have known from the beginning that we weren't getting complete pressure stabilization on many wells in 7 days. Actually the 7 days was just --

Q Yes, but everybody had the same --

A We had to be practical, you can't shut the field in 200 days to get a shut-in pressure.

Q What you are saying is that everybody was stabilizing for the same length of time and was operating under the same rule and presumably was receiving the same treatment so far as calculating deliverabilities are concerned, stabilized absolutely or not, isn't that right?

A I think that you simply have to study a pool as you produce it and try to determine in the light of past production history on a well, and in an area where the stabilization history has been, and if you find areas such as this where you obviously are getting abnormally low pressures due to disproportionate withdrawals, I think it's going to be necessary that we do correct shut-in pressures, otherwise it will become aggravated the next year because you calculate a higher deliverability. This gives the well a large production, this pulls the well down even further so the next year you calculate an even higher deliverability.

Q What is your definition of abnormally low?

A Well, there isn't any fixed definition for abnormally low; it's in the light of the other information in the area and how it is affecting the deliverability calculation and we did look at the five thousand deliverability test in making a determination of just what the effect of these low pressures were.

Mr. Kendrick will testify in detail as to just what that study was.

Q Abnormally low is -- might mean one thing to me and abnormally low might mean one thing to you. As a matter of fact that's what we are talking about here.

A In this particular case. I think what we need to get a proper deliverability test is something that would represent a stabilized pressure that we're working in. I realize that the amount of area that we use there has to be a matter of judgment.

However, we determine that if we used only the direct offset drill blocks to the well in question that we couldn't go very wrong because certainly the pressure used by the Pubco State #6 well, even after we have averaged it, is a lower pressure than any of the offset pressures. So that I fail to see how the Pubco State #6 well can be adversely affected by using this average of that area. Those are the wells which we maintain are in pressure communication with each other.

Q What evidence do you have to demonstrate that they are in communication; have you got any interference tests?

A No, I don't have any interference tests.

Q Well then, what you've done is to read the pressures on the other wells and read the pressure on this well, which is conceded to be accurate, and say, since there is a difference, the six months must be abnormally low, isn't that the essence of your conclusion?

A No, I don't think so.

Q What is it then?

A Let me have that question one more time, now.

Q Well, what you have done without having conducted, you have reached the conclusion that these wells are in communication. That's number 1.

A Right.

Q Without any evidence of that. Number 2, you have said that "I'll take a look at the pressures on the surrounding wells and since they appear to be higher than the State #6 well, that State #6 must be abnormally low", that's the extent of your comparison?

A We knew because of the fact that the State #6 is an unusual well, that it has a disproportionate production with comparison to the offset wells, also we presume that that particular area, because the wells are better than average, did have better than average, Blanco-Mesaverde well did have better permeability than the average. If we are going to prorate a pool we have to make the assumption that the pool is in a common reservoir, if we don't assume that's a common reservoir I suppose then we would have to chop it up into various small pools and prorate it that way.

Q We have shown you the cross sections which shows you the different intervals of the cross section open. In the J. Glen Turner No. 2 State, this well's 1963 deliverability was 518. It's got 34 feet perforated, the next well is the Union of Texas which is a new well. It was completed September 27, 1963, an IP of 3,790 Mcf per day. It's 1963 deliverability was 692.

Pubco State, which you have said was re-completed in 1960, has initial potential of 23,000 Mcf per day, had a 1963 deliverability of 16,716 Mcf per day, the total of 439 feet perforated. The next one is Pubco's State Well #5, has an IP of 7,440 Mcf per day, 1963 deliverability of 1,543 Mcf per day. And the Delhi-Prichard had an IP open hole completion of 14,140 Mcf per day and '63 deliverability of 63,772. Do you consider that these wells are producing from the same reservoir?

A Yes, I certainly do.

Q You mean nomenclature designated Blanco-Mesaverde Pool?

A I didn't say necessarily that those wells are comparable wells and certainly allocation formula hasn't treated them as such.

Q I believe you said they were about average wells?

A For the Pool, I said all of those wells are at least above average, at least it's above average area in the Blanco-Mesaverde Well.

Q Primarily because of the Pubco #6?

A Well, the Delhi-Prichard #2 still has a Q rate of 4,549 compared to the Q rate of 6,968 on the Pubco State #6. So, actually those two are relatively comparable, I would say.

Q That's the Delhi what?

A Prichard #2. Actually it doesn't show very much section open at all on your cross section, but it's evidently in communication with a great amount of reserves.

GOVERNOR CAMPBELL: Mr. Sperling, are you approaching the conclusion of your cross examination or shall we recess now?

MR. SPERLING: I'm about through with Mr. Arnold. I believe I am through.

MR. DURRETT: We have no re-direct.

MR. PORTER: The hearing will recess until 1:30.

(Whereupon, a recess was taken.)

MR. PORTER: The Hearing will come to order.

Anyone have any further questions of Mr. Arnold?

MR. DURRETT: If the Commission please, I noted during the lunch hour I neglected to get my Exhibits into the record, I would like very much to ask Mr. Arnold one more question for the purpose of getting the Exhibits in the record.

DIRECT EXAMINATION

BY MR. DURRETT:

Q Mr. Arnold, were Exhibits One through Five prepared by you or under your supervision?

A Yes.

MR. DURRETT: That's all.

If the Commission please, I would like to move the introduction of Exhibits One through Five.

MR. PORTER: Without objection, the Exhibits will be admitted into the record.

(Whereupon, Applicant's Exhibits One through Five were offered and admitted into evidence.)

MR. PORTER: Anyone else have any questions of Mr. Arnold?

MR. HOWELL: I would like to ask a few questions.

CROSS EXAMINATION

BY MR. HOWELL:

Q Mr. Arnold, I realize that you would be reluctant to give a legal interpretation, but as an administrator charged with administration of the Rule, I would like to find out how you in that capacity interpret the portion of the Rules referring to abnormally low pressured, as to what that Rule means, that portion of the Rules?

A Well, we made an inspection of all five thousand, over five thousand wells in a field, particularly those with high multipliers where we knew we possibly had draw-down problems, and compared those problem wells with the pressure from the offset wells in each case, and if we found that by using the average of the offset pressures we came up with a higher pressure than we presumed; that that would at least partly get rid of the problem, and the reason we had draw-down problems on that well.

Q Well, do you consider that the term, "abnormally low" refers to a test which is inaccurate and does not correctly reflect the shut-in pressure of the well?

A Does not accurately reflect the shut-in pressure of the well?

Q Yes.

A Of the reservoir I would say; yes.

Q And do you understand the Rule to mean that it is applicable in the cases in which the test is not an accurate test?

A That's right.

Q Now, I believe you are familiar with Mr. Utz's testimony in Case No. 2695 when the Rule was adopted?

A Yes, sir.

Q Did you find in his testimony any statement of any other incident in which "abnormally low" would be used other than the case of inaccurate testing?

A Yes, I believe that it was inferred by Mr. Utz in his testimony that we did have problems, low shut-in pressure problems which were caused by other things than liquid accumulations in the wellbore. He did testify in fact, we were going to contour pressures in the pool in order to make a determination if we did have abnormally low pressure.

This, in itself, infers that we would not. It was low because of the fact that it was lower than the other wells in that offset, that contour. Of course, we haven't used a contour method in recalculating allowables because we felt that the way the Order was written we were only authorized to use offset shut-in pressures, and actually, from an engineering standpoint, I believe you are less apt to enter areas in the deliverability calculation in doing it that way than if you used contour pressures over the whole pool.

Q Do I understand your testimony as being to the effect that in addition to applying abnormally low to incorrect tests you, as an administrator, also apply it to areas in which the pressure may be lower than in other portions of the pool?

A I am not sure I understand your question, will you --

Q Well, do you apply the Rule and a portion of the Rule that speaks of "abnormally low pressures" in cases in which the actual reservoir pressure is considered by you lower than that of other portions of the pool?

A That's a rather difficult question, and I am not sure I understand all of the ramifications of it. Yet, we certainly have variable pressure through the Blanco Mesaverde Pool. We have some areas which are higher than the average, some areas that are lower than the average.

Actually, we looked at this problem on an individual well basis compared to that portion of the reservoir immediately surrounding it, and as I say, to begin with, we tried to determine by looking at the multiplier which wells had a sizable problem in the deliverability calculation.

Actually, Mr. Kendrick is going to testify also to this matter a little more in detail. You might want to ask him a few of those questions.

Q Mr. Arnold, your Exhibit Number One contains this statement as may be seen from the formula; "It is very important that the shut-in pressure be an accurate pressure because it appears twice in the formula and the deliverability pressure is directly related to the shut-in pressure. You do subscribe to that statement; do you not?

A That the deliverability pressure is related to the shut-in pressure?

Q No; that it is very important that the shut-in pressure be an accurate pressure.

A Yes, I do.

Q Well, now, in this particular case are you not using an inaccurate pressure in the face of a test which the operator of the well made and showed that the accurate pressure of the well was as reflected in the test?

A No, I don't think so at all. I think that in the first place, the deliverability calculation formula anticipates you use an accurate reservoir pressure for the area.

Actually, it infers that you use a single reservoir pressure. However, we know we can't accomplish that in the Blanco Mesaverde Pool., so, we figured that we can come up with much more accurate pressures by at least trying to determine what the average pressure in a drainage area is in a segment of the pool.

There isn't any way that you can build inaccuracies using those pressures that I can see, because those are the wells that are in complete communication with each other, and as I say, just because a pressure is measured at a well and it is accurately measured doesn't necessarily mean that it is accurate for purposes of using in the deliverability calculation.

We also have some further authority on this point, which will be put in the record.

Q Now, Mr. Arnold, referring a little further in the Rule, it appears that the Rule permits three alternate things to be done in the event the Commission does determine that the shut-in pressure is abnormally low. In your action as an Administrator interpreting that Rule; do you find there is any priority as to any one of those three methods that should be applied?

A No, I feel that the one that should be used in these particular instances should be one which in the judgement of the Commission best reflects the reservoir pressure for that area.

Q Would you deny an operator the right then to test a well, make a test and obtain the correct pressure and substitute or use that correct pressure instead of one that the Commission might determine?

A Yes, I believe that it should be at the option of the Commission as to which pressure is used. if we become convinced that we are calculating an accurate deliverability by using any one of the other means.

Q Then, in your administering of the Rule you are,in effect, denying the operator the opportunity to use that third alternate that is set forth; are you not?

A I don't believe that we could effectively administer the Rule unless we did that.

Q As I understand your answer to the question, you say you are doing that?

A Yes.

MR. HOWELL: That's all.

MR. PORTER: Does anyone else have a question?

MR. SPERLING: I do.

FURTHER CROSS EXAMINATION

BY MR. SPERLING:

Q Do I understand in your responses to Mr. Howell's questions you propose to average the well pressures through the Blanco Mesaverde field for the purpose of determining deliverability?

A I do not. I am not sure what route the Commission may have to take to solve this problem in the future. As I said, we started out by choosing those cases where we knew we had high multiplier problems in their pressure areas.

Q But according to your statement you feel that the Commission would be justified in averaging the pressures through the field for each well on the basis of the offset wells?

A I think --

Q If you determined that a problem existed?

A I think that it would certainly be correct from an engineering standpoint, I am not sure. The problem would be an administrative problem, because it is going to be rather difficult, for instance, with nineteen hundred wells to make these determinations. However, it may become necessary that we do that.

Q So in the meantime, you just select a few of them as the target wells?

A We selected those where we knew we had very sizable deliverability areas. I am not saying we have perfection on deliverability tests in the San Juan Basin, you can't -- you can come a lot closer to actual calculated deliverability on some wells than you do others.

In the first place, if you have 25 per cent draw-down or more as will also be testified by Mr. Kendrick, the mathematical error which we have been discussing becomes much smaller.

So that you have very small areas percentage wise, and have small total areas on the majority of the wells. However, this becomes magnified when you have less than 25 per cent draw-down, and I belive on this State 6 Well we had about 6 per cent draw-down, and actually this is the point that we are making. This is what is entering the mathematical error in the deliverability calculation on this well, because of the fact it has such a high rate of flow.

The calculated deliverability really does become exagerrated compared to other wells in the field. I believe we then had two wells in the Blanco Mesaverde Pool with a calculated deliverability of over five thousand MCF. This is one of them, and there is one other. And actually, you see the Pubco State Six Well as a calculated deliverability almost double that, the next largest well in the pool.

Q What you are saying is that you place the least reliance upon the seven day shut-in stabilized pressure proportion to the formula as opposed to any other factor that you might select even though the Rule provides for the measurement of a pressure following the seven day shut-in period; but that is the least reliable of all the factors?

A That's right, because of the fact that it actually is involved in three of the factors. I mean, if the shut-in pressure is unreliable and the deliverability base is different for that particular well.

Q Would you consider stabilization within fifty-five hours of an overall seven day test period as any indication of stabilization at all, reservoir stabilization?

A I wouldn't be ready to make that kind of a statement. I don't -- As Mr. Utz testified, in some wells in the pool it takes two and a half years to get complete pressure stabilization.

Q But you readily concede it is highly impractical?

A Yes.

Q It might be desirable from a strictly engineering standpoint?

A That's right.

Q Wouldn't it follow that it's the wells that take two and a half years to stabilize, aren't they the ones that need the correction and not the ones that stabilize within the prescribed period?

A Actually, if you have -- The slowest stabilizing wells are the ones with the lowest permeability as a general rule; and, of course, those low permeability wells have small flow rates.

As a result of that you have no problem getting draw-down. In other words, your shut-in pressure may even be 200 pounds low, but still due to the fact that you are getting 50 or 60 percent draw-down on the well you do not enter any into your deliverability calculation, or a very small error.

Q Well, then it is a basic dispute with the philosophy of the seven day or annual deliverability test that you are concerned with; you just don't agree with that formula, do you?

A I agree with the Order as written.

MR. SPERLING: That's all.

MR. PORTER: Are there any further questions? The witness may be excused.

(Witness excused.)

MR. PORTER: Call your next witness, Mr. Durrett.

MR. DURRETT: The Commission will call Mr. Kendrick to the stand.

* * *

A. R. K E N D R I C K, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. DURRETT:

Q Please state your name and position for the record?

A A. R. Kendrick, Engineer, District Three for the New Mexico Oil Commission.

Q Mr. Kendrick, do you have an Exhibit that is marked as an allowable graph?

A Yes, sir.

Q You just have one copy of that, don't you?

A Yes, sir.

Q Please post that on the board and identify it. First, Mr. Kendrick, how is that Exhibit marked, what number?

A It is marked as Exhibit Six.

Q Will you please explain to the Commission what that

Exhibit shows?

A This graph, the scale on the left-hand side is calculated allowable based on average allowable allocation factors actually used for a twelve month ending -- Or from March of last year through February of this year.

The scale is in million cubic feet per month. The horizontal scale is deliverability calculated as by the deliverability test in million cubic feet per day. This graph is drawn with two lines across the scale here. The lower line identifies the allowable volume as read from the scale to the left as allocated to a well of the deliverability identified on the lower scale due to deliverability times acreage.

The distance between these lines is the allocation to any well with a standard acreage factor; that volume of gas allocated by the formula for acreage. Now, the formula says 25 per cent acreage, 75 per cent deliverability. That is only on a pool basis. That at a deliverability of one million feet per day, 78.4 per cent of the allowable is allocated on deliverability. At five million feet per day, 94.79 per cent of the allowable is based upon deliverability. At ten million feet per day, 97.33 per cent is allocated on deliverability, and at thirty million feet per day, 99.09 per cent on deliverability. This is to show the importance of deliverability being accurate when we pass about one million feet per day, or the higher the deliverability the more the need for accuracy because this absolutely controls the allowable in the anulus. The problem we are discussing is not on a pool basis.

Of nineteen hundred and one deliverability tests submitted in 1963, seventeen hundred and twelve had deliverability less than one million feet. Of the one hundred eighty-nine other tests, twenty-nine had deliverability in excess of two million feet; and in excess of five million feet, two wells.

Q Is that all you have as far as that Exhibit is concerned, Mr. Kendrick?

A I think so.

Q Will you please turn to your Exhibit Number Seven?

A Exhibit Number Seven is a small page, and I believe is in the folder that the Commissioners have. The scale on the left-hand side or right side of this Exhibit is what has been termed multiplier by Pubco's witness, and I believe this reflects his Exhibit Seven which is a deliverability multiplier factor. The horizontal scale at the base of the page is a percent draw-down; that is a portion of the denominator in the factor which is PC-PW. That is the shut-in pressure minus the working pressure. This hard line represents the multiplier or the value of this fraction raised to .754, where most of the deliverability pressure is 80 percent of the shut-in pressure.

These are the situations that occur in the Blanco [illegible] In a few copies of Mesaverde [illegible] near the [illegible] this Exhibit, [illegible] pencil lines [illegible] a 2% percent side [illegible] difference between a 2% percent draw-down [illegible], a 25 percent draw-down and 25 percent draw-down [illegible], a 1 percent error causes draw-down. In this range of draw-down, a 1 percent error this multiplier to increase by 2.76% per cent. A little to the right on this scale some other pencil lines have been inserted on some of these which is a difference between a 6 percent draw-down situation and a 5 percent draw-down. The multiplier changes 14.2 per cent; that is, it increases 14.2 per cent between a 6 percent draw-down situation and a 5 percent draw-down situation.

Now, this percent is the percent of the total deliverability as a net rule of the calculations due to a percent error in the draw-down situation which includes the shut-in pressure and the working pressure. The causes of these errors can be the human element of misreading the gauge, mechanical problems in the gauge, a lack of pressure buildup in the reservoir, and these situations all exist.

In this case, we are not accusing Pucco of submitting non-erroneous information or of not being able to read a dead weight gauge. We believe the problem here is entirely based on a slow pressure buildup in the reservoir [illegible] this well. This situation fits all back pressure tests this deliverability test is a back pressure test.

And the way it is used in the proration formula represents the calculated reservoir under the tract for allocation purposes.

Q Mr. Kendrick, do you agree with Mr. Arnold that the problem as far as the Pubco State Six Well is concerned is in the slow rate of buildup?

A Yes, sir.

Q Is it your opinion, Mr. Kendrick, that this is an accepted engineering theory that this does occur in reservoirs of this nature?

A Yes, sir.

Q Do you have, Mr. Kendrick, any authority for that conclusion?

A Yes, sir.

Q In that connection do you have an Exhibit; I believe it is marked Exhibit Number Eight?

A Yes, sir.

Q Which sets out various authorities on this proposition?

A Yes, sir.

Q Would you please refer to that Exhibit, Mr. Kendrick; and also let me interrupt myself, and ask you if you also have the various documents of publications, books, that we are talking about that are listed on this Exhibit?

A Yes, sir, I have the publications present. This Exhibit merely refers to page numbers of publications which are available and identifies the page number to which we refer in each instance.

Q Will you, Mr. Kendrick, in the length of, as far as considering the length of time; I don't necessarily want to ask you to read each one of these authorities, but will you please read just one or two of these authorities to give the Commission an idea of what you are speaking about?

A I would like to read a portion of a paragraph in the handbook by Kats and others, handbook of Natural Gas Engineering, on page 422.

"In low permeability formations appreciable pressure differences may exist between various points even after the long shut-in times. These differences are due to the low rates at which gas can flow through the low permeability formations to reach the depleted zones. Such pressure differences should be recognized and taken into account by the calculation and the use of, 'equal reservoir pressures'".

Another place in this same book they refer to some early well back in 1935 by Rawlings and Shell Heart, and in the U.S. Bureau of Mines Monograph Number Seven where they expressed need for accuracies for the reservoir pressures and in calculating back pressure tests. At that time in the early studies of gas well delivery testing, they thought it important enough that they appended an article in the back of the page, because of the effects of error in back pressure data.

I believe that the publications substantiate the need for accurate reservoir pressures because each of these people refer to the fact that you need accurate reservoir pressure.

Q Mr. Kendrick, how many authors wrote or subscribed or, at least, are named in the Kats books, approximately?

A Seven authors are listed on the dust cover.

Q Are these men recognized as experts in the field of oil and gas engineering, in your opinion?

A Yes, sir.

Q Would you just name one or two of them that you feel is outstanding?

A Donald L. Kats, Professor of Chemical Engineering and Chairman of the Department of Chemical and Matallurgical Engineering at the University of Michigan; Fred H. Poettmann, Supervisor of the Engineering Department's Research Organization for the Ohio Oil Company; John A. Very, Chief Reservoir Engineer, Michigan Consolidated Gas Company.

Q That is satisfactory. Thank you. Is it your opinion, Mr. Kendrick, that as far as we are talking now about each of these other authorities that you have listed on your Exhibit Eight; that they are written by equally qualified men?

A Yes, sir. Qualified men, both in research, education, and in application of the petroleum engineers knowledge.

MR. DURRETT: If the Commission please, I would like to move at this time, in the interest of time; that the Commission take administrative notice of the contents of each of the documents that is set out on the Exhibit in order that we won't have to have the witness go through the record and read them all into the record.

GOVERNOR CAMPBELL: You just want to put those excerpts into the record?

MR. DURRETT: By administrative notice.

MR. CAMPBELL: Yes, sir.

I think they should be in the record. They are just excerpts?

MR. DURRETT: They are excerpts, yes.

MR. CAMPBELL: If you are going to rely upon them as evidence, you should put the excerpts into the record, if it can be stipulated without reading them in full.

MR. SPERLING: How long are they?

MR. DURRETT: Each one is about a page long, or half a page, something like that.

MR. SPERLING: You don't propose to incorporate the book, just a specific page? All right.

MR. DURRETT: You would stipulate to that without the necessity of reading each?

MR. SPERLING: Yes, sir.

MR. PORTER: Is that page referred to in this Exhibit?

MR. DURRETT: The page is referred to on the Exhibit, Mr. Commissioner.

MR. PORTER: Would you have those incorporated as a part of Exhibit Number Eight?

MR. DURRETT: Yes, we would have that incorporated as Exhibit Number Eight by stipulation of opposing counsel.

Mr. Kendrick, why don't you just run down through that --

MR. SPERLING: Just something occurred to me, I am moving a little slow. We would like to reserve the right to object to the materiality of these excerpts which we have not read, and to which we may have an objection at the time we are able to read them or hear about them.

MR. DURRETT: We would be --

MR. SPERLING: It is my understanding we would reserve the right to object to the materiality. We can dispense with the reading of them.

MR. DURRETT: We can so stipulate.

Q (By Mr. Durrett) Mr. Kendrick, let's move on to your next Exhibit which is, I believe, Number Nine.

A Exhibit Number Nine is a comparative production graph showing the cumulative production during the life of the well, of this Pubco State Six Well and the four offset wells.

The vertical scale is shown in five billion cubic foot intervals, and the Pubco State Six production which is shown in the left-hand column up about eight billion cubic feet, or where the line crosses ten billion cubic feet the scale increases much more rapidly than prior to that time. That is during the year of 1960, the year the well had remedial action and caused its rate of production to increase. Since that time, each of the offset wells remained relatively constant or tapered off so their rate of increase or their rate of production did not substantially increase.

Just below the five billion cubic foot line on this graph, the horizontal line represents approximately 4.4 billion cubic feet. That volume is the average total production of the offset wells.

Up near the top of the graph there is a line between fifteen and twenty billion cubic feet which is approximately 17.8 billion cubic feet; that is the total production of all four of the offset wells. As of the first of this year, the Pubco Well had produced approximately 18.1 billion feet and the total offsets had produced, or the total of the four offsets was 17.8 billion feet. Pubco Well has produced more gas each year since 1959 than the sum of the other offset wells.

In 1963, the Pubco Well produced more than one billion cubic feet, more gas than all four offset wells. I think this tends to incorporate itself with our next Exhibit.

Q Will you please refer to that Exhibit; is that Exhibit Ten?

A Yes, sir, I think I might can make my abstract art available to some of the people sitting a little bit closer here.

Q Yes, if you will put those up, please.

MR. DURRETT: I would like to state for the Commission --

MR. PORTER: Could you put that one over here?

A To the side?

MR. PORTER: Yes.

MR. DURRETT: -- that all of the Exhibits we have handed out here, the copies of that Exhibit are not colored, but I believe they can look at that color and tell where the various contours are.

A This Exhibit Ten consists of fourteen plats of an area surrounding the Pubco Well and constitutes my interpretation of pressure contour maps for the seven day shut-in pressure as measured on deliverability tests in 1954, 1957, 1960 and in 1963.

The pink color on the 1954 plat is that pressure between a thousand and a thousand and fifty pounds; and there are two wells uncolored which existed a thousand fifty pounds; so essentially the pink color is the higher pressured area.

The next lower pressure will be represented by a bright red area; the next lower in turn then would be an orange or golden area; and the next lower in turn will be a yellow area. And from that point on more blue in the color would then identify a lesser pressure.

In 1954 the Pubco State Six Well which is identified by an arrow in the southwest corner of the quarter of Section 36, Township 31 North, Range 9 West, is in this primarily high pressure area. In 1957 the Pubco Well is still in the then existent high pressure area for the area of the plat here. In 1960, immediately after this well had been reworked, I believe the well was reconnected in May; the October pressure on the Pubco Well had at that time dropped from the high pressure area existing at that time beyond the next fifty pound contoured area and well down into the next portion which shows that the pressure surrounding this well has substantially been reduced, and I believe the cause is due to the difference in the rate of production from May through October.

In 1963 the Pubco State Well is down one more band of fifty pound contour and almost out the next band, so that at this time it is one hundred and forty-two pounds below the then existing high pressure area within this plat.

In my opinion, the pressure decline is caused by a faster relative rate of removal of the reserves or production than the other offset wells.

Q Mr. Kendrick, are you of the opinion that the Pubco State Six is in communication with the offsetting well or wells that directly offset?

A Yes, sir.

Q In that connection you were here this morning, were you not, and heard the testimony of Mr. Ramsey concerning his Exhibit Six "A", I believe it is, the seven day shut-in result; is that Six "A"; did you hear his testimony concerning that Exhibit?

A It is pressure buildup?

Q Yes, sir.

A Yes, sir, I heard his testimony.

Q Do you agree with Mr. Ramsey that that is a stabilized pressure?

A I do not think that is a stabilized reservoir pressure for this area.

Q What would you base this opinion on, Mr. Kendrick?

A The rate of production, I believe, that Mr. Ramsey testified to, one hundred twenty-seven days continuous production prior to the time this test was taken. From the rate of production taken from the 1964 deliverability test which is in excess of 6.8 million feet per day, this well would have produced considerably in excess of three quarters of a billion feet of gas immediately before this test was taken. The reservoir voidage by the three quarter billion feet of gas would require a very large relative radius of drainage so that a large volume of the reservoir has a pressure decline; therefore it will take a long time to move the gas back through a relatively tight surrounding reservoir to replace the gas removed.

Q Mr. Kendrick, referring back to your Exhibit Number Eight which was the Exhibit showing your various authorities and the pages on which they could be found to support this theory, I would like to ask you specifically if each of these authorities at the page that you have set out there on that Exhibit, agrees with the proposition that averaging shut-in pressures of offset wells is an acceptable engineering practice if you are not getting proper draw-down in the area?

A Each of the authorities do not so set out in their publications. It is established by at least one, and I think others, where that is the first chosen method of averaging reservoir pressures for calculations of reserves or of test data.

Q Now, Mr. Kendrick, are you of the opinion that the action that the Commission took with respect to the Pubco State Six Well will enable each operator in the Blanco Mesaverde Pool to recover or at least the opportunity to recover his just economic table gas in the pool?

A I think it will be an assist to help each operator have the chance to produce his fair share of the reserves.

Q Were Exhibits Six through Ten prepared by you or under your supervision?

A Yes, sir.

MR. DURRETT: If the Commission please, I move the introduction of Exhibits Six through Ten.

That would conclude my examination on direct to Mr. Kendrick.

MR. PORTER: Are there any objections to the admission of the Exhibits?

MR. SPERLING: No.

MR. PORTER: The Exhibits will be admitted into the record.

(Whereupon, Exhibits Six through Ten were admitted into the record.)

MR. PORTER: Does anyone have a question of Mr. Kendrick?

MR. SPERLING: Yes, sir.

CROSS EXAMINATION

BY MR. SPERLING:

Q You previously opened your testimony, Mr. Kendrick, with the statement that you felt that the vital portion of the deliverability formula was the relationship between the shut-in pressure and the working pressure, PDW, which gives you draw-down; is that correct, P_c minus P_w?

A That has a very direct bearing on the test.

Q That does represent draw-down; does it not?

A Yes, sir.

Q Now, you mentioned some factors that you considered as bearing upon the ability of a well to draw down; I don't recall exactly what they were, but I remember one that was not mentioned that strikes me as being a significant one. In a reservoir, as the pressures, we will say the pressure on a given well, more nearly approaches the pipe line pressure into which it is producing; what is the effect upon the ability of a well to show a draw-down?

A The draw-down is limited by the ability, or by the pressure approaching the working pressure, or the pipe line pressure in this case?

Q So that could be a factor in failure to obtain what you consider to be adequate indication of draw-down?

A Yes, sir.

Q Wouldn't it be fair to oppose at least some adjustment insofar as that factor is concerned; that is, some elimination of that possibility in order to confirm the accuracy or in-accuracy of what you say is the vital portion of this

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deliverability formula?

A I don't think I quite understand you.

Q If you changed the pressures, if you lowered them, this gives a greater opportunity for the well to demonstrate draw-down, isn't that correct?

A You mean lower the working pressure?

Q Yes, sir, and wouldn't that be evidentiary of whether or not that the well is capable of and acceptable by your findings of a draw-down?

A I hate to give you a "yes" on that, because we have no way to change the working pressure. I mean, it is an existing pipeline pressure of which we have no control.

Q Well, are you trying to adjust for that factor then by some other means?

A Well, I don't think so.

Q Well, you are saying that these other factors; that what you consider to be the inability of the well to stabilize to reservoir pressures as distinguished from wellbore pressure is a factor that you consider insofar as draw-down is concerned; isn't that right?

A Yes, sir, it is a factor we must consider.

Q So you are adjusting other factors because you have no control over one of them; is that correct?

A Yes, sir.

Q All right.

A We have evidence here on the Exhibits that in this Lease Seventy-Four higher pressures do exist.

Q Well, now, let's talk about our Exhibits a little while.

A All right, sir.

Q Going back to Seven "A" which I believe was referred to by Mr. Durrett, which is the graph of the pressure buildup that you talked about before, would you say that the stabilization of, or an increase in shut-in pressure in a thirty minute period -- well, whatever it shows on that graph, plus a complete stabilization at fifty-five hours of a seven day test is any indication at all of the wells ability to stabilize to reservoir pressure in the area from which it is producing?

A After the study I have made, I can only make the interpretation that there is such a large area of good permeability in contact with the well that once this volume of gas is taken out it is going to take a tremendous time to put this gas back into this part of the reservoir so it will be at the same pressure as the remainder of the reservoir.

Q You are assuming that the gas isn't already there and it has got to come from someplace else?

A Well, we have the pressures here, it was there.

Q And the ability to stabilize back to this pressure indicates since there is no further buildup it is there again to be produced, and if there is no increase in the pressure over a considerable period of time, not one half pound, it's not coming from any place else; is it?

A Well, in my opinion it is part of the reservoir; therefore, there would be gas feeding into it.

Q Well now, let's analyze your conception of what this reservoir is.

Now, we have got to go back to the Cross Section; where is it? Now, in looking at that Cross Section which represents the log in perforated intervals as well as the State Six Well; does that appear to you that all of these wells are producing from the same zones, the reservoirs, or whatever you want to call the area from "C", or where there is gas in place?

A I believe that each of those wells being completed in the Blanco Mesaverde Pool are in communication with each other through the reservoir.

Q Through the reservoir?

A Yes, sir.

Q Well, apparently Pubco spent a lot of unnecessary money in recompleting its well and opening up additional sections if they are all in communication; that was money needlessly spent in your opinion because the reservoir is in communication?

A I did not set on the well, but it is possible.

Q Well, would you see any relationship between the productivity of this well, its ability to produce prior to the work-over and after the work-over, realizing that only a portion of these sections were open prior to the work-over and the sections were opened in the condition that we find them now after the work-over? There was a tremendous increase in deliverability, was there not?

A Yes, sir.

Q Does that have any relationship to opening these additional sections?

A Possibly, and possibly it is due to a fracture treatment which would then make a communicative route between the well-bore itself and a natural fracture network within the Blanco Mesaverde Reservoir.

Q What evidence of that do you have other than pure speculation, what evidence do you have?

A That there is a fracture in it.

Q Where?

A On one well completed in Township 31 North, Range 9 West, the information I received orally is that the bit fell through some three or four feet, and they don't fall unless there is a void there for them to fall through.

Q Where is that in reference to these wells?

A I don't recall the exact location. It's a little bit further north than this Pubco State Well. It is Southern Union's Nordhaus Number Five.

Q How far north?

A I don't recall the section number; maybe in Section 12.

Q In miles?

A Two or three miles, but there was a fracture that is wide enough for a bit to fall through. It is not a hairline crack, this is a wide gap in the existing sand down there.

Q So you are assuming since the Pubco State Six after recompletion is a good well; that it must be in one of those caverns?

A It is possible.

Q It is possible. Anything is possible, but you haven't got any proof of that, have you?

A No, sir, no, sir, neither do I have any proof it came out of one of these zones here, here, here, here, or here; by being a completion due to the sand alone.

Q Mr. Kendrick, I don't want to be facetious on this thing, but it is possible that the Pubco Six could be bottomed or in a gas storage reservoir which would increase its volume tremendously, too; but I don't think that is the case in this particular instance.

Do you have any idea as to how long it would take for these reservoirs that you say are in communication to stabilize so that their pressures would be equal and identical, one well to the other?

A With the exception of the hydraulic lead head pressure differential across there, I think it would take approximately as long to get these pressures back to one uniform pressure through the pool as it has taken the wells producing to get them into the pressure disorder they are today.

Q Well, now, tell me why you believe that to be true, is that directly related to the permiability, is that related to reserves; what is it related to?

A It is related to the permiability and what approaches an infinitive ability or unmeasurable difference between the pressures in the reservoirs so there is less pressure differential to cause the pressures to stabilize and the gas flows with resistance through the reservoir, so that it would take a long time to get to an absolute one pressure reservoir.

Q Well, now, is it your theory that given enough time that this pressure here would stabilize with this pressure here, and this one with this one here, and this one down here with this one here?

A Yes, sir, at a same datum point pressure; that is --

Q You mean that is related to depth?

A So that we are not calculating one pressure at a different depth to another.

Q Well then, in effect there is permeability of a greater or lesser amount vertically throughout all of these sections we are looking at there on that Cross Section?

A Well --

Q Within the reservoir, within what we call the Blanco Mesaverde Pool?

A At the present time we have some nineteen hundred wells completed in there. I think the communication throughout the wellbores would stabilize those pressures.

Q If they were all open?

A If they were all open, or enough open to stabilize the pressures over.

Q That, you think, would do it. Isn't it true that each of the operators of the wells on the Cross Section that we see here has had an opportunity to selectively perforate any interval that he chooses in a course of drilling his well?

A Yes, sir.

Q Apparently the operators of the other wells exercised some judgement which we have got to assume was not without basis in deciding which of these zones would contribute to the gas production and which would not; isn't that the logical assumption by looking at what was perforated and what was not?

A Yes, sir.

Q Do you feel that because Pubco chose to open up more sections than the other operators they should be penalized for having done so?

A No, sir.

Q Isn't that the effect of the administrative action which you have taken?

A No, sir.

MR. DURRETT: I object to that question, it calls for a conclusion, a legal conclusion.

Q (By Mr. Sperling) Isn't the reduction of deliverability from 16,000 MCF to 8,000 somewhat of a penalty, it hurts, doesn't it?

A Not being a stockholder, I couldn't say it would hurt.

Q If you owned the well, it would hurt, wouldn't it?

A I think I would look into the situation.

Q Well, do you think there is any relationship between the period before the work-over in the State Six and a period after the work-over; that is, with reference to sections opened and the capability of the well prior to that time and after that time?

A Yes, sir, I think that was presented on Exhibit Three by Mr. Arnold, if you care for me to elaborate on that a bit. I would put a copy of that Exhibit on the board, here. This is

Exhibit Two instead of Exhibit Three, I am sorry.

In 1958 when the first deliverability tests were taken the shut-in pressure on the Pubco Well was a thousand forty-two pounds. The average shut-in pressure for the four offset wells was about nine hundred and seventy-five pounds, and up until the well was reworked in 1960 these pressures are taking substantially the same type pressure decline curve.

In 1960 the Pubco Petroleum Corporation State Six Well started an abrupt pressure decline relative to the prior rate of decline. The average pressures of the offset wells has remained on a lesser slope or a lesser rate of decline.

I am thinking these average offset pressures might have exhibited an even flatter curve had this Pubco Well not drawn this down below these, and possibly bringing these down with it.

Q Well, it didn't bring them down with it, did it?

A We don't know.

Q Well, I mean as demonstrated by your curve?

A We don't know whether this rate of curve would have continued to be relatively flat across here, say, another twenty or thirty pounds higher for the average of these four offset wells, because this pressure has drawn down even beyond them by approximately eighty-five pounds; or whether they would have maintained this constant rate, because we haven't any way to go down in the reservoir and see.

Q Well, incidentally, do you know what the latest reported pressure for the Johnson Number Nine Well is, a '64 pressure?

A Do we have that on the cards, Arnold?

No, sir, I don't have that pressure recorded here. I had the test in the office, but I didn't get the pressure recorded.

Q The pressure which we have taken from the Commission files for your information, is 672 pounds which is substantially below the State Six pressure of 697 pounds; that is one of the wells you have averaged or did average prior to the action taken?

A I don't have that pressure. If that --

Q I am sure that is correct.

How would you explain that?

A The pressure of the Johnson Five Well which is in the northeast of Section 35 in 1960 showed 714 pounds, and the well was not tested in 1963; it was plugged because they had experienced some mechanical problems with this well.

I am not acquainted exactly with what the problems were, but some mechanical problems did exist in this well which they could not remedy. The plugged the well and redrilled the Johnson Number Nine on the adjacent forty acre tract to the south. That well is as close as practical in line between the Johnson Five and Pubco State Six. It in in an area which apparently is of low permiability.

Q This is the Number Five Well here, (indicating.)?

A That's correct.

Q In the same forty?

A That's correct, at the time this well was completed, the Johnson Nine, the initial pressure shown is 782 pounds, which, incidentally, happened to fit real good in this contour plat for 1963.

Q Do you know when the Johnson Nine was completed?

A I think I have a record here of that, sir. We show a drilling completion date of September 17th, 1963. The first delivery into the pipeline on November 29, 1963.

Q Do you consider that a new well?

A Yes, sir.

Q Well, does the fact that the pressure has declined to a 1964 pressure of 697 pounds as compared to the initial pressure indicate anything to you?

A In these tight or low permiability reservoirs the initial pressure draw-down is at a much faster rate than at later life in the well.

Q Well, do you think then that the initial pressure measured for that well was representative of the reservoir pressure?

A Not necessarily. I am not sure it was a stabilized pressure because I do not know the length of time the well was blown to the atmosphere.

Q How come you have included it in the average, if it wasn't a good pressure?

A That is the only pressure available. If we had left this one out I don't think it would have affected the 775 pound average very far.

Q Now, Turner State Number Two which is another one of the wells in the averages, our information is that during the period 1962 to 1963 the pressure on that well actually produced, I mean, increased even though the well was being produced. Is that normal performance?

A We find this to be a normal performance in Blanco Mesaverde Wells caused, we think, by two reasons: The 1962 pressure as recorded as 694 pounds absent. At that time the well may have been shut-in just before unloading a slug of liquids. Then the 1963 pressure of 724 pounds could have been -- the well could have been shut-immediately after such a collection of liquids had been discharged. Therefore, the 30 pound pressure differential could have amounted to some sixty feet of fluid in the wellbore.

Q Was any test run to see if there were any liquids in the hole?

A No, sir, these pressured differ from year to year because of the production shut-in characteristics immediately prior to the conduction of the deliverability test.

Q The sum of that statement is: You don't know whether it was an accurate pressure or not, either one of them?

A We do not think this to be the average reservoir pressure of that well.

Q At either end of the scale?

A Right.

Q Do you have idea how that is going to end up, pressure wise, with relation --

A Nothing definite.

Q Although that is the offset well to State Six?

A Yes, sir.

Q To your knowledge, have any interference tests been conducted in this immediate area to indicate whether or not these reservoir zones are in communication?

A You mean test vertically between the two?

Q Interference tests in connotation to that term, which I understand, it is one way to determine whether wells are in communication.

A By your term "interference test" to see if the wells are in communication; are you implying that the test is to see if this zone is in communication of this zone, or if --

Q I meant well to well.

A I don't know whether any have been conducted in this immediate area or not.

Q Have any been conducted vertically to see if these zones are in communication other than through the wellbore?

A Not to my knowledge.

Q Would such a test be practical?

A I doubt it, because the shut-in time required on many of the Mesaverde field pool wells require two hundred days and some have gone more than a thousand days to reach maximum pressure buildup.

Q If there were communication, the best evidence that you have would be that with the production from the State Six Well, the pressure ought to decline in the Johnson Number Nine -- not the Nine, the Turner State Well; why would it increase if it was in communication? If you produced a lot of gas from the same reservoir why would it go up; is this the liquid problem again you are talking about?

A The liquid problem could exist, or the Turner State well may have been shut-in for a substantial period of time prior to the time that the well went on deliverability test, then the shut-in pressure would be higher.

Q These are all suggestions we have, all with possibilities, with none of them pinned down; isn't that a fair statement?

A No, sir, I think we have test information which will prove that well shut-in for substantial periods of time would have a higher pressure after the test.

Q I am not arguing with that statement, I am talking about whether these wells are in communication producing from the same reservoir, subject to the same conditions; that is all supposition and theory.

A As far as these five wells are concerned; yes, sir, because no test has actually been performed.

Q To your knowledge, have any of the offset operators, the owners of these other wells, made any protest to the --

A No, sir, not to my knowledge.

Q Then this whole thing has been precipitated on the engineering theory of the Commission staff which has assumed some conditions to be present which are not substantiated by evidence, and accordingly subject to readjustment in the opinion of the staff; is that a fair statement?

MR. DURRETT: I object to that question. If the Commission please, he is now asking the witness to weigh the evidence and tell the Commission what he thinks about it.

MR. SPERLING: That is exactly what I mean. The evidence is before us, he is qualified as an expert, I am entitled to ask for an opinion.

MR. PORTER: Mr. Kendrick, go ahead and answer the question, if you can.

MR. SPERLING: Will you please restate the question, Mr. Reporter?

REPORTER: (Reading.) Q. Then this whole thing has been precipitated on the engineering theory of the Commission staff which has assumed some conditions to be present which are not substantiated by evidence, and accordingly subject to readjustment in the opinion of the staff; is that a fair statement?

A The evidence of numerical values in the record of pressures between the wellbores within the formation are not substantiated. However, in the engineering training that I received and based upon these authorities here, they imply that there is a pressure between the wellbores within a reservoir, and I would use that as substantiating evidence that this situation possibly exists.

Q Those studies weren't based on the Blanco Mesaverde Pool; are those conclusions, whatever they are, the theories contained in that book?

A Some of the statements refer specifically to the San Juan Basin.

Q To the Blanco Mesaverde Pool?

A I believe they would in that.

Q As it is part of the Basin?

A It is part of the San Juan Basin, referring to low

MR. SPERLING: Will you please restate the question, Mr. Reporter?

REPORTER: (Reading.) Q. Then this whole thing has been precipitated on the engineering theory of the Commission staff which has assumed some conditions to be present which are not substantiated by evidence, and accordingly subject to readjustment in the opinion of the staff; is that a fair statement?

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Q To the Blanco Mesaverde Pool?

A I believe they would in that.

Q As it is part of the Basin?

A It is part of the San Juan Basin, referring to low permeability reservoirs as exist in the San Juan Basin.

Q Now, look at your 1963 pressure contour map up there, Mr. Kendrick. I think the substance of your testimony was that the volume withdrawn by the State Six in that area contributed to the low pressure condition which you find to be present in that area; is that substantially what you said?

A Yes, sir.

Q Now, in looking at this 1963 pressure map, I find to the south in Section 11 a reported pressure; this is in the west half of 11 of 696 pounds. Now, you go on up and you get into, let's see, Section 24 and you find a well there that has 669 pounds pressure contoured. There is a well in the west half of Section 11 which has a pressure of 615 pounds; are these contributing at all to the situation you find there, and have contributed to the State Six?

A It is possible.

Q Their pressures are lower than the Six, aren't they?

A Yes, sir.

Q So they must have some effect on the so-called low pressure area that you are talking about. Do you know whether these wells have any comparable characteristics to the State Six or any of the other wells?

A No, sir.

Q Other than they are completed in the Blanco Mesaverde?

A If you like, I can give you a deliverability test summary.

MR. SPERLING: That is all I have. Thank you.

MR. PORTER: Are there any further questions of Mr. Kendrick?

MR. DURRETT: If the Commission please, if there is no more cross examination, I do have one more question on redirect.

REDIRECT EXAMINATION

BY MR. DURRETT:

Q Mr. Kendrick, referring to the Johnson Number Nine that was discussed by Mr. Sperling with you, would it be your opinion as an engineer that it could be a possibility that this well, when it was completed, or I guess it was recompleted, could have a lower pressure to cause an area in which it was completed to have previously been drained?

A Yes, sir.

Q Now, discussing this matter of whether or not the well should be put in with the average, one of the average of the area, would you want to include every well in that area regardless of what the pressure was?

A Yes, sir, as much information as we have to substantiate our move; we considered in this study of not using the pressures on wells like this State Six well; that we would use four offset pressures, but we determined that since this well did represent a portion of the reservoir; that in all fairness it should be included.

MR. DURRETT: Thank you.

MR. PORTER: Are there any further questions?

GOVERNOR CAMPBELL: Yes.

RECROSS EXAMINATION

BY GOVERNOR CAMPBELL:

Q Mr. Kendrick, I don't know whether you answered this or not. Do you concur with the statement of Mr. Arnold that Pubco tests were accurate tests in 1963, and that they complied with the provisions of Rule R-333?

A In respect to the pressure measurement?

Q Yes.

A Yes, sir, we agree or have no quarrel with the pressures as submitted as a dead weight pressure, gauge pressure.

Q In compliance with the Rule?

A And that the pressure was measured in the compliance with the Rule. We believe the pressure problem exists on a reservoir condition of slow stabilization.

Q And will you state for me what basis you used for concluding that this accurate pressure was abnormally low; was it on just a comparative basis with pressure surrounding the well, or was there something more than that?

A There was much more study involved than that.

On the Exhibit depicting the history of the deliverability tests.

Q Yes, I remember that Exhibit.

A Where the flow rate decreased, where the working pressure decreased, and where the shut-in pressure decreased, the deliverability should not increase. We have an arithmatic reversal which causes them to go higher than the actual deliverability should be because of depletion of the reservoir.

Q That is the basis for your concluding that this well required special treatment under the amendment to the Rule of November, '62, on the basis that it was an abnormally low pressure; is that correct?

A Yes, sir.

GOVERNOR CAMPBELL: That is all I have.

MR. PORTER: Does anyone else have a question of Mr. Kendrick?

You may be excused.

(Witness excused.)

MR. DURRETT: That will conclude our case.

MR. SPERLING: We do have a small amount of rebuttal testimony, if the Commission please.

MR. PORTER: All right.

You will be using the same witness, Mr. Sperling?

MR. SPERLING: Yes, sir.

MR. PORTER: Let the record show the witness has been sworn.

* * *

C H A R L E S   R A M S E Y, having been previously sworn, was now recalled to testify as follows:

DIRECT EXAMINATION

BY MR. SPERLING:

Q You are Charles Ramsey who testified previously and as a part of the Applicant's Case in this matter?

A That's correct.

Q You understand you are still under oath?

A Yes,sir.

Q I notice that you have placed on the board up there another Exhibit which is entitled, "Deliverability History," and I assume this has some relationship to the testimony of Mr. Arnold and Mr. Kendrick relating to the deliverability history of this particular well as they have interpreted it.

Now, would you step up there and tell us what you conclude and what that graph is supposed to show from your standpoint?

Also, if the Commission please, I would like to have the Exhibit marked for identification as Exhibit Number Twelve.

(Whereupon, Exhibit Number Twelve marked for identification.)

A This Exhibit, which I think is Exhibit Twelve, is essentially the same plat of deliverability versus time, as their previous Exhibit. I am not sure of the number of that.

GOVERNOR CAMPBELL: Three.

A Exhibit Number Three.

What we have done in this case, the current formula provides that the deliverability be calculated on the basis of a deliverability pressure which is a per cent of the shut-in pressure, so we have taken all of our past deliverabilities, right back to the initial deliverability in 1952 and recalculated them on the 80 per cent basis, merely so we could show them all on the equal curve and compare them instead of getting into this changeover problem of 50 per cent and 80 per cent, and we have the deliverability scale increasing here on the vertical scale and the time, or years, on the horizontal scale.

Starting in 1952, we had deliverability of approximately 5,000,000 cubic feet on this well. This deliverability declined as Mr. Arnold pointed out, I believe, very steadily into 1957 at which time it was around 3700 MCF per day.

Now, in this period from initial completion up and to May 7, 1958 the State Six was completed open hole, we had casing set above the entire Mesaverde Section. They are up in this area, and we had tubing set through the Mesaverde open hole down into the Point Lookout at about 5,000 feet. At that time we had a considerable amount of caving problem with this open hole. The open hole actually caved in around the tubing and was a serious restriction toward getting gas down through all of these cavings of shale and silt and some sandstone. We are having considerable trouble getting the gas into the well-bore and into the tubing. In 1958, March 7th, 1958, we perforated the tubing from 4607 to 4610, three feet; and from 4507 to 5010, which is a total of six feet.

Now, we did this in an effort to open up more pay sand or more pay section to the tubing to eliminate this problem of the caved hole, and you can see because of the deliverability increase there, we did have results in increased deliverability between the '57 and '58 tests. So, that in 19-- from this completion up until this time of the workover we had oh, somewhere in the neighborhood of sixty to seventy feet open. We perforated a few additional feet in 1958 and got a slight increase in deliverability. We again worked the well over in 1959, perforated the tubing again, this time from 4579 to 4942 and had another slight increase in deliverability.

So this upward trend in deliverability in this area is correctly related to the small tubing intervals that we perforated right here and shows what results we could have and what results we did have as a result of opening up a little more section to the wellbore, in this case, about six feet each time.

Then we had a very serious casing leak with gas flowing out of the ground in 1960, March 26th, 1960, and repaired the casing leak; however, more significant at that time, we set casing through the entire section, remended this casing. We perforated over four hundred feet of pay in this casing and treated the well so that at this time we have a proper completion of all of the zones which were open before in the open hole, but we restricted plugging the hole because of its being caved in around the tubing; so we are talking about a brand new well for State Six in 1960 following the completion of the well, recompletion of the well in 1960.

We have these deliverabilities for 1960. Now, these are converted to the 80 per cent factor, so they are all on the same basis.

Of approximately twenty-two thousand initially new wells at this point in 1960, down in 1961 to slightly over sixteen thousand. As Mr. Arnold has pointed out we had an increase here from '61 to '62 of up to eighteen thousand five hundred roughly, and then a decrease to the '63 test which is in question of sixteen thousand seven hundred; and the 1964 test of fifteen thousand one hundred. It is quite obvious here we have a straight line deliverability from 1960 through 1964, there is one enormous test.

This test, in my opinion, is wrong. I have talked with our field people about it and they feel there was some problem with the test; however, it is in the past and we don't exactly know what the problem is, but in this case we have 1960, 1962, 1963, 1964 lined up right in a row, four tests, and we have one which is enormous; and the 1963 test is certainly in line with the normal deliverability of this well since its essential recompletion as a new well in 1960.

Q Well, now, it is interesting to note, Mr. Ramsey, that while you pointed out you had a new well essentially there, the capability of the well increased tremendously; what caused that; in your opinion?

A Well, I think the cause of this is quite obvious. At the time of the open hole completion we had essentially all of the section up above the tubing closed off because of the wellbore cables. This is evidenced by the fact that by perforating small sections of the tubing we were able to get small deliverability increases, and at the time we were working the well and opened this section adequately; only then for the first time in this well's history were we able to have all of the pay zones flowing unrestricted into the wellbore.

Q You may sit down, Mr. Ramsey.

Now, in closing, Mr. Ramsey, this isn't the only well that Pubco has in the Blanco Mesaverde Field or San Juan Basin, is it?

A No, sir, we operate somewhere around eighty-eight wells and have part interest in many more wells.

Q How would you rate this well with the others?

A This is by far the best well we have.

Q Do you have some wells that have not paid out?

A Yes, sir, we have some wells that have not paid out, and a great many wells, that in my opinion, unfortunately will never pay out.

Q Okay.

MR. SPERLING: That's the end of the rebuttal.

CROSS EXAMINATION

BY MR. PORTER:

Q Have you contemplated giving any of your other wells the same treatment you gave this one as far as perforating the zones?

A We have reworked essentially all of our open hole completions. We have not had the success with most of them that we had with this one; however, all the ones we reworked we have had very good success.

Q I mean --

A Yes, we have had substantial increases. We have not had any of this range.

MR. SPERLING: Does Pubco have any wells?

A Yes, we have a two well program going on at the moment.

MR. SPERLING: That's all.

MR. PORTER: Does anyone else have a question of Mr. Ramsey?

MR. DURRETT: I do, if the Commission will give me just a minute.

I don't think I understand the question yet.

CROSS EXAMINATION

BY MR. DURRETT:

Q Maybe I understand it now. I will ask it anyway.

Mr. Ramsey, in 1957 when you reworked the well, I believe you said that you perforated six feet?

A That was in 1958, that was our first workover, at which time we perforated six feet.

Q Was that when you had caving?

A Yes, sir, that was at the time we had open hole cavings around the tubing. We had no casing down into the Mesaverde, we had only tubing.

Q Do you know where the top of the caving was?

A The top of the caving?

Q Yes, sir.

A No, sir, we did not know where it was precisely.

Q Then you don't know whether you opened up six feet or opened up the entire Cliff House section, do you, Mr. Ramsey?

A No, sir, we would have no way of proving that.

Q That is all of that one. Let me try another one.

Referring to the straight line we are talking about, what is the number of that Exhibit?

A That is Exhibit Twelve, I believe.

Q You were present here when Mr. Arnold testified concerning his Exhibit Number Three which is the one where he had the various deliverability pressures of 5 and 80 per cent?

A Yes, sir.

Q As far as the straight line is concerned, do you agree with him that if you draw a line on the two pencil dots he was talking about, which would have been averaging the pressures on this well since 1960; that that also would give you a straight line?

A Yes, sir, and I could put some more pencil dots on there and we would --

Q We could just draw straight lines?

A Yes, sir, but these are ones we measured on the performance of this well. We have not determined the best average pressure performances of the wells.

Q You do believe, do you not, that Mr. Arnold did actually calculate from actual measured --

A Yes, sir, I am sure he did calculate them.

MR. DURRETT: Thank you, I believe that's all I have.

MR. PORTER: Are there any further questions?

MR. SPERLING: Just one.

REDIRECT EXAMINATION

BY MR. SPERLING:

Q Mr. Ramsey, Mr. Durrett asked whether you knew whether you had the entire Cliff House open or six feet of it open, and you said you didn't. The fact remains that the more holes you made through the tubing, when you recomplete it, the better well you have got; isn't that right?

A Yes, sir, we proved that three times, I would say. We recompleted it in 1958, got a small increase with six feet of additional perforations; we did it again in 1959, got another small increase with six feet; and when we opened the entire zone we got a very large increase.

MR. SPERLING: I would like to offer Exhibit Twelve, please.

MR. PORTER: Without objection, the Exhibit will be admitted into the record.

(Whereupon, Exhibit Twelve was admitted into evidence.)

MR. SPERLING: Now, that concludes our testimony in this case.

MR. PORTER: Are there any further questions, any further questions of this witness?

You may be excused.

MR. SPERLING: Except that we would ask that there be incorporated as a part of this record, the testimony taken at the Hearing in Case No. 2695 which gives, or which was the public exposition of the proposed Rule changes which we are dealing with here today and which provide a sort of legislative history of what the purpose of the suggested changes was.

I think in making a determination as to whether this particular situation falls within the framework of the Hearing is a material matter, so we would make that request at this time.

MR. PORTER: Your motion is to incorporate the record of Case Number 2695 as a part of this record?

MR. SPERLING: Yes, sir.

MR. DURRETT: We would join in the motion to incorporate the entire record in this Case.

MR. PORTER: The record of Case 2695 will be made a part of this record.

MR. SPERLING: Thank you very much.

I don't propose to expand on the length of time on this case that has been presented to you, there are a few things I do want to point out.

Our first position is which I tried to make clear in the opening statement that the Rule as it has been used here has no application to what has been intended by the proposed Rule change adoped in 1962.

That Rule was designed to deal with abnormal situations where inaccurate readings were being obtained as a part of the deliverability formula, and which were not true, accurate representations of a vital factor which goes into that formula; that being a shut-in pressure of a particular well which all of these other factors are related. I think it has been demonstrated that any change in a value assigned to the shut-in pressure without changing any of the other values which are dependent thereon, is a distortion of the formula itself.

We feel that legally this Rule was designed for one purpose and is being used for another. If the matter is to receive consideration as indicated by the testimony of the Commission in this case, this is not the method, the time, nor the place in which to do that.

In substance, we don't think the Rule should have been applied there because we had an accurate test. We have demonstrated this accuracy, it has been conceded. We have a situation which demonstrates that the Rule can be invoked only in thos instances that is, the portion of it that relates to averaging offset well pressures when the offset wells and the well in question which is presumed to have an abnormally low pressure, are completed in the same zone. We think we have demonstrated that these wells are not completed in the same zone, and therefore, not comparable on any kind of an averaging basis.

We think our Exhibit up there amply demonstrates that as well as the other information which we have presented. Ad-mittedly, we are in the Blanco Mesaverde Pool and we are not in the same formations, zones.

I think the term of the Order is zone, as these other wells, and to attempt to average this pressure or reduce, I mean, increase this pressure has reduced the deliverability on an arbitrated basis based on a well average is unfair and unjust. There has been no evidence presented that these wells are in communication. All of the evidence that has been presented is to the contrary; so I don't think it can be concluded that the average pressure well basis correcting shut-in pressure and consequently deliverability pressure has any application what-soever to this particular well.

The point has been made that nobody else, particularly the operators of these offset wells have seen fit to protest or, to my knowledge, even show up here today in an attempt to support the revision of the deliverability assigned to this particular well. For that reason we think that some weight should be attached to that situation. They had equal opportunity to,on the same zones if they existed, and they chose not to do so.

On the basis of that brief statement we would ask that the Commission consider and take from the action leading to the revision of the Application of the Rule in this case to the State Six Well resulting in the revision, the recalculation of the deliverability formula based on 1963, which was the one in use for 1964, and that the well be given an opportunity as a result of having suffered, if it has, from the cut in allowable; that it be allowed to resume its production to the end; that it is not penalized in any way.

We ask that the Commission give this matter serious consideration, and its impact upon not only this operator, but other operators who have received the same treatment or may possibly receive the same treatment as the State Well Number Six; and we ask that the Rule be found to be not applicable to the State Six Well.

Thank you very much.

MR. DURRETT: If the Commission please, I would like to state that at the outset I certainly do not feel that any weight should be attached to the failure of any operator, whether his well is affected or not, to show up here today or

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not show up here today; mainly on the proposition that the Case is advertised and docketed and presented today concerning a Pubco State Well Number Six, and certainly not the other wells; and that might explain to a great degree why the other operators were not here today, since we were concerned with the State Six and not their wells.

I also would like to state very briefly that as far as the question as to whether or not this is the same zone, I would like to call the Commission's attention to the fact that the Commission determined at the time that it prorated this pool and wrote the Order or Orders concerning this pool; that it was the same common source of supply as designated by the Commission. There was, therefore, necessarily communication, it is always assumed that there is communication in the pool or you sure shouldn't have one pool, and we would suggest that when the Commission comes to the proposition of the conclusion that there is no communication -- there is not communication in this pool between the various wells, then it would certainly seem feasible to take another look at the pool and start designating some small pools, because that must be what there is if there is not one pool in communication.

We feel that we have shown to the Commission here today that the intent of the Order R-333 has been followed by the Commission Staff and that this was just such a situation that this Rule or Order was intended to cover.

We think we have shown that the shut-in tests, shut-in pressures were used abnormally low as contemplated by Order Number R 333, and we would invite the Commission's attention to the record in the case promulgating this Order R-333 to substantiate this proposition.

We have shown that this is a definite sink area involved, or maybe I should say sink areas involved in this pool that are causing the problem. It is not a matter of somebody's failure to read the pressure, it is a sink area, so to speak, which is causing a lack of buildup and a resulting mathematical provision in the formula so that you do not get true deliverability as it is contemplated and used the formula and you have it where you have the sink areas.

In other words, it is the position of the Commission Staff that this formula is valid, that it works, if you don't get into the situations where you have the sink areas, and if you are in the sink area some action must be taken or the formula will not properly allocate the gas in the pool as it was contemplated that it would do; and we submit that this is just exactly what Order R 333 was intended to correct, situations like this where inaccuracies were resulting.

We would also suggest that not only as a method that the Commission has selected-- specifically set out in Order R333 it has been established here today that this is a very common accepted engineering principle, I am speaking of averaging the offset wells a reasonable engineering theory.

It is on this basis we submit to the Commission that the action of the Commission Staff, the action it has taken in relation to the Pubco State Well Number Six is in the interest of conservation, that it will afford to the operator of each well in this pool the opportunity to produce his just share of the gas, and we would urge the Commission to make such findings and to issue an order substantiating the action of the Commission Staff.

Thank you.

MR. PORTER: Does anyone else have anything to say?

MR. MORRIS: If the Commission please, Tenneco Oil Company is now the operator of the Delhi Taylor-Prichard Well Number Two which is the northeast offset to the Pubco Well under consideration here today. Tenneco wishes to go on record as being in support of Pubco's Application, particularly on the point that where an accurate test of a well's shut-in pressure is available there is no occasion for the Commission to resort to the use of average pressures of offsetting wells.

Tenneco tends to supplement and amplify its position by statement as authorized by the Commission at the outset of this Hearing.

While I am up, I would like to make a further statement on behalf of Southern Union Production Company. Since deliverability is such an important factor in the allocation of gas in the San Juan Basin, it is essential that each well's deliverability be properly determined in order to afford to each operator the opportunity to produce his just and equitable share of the recoverable gas reserves.

Also, since a well's shut-in pressure directly enters into the calculation of the deliverability of that well, it is obvious that the well's shut-in pressure must also be properly determined in order to achieve proper allocation of the allowables.

Actual conditions existing in a portion of the reservoir drained by the well may best be determined by accurate tests of that well. Tests on other wells should be used only when it is impossible to obtain an accurate test on the well under consideration. The mere fact that a well's shut-in pressure is substantially lower than an average on an offsetting well in itself is no basis for the assumption that the average is a more accurate reflection of the characteristics of the reservoir drained by that well.

Southern Union Production Company opposes the Commissions use of such average figures and accordingly wants to go on record in supporting Pubco's Application in this Case.

Thank you.

MR. HOWELL: Ben Howell, representing El Paso Natural Gas Company.

We have an unfortunately small fractional interest in this well, and are the operators of a number of wells that have received the same treatment. We are also the operator of the Turner State Number Two which is one of the offset wells and we feel that in the adoption of the Rule, and certainly the concurrance this company gave at this time in the adoption of the Rule was apparently a misunderstanding of the purpose, because we understood that the purpose of the Rule was to provide a method to substitute pressure when the test was inaccurate and that it was not intended to make this Rule applicable as to substitution of average pressures when the test was valid and good.

We are considerably concerned with the interpretation that the Commission may deprive an operator of the right to take a valid test, make a good test and substitute that for a test which was admittedly inaccurate.

GOVERNOR CAMPBELL: Mr. Howell, may I interrupt a moment on this general proposition that you are referring to here as to the intent of the Order in December, 1962; is there anything in this transcript that is now a part of the record in this Case that sheds light on that point directly?

MR. HOWELL: We think it does, we think that the testimony of Mr. Utz, we refer to liquids in the wellbore, as being an occasion on which the test would not be valid.

GOVERNOR CAMPBELL: Would not be accurate for extenuating reasons?

MR. HOWELL: That's right.

GOVERNOR CAMPBELL: But there is no reference to inaccurate tests as such, in the record; is that the case? You just assumed that this was it by reason of the discussion relative to liquids in the hole and other --

MR. HOWELL: I think liquid in the hole does result, as I understand from the engineers, does result in an inadequate test and that is one of the common reasons for a test being inaccurate.

Now, we wish to supplement these few remarks by filing within two weeks, a formal written statement. And I will conclude merely by saying that we believe that the Rule, the language of the Rule, meaning an intent of the Rule does not go to the extent to which the Staff is requiring this hearing.

GOVERNOR CAMPBELL: Will you include in your statement, since you brought it up here, what basis there is in the record of the prior case?

MR. HOWELL: We will make reference to it.

GOVERNOR CAMPBELL: All right.

MR. PORTER: Does anyone else desire to make a statement? The Commission will take the case under advisement.

* *

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, CHARLES WALKER, Notary Public in and for the County of Bernalillo, State of New Mexico, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me; that the same is a true and correct record of the said proceedings, to the best of my knowledge, skill and ability.

Witness my Hand and Seal this 9th day of October , 1964.

Ada Dearnley
Charles L Walker
NOTARY PUBLIC

My Commission Expires:
March 25, 1968.

I N D E X

NUMBER	MARKED FOR IDENTIFICATION	OFFERED	ADMITTED
Comm. 10	107	111	111
Appl. 12	134	141	141

* * *

n.- 6

Phone DAvis 5-2393

TEMPERATURE ★ B&R SERVICE, INC. ★ SURVEYS ★ ★

BOX 1048 - FARMINGTON, NEW MEXICO

Pressure Survey

COMPANY	PUBCO PETROLEUM CORP.	LEASE	STATE	WELL	#6
FIELD		LOCATION		DATE	9-4-64 TO 9-11-64
COUNTY	SAN JUAN	STATE	NEW MEXICO	DATUM	-700
SHUT IN		ELEVATION		CASING PRESSURE	
ZERO POINT	MASTER VALVE	TBG PRESSURE		P.B.T.D.	
TBG DEPTH		CASING SET		MAX. TEMP	168°F
PACKER SET		CASING PERF.			
FLUID LEVEL					

RUN 7 DAY BUILD-UP PRESSURE @ 4949'

DEPTH		PRESSURE	GRADIENT	Calculated Surface Pressure*
4949'	(0 HR. 11:30 A.M. 9-4-64)	708 PSIG		646
	1 HOUR	710		647
	2 HOUR	711		648
	3 HOUR	712		649
	4 HOUR	713		650
	8 HOUR	714		651
	10 HOUR	715		652
	15 HOUR	717		654
	20 HOUR	718		655
	35 HOUR	719		656
	45 HOUR	720		657
	55 HOUR	722		65[illegible]
	95 HOUR	722		658
	96 HOUR	722		658
	167 HOUR	722		658

WELL SHUT IN 30 MINUTES BEFORE)0) HOUR.

*Surface pressure calculated using U.S.B.M. formula as presented in Monograph 7. Surface pressure measured with DWT [illegible] 659 psia on 9-9-64.

No. 1

TEMPERATURE * B&R SERVICE INC * SURVEYS * *

BOX 1045 FARMINGTON NEW MEXICO

Pressure Survey

PUBCO DEVELOPMENT CORP. LEASE PUBCO STATE WELL 6

LOCATION DATE 4-2-63

COUNTY SAN JUAN STATE NEW MEXICO

SHUT-IN FLOWING ELEVATION CASING PRESSURE 575 DWT

ZERO POINT TBG. GATE TBG PRESSURE 662 DWT

TBG DEPTH CASING SET MAX TEMP

PACKER SET CASING PERF

FLUID LEVEL NONE

DEPTH		PSIG	GRADIENT
		659	—
LUBE		680	.02
1000		699	.02
2000		717	.02
3000		742	.02
4000		747	.01
4500		749	.01
4700		751	.02
4800		753	.02
4900		755	.04
4949	Bottom tubing		

No #2

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

State of New Mexico
Oil Conservation Commission

LAND COMMISSIONER
E. S. JOHNNY WALKER
MEMBER

STATE GEOLOGIST
A. L. PORTER, JR.
SECRETARY - DIRECTOR

1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO

March 16, 1964

Pubco Petroleum Corporation
P.O. Box 1419
Albuquerque, New Mexico

Gentlemen:

The annual deliverability testing schedule on file in this office indicates that your Pubco State 4 well is now on deliverability test and will have the shut-in pressure measured on Monday, March 23, 1964. We are conducting a pressure study in this area and are requesting that bottom hole pressures be measured on this well at the time the surface pressure is determined.

Please have your local representative contact us by telephone when these pressures will be measured Monday in order that we may have a witness present.

Yours very truly

Emery C. Arnold
Supervisor, District [illegible]

ECA:ks

cc: Pubco Petroleum Corp.
Box [illegible]
Aztec, New Mexico

No. 3

Phone DAvis 5-2393

TEMPERATURE ★ B&R SERVICE, INC. ★ SURVEYS ★ ★

BOX 1048 - FARMINGTON, NEW MEXICO

Pressure Survey

COMPANY	PUBCO PETROLEUM CORP.	LEASE	PUBCO STATE	WELL	#6
FIELD		LOCATION		DATE	3-23-64
COUNTY	SAN JUAN	STATE	8 NEW MEXICO	DATUM	
SHUT-IN	7 DAYS	ELEVATION		CASING PRESSURE	685 DWT
ZERO POINT	TBG. GATE	TBG. PRESSURE	685' DWT	P.B.T.D.	
TBG. DEPTH		CASING SET		MAX. TEMP.	
PACKER SET		CASING PERF.			
FLUID LEVEL	NONE				

DEPTH	PRESSURE	GRADIENT
LUBE	687	
		.02
	708	
1000		.02
	727	
2000		.02
	741	
3000		.02
	762	
4000		.02
	772	
4500		.02
	779	
4900		.04
	781	
4949		

no. 4

NEW MEXICO OIL CONSERVATION COMMISSION
1000 RIO BRAZOS ROAD
Aztec, New Mexico
August 17, 1964

Pubco Petroleum Corporation
P.O. Box "P"
Aztec, New Mexico

Gentlemen:

Effective August 1, 1964 the calculated deliverability for your State #6 well, located L-36-31N-9W, Blanco Mesaverde Pool is being corrected pursuant to Chapter II, Section II, Paragraph 9 of Order R-333-F of the New Mexico Oil Conservation Commission.

It is the Commission's position that the shut-in pressure previously measured and used for the 1963 annual deliverability test was abnormally low and does not accurately reflect the average reservoir pressure. We have therefore corrected the shut-in pressure used in the deliverability calculation by averaging its pressure with the deadweight pressures measured on the offset wells listed below.

WELL	LOCATION	PRESSURE
Delhi-Taylor Prichard #2	H-1-30N-9W	873
Pubco Petroleum State #5	H-36-31N-9W	789
EPNG Turner State #2	A-2-30N-9W	~~[illegible]~~ 724
Pubco State #6	L-36-31N-9W	708
Union Texas Johnston #9	H-35-31N-9W	782

Gas supplement number NW ~~8493~~ 7492 is being issued this date correcting your gas allowable effective August 1, 1964. The corrected deliverability for your well as recalculated is 8913 MCFPD. Revised Form C-122-A is attached.

If you have any question regarding the above action or find errors in the deliverability recalculation please contact this office.

Yours very truly,

Emery C. Arnold

Emery C. Arnold
Supervisor, District #3

PUBCO PETROLEUM CO.
RECEIVED
AUG 1 1964
AZTEC, NEW MEXICO

cc: OCC, Santa Fe
Transporter, EPNG, Farmington

Form C-122-A
Revised April 20, 1955

NEW MEXICO OIL CONSERVATION COMMISSION

GAS WELL TEST DATA SHEET - - SAN JUAN BASIN

(TO BE USED FOR FRUITLAND, PICTURED CLIFFS, MESAVERDE, & ALL DAKOTA
EXCEPT BARKER DOME STORAGE AREA)

Pool **Blanco** Formation **Mesaverde** County **San Juan**

Purchasing Pipeline **El Paso Natural Gas Company** Date Test Filed **5-1-63**

Operator **PUBCO PETROLEUM CORP.** Lease **State** Well No. 6

Unit **L** Sec. 30 Twp. **31N** Rge. **9W** Pay Zone: From 4493 To 5191

Casing: OD 5 WT. 15 Set At 5200 Tubing: OD 2 WT. 4.7 T. Perf. 4949

Produced Through: Casing X Tubing Gas Gravity: Measured .663 Estimated

Date of Flow Test: From 3-30-63 To 4-7-63 * Date S.I.P. Measured 4-14-63

Meter Run Size 4 Orifice Size 3.000 Type Chart **Sq. Rt.** Type Taps **Flange**

OBSERVED DATA

Flowing casing pressure (Dwt)	575	psig + 12 =	587	psia	(a)
Flowing tubing pressure (Dwt)	662	psig + 12 =	674	psia	(b)
Flowing meter pressure (Dwt)	550	psig + 12 =	562	psia	(c)
Flowing meter pressure (meter reading when Dwt. measurement taken:					
Normal chart reading		psig + 12 =		psia	(d)
Square root chart reading (7.5) ^{2} x spring constant	10	=	568	psia	(d)
Meter error (c) - (d) or (d) - (c)	±	=	-1	psi	(e)
Friction loss, Flowing column to meter:					
(b) - (c) Flow through tubing: (a) - (c) Flow through casing		=	25	psi	(f)
Seven day average static meter pressure (from meter chart):					
Normal chart average reading		psig + 12 =		psia	(g)
Square root chart average reading (7.65) ^{2} x sp. const.	10	=	585	psia	(g)
Corrected seven day avge. meter press. (p_f) (g) + (e)		=	584	psia	(h)
P_t = (h) + (f)		=	609	psia	(i)
Wellhead casing shut-in pressure (Dwt)	696	psig + 12 =	708	psia	(j)
Wellhead tubing shut-in pressure (Dwt)	696	psig + 12 =	708	psia	(k)
P_c = (j) or (k) whichever well flowed through		=	708	psia	(l)
Flowing Temp. (Meter Run)	77 °F + 460	=	537	°Abs	(m)
P_d = ½ P_c = ½ (l)		=	566	psia	(n)

FLOW RATE CALCULATION

Q = 6974 (integrated) X ($\sqrt{(c)}$ 562 = 23.70654 / $\sqrt{(d)}$ 563 23.72762 = .99911) = 6968 MCF/da

DELIVERABILITY CALCULATION

D = Q 6968 $\left[\frac{P_c^2 - P_d^2 = 180,908}{P_c^2 - P_w^2 = 50,344}\right]^n$ $(3.2107)^{.75}$ = 2.399 = 16,716 MCF/da.

216,225 / 155,705 1.2791 = 8913

"D" at 512 = 9407

SUMMARY

P_c =	708	775	psia
Q =	6968	6968	Mcf/day
P_w =	587	667	psia
P_d =	566	620	psia
D =	16,716	8913	Mcf/day

Company PUBCO PETROLEUM CORP
By H. E. Maxwell, Jr.
Title Mgr. Aztec District
Witnessed by Glen O. Rhodes
Company PUBCO PETROLEUM CORP.

RECEIVED MAY 2 1963 OIL CON. COM. DIST. 3

* This is date of completion test.
* Meter error correction factor

REMARKS OR FRICTION CALCULATIONS

R	$(1-e^{-s})$	$(F_cQ)^2$	$\frac{(F_cQ)^2 (1-e^{-s})}{R^2}$	P_t^2 (Column i)	$P_t^2 + R^2$	P_w
3201	.21	349.041	74.039	370.881	444,920	667

No. 1

TEMPERATURE ★ B&R SERVICE INC ★ SURVEYS ★ ★

BOX 1645 FARMINGTON NEW MEXICO

Pressure Survey

PUBCO DEVELOPMENT CORP. PUBCO STATE 6

4-2-63

NEW MEXICO

SAN JUAN

FLOWING

575 DWT

662 DWT

TBG. GATE

NONE

DEPTH	PSIG	GRADIENT
	659	
0	680	.02
1000	699	.02
2000	717	.02
3000	742	.02
4000	747	.01
4500	749	.01
4700	751	.02
4800	753	.02
4900	755	.02
4949		.04

proves no liquids in hole

No. 2

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

State of New Mexico

Oil Conservation Commission

LAND COMMISSIONER
E. S. JOHNNY WALKER
MEMBER

STATE GEOLOGIST
A. L. PORTER, JR.
SECRETARY - DIRECTOR

1000 RIO BRAZOS ROAD
AZTEC, NEW MEXICO

March 1[illegible], 1964

Pubco Petroleum Corporation
P.O. Box 1419
Albuquerque, New Mexico

Gentlemen:

The annual deliverability testing schedule on file in this office indicates that your Pubco State # [illegible] well is now on deliverability test and will have the shut-in pressure measured on Monday, March 23, 1964. We are conducting a pressure study in this area and are requesting that bottom hole pressures be measured on this well at the time the surface pressure is determined.

Please have your local representative contact us by telephone when these pressures will be measured Monday in order that we may have a witness present.

Yours very truly,

[illegible signature]

Emery C. Arnold
Supervisor, District [illegible]

ECA:ks

cc: Pubco Petroleum Corp.
Box [illegible]
Aztec, New Mexico

No. 33

Phone DAvis 5-2393

TEMPERATURE ★ B&R.SERVICE, INC. ★ SURVEYS ★ ★

BOX 1048 - FARMINGTON, NEW MEXICO

Pressure Survey

COMPANY PUBCO PETROLEUM CORP.
FIELD
COUNTY SAN JUAN
SHUT-IN 7 DAYS
ZERO POINT TBG. GATE
TBG. DEPTH
PACKER SET
FLUID LEVEL NONE

LEASE PUBCO STATE
LOCATION
STATE 8 NEW MEXICO
ELEVATION
TBG. PRESSURE 685' DWT
CASING SET
CASING PERF.

WELL 36
DATE 3-23-64
DATUM
CASING PRESSURE 685 DWT
P. B. T. D.
MAX. TEMP.

DEPTH	PRESSURE	GRADIENT
LUBE	687	
1000	708	.02
2000	727	.02
3000	744	.02
4000	762	.02
4500	772	.02
4900	779	.02
4949	781	.04

no. 4

NEW MEXICO OIL CONSERVATION COMMISSION
1000 RIO BRAZOS ROAD
Aztec, New Mexico
August 17, 1964

Pubco Petroleum Corporation
P.O. Box "P"
Aztec, New Mexico

Gentlemen:

Effective August 1, 1964 the calculated deliverability for your State #6 well, located L-36-31N-9W, Blanco Mesaverde Pool is being corrected pursuant to Chapter II, Section II, Paragraph 9 of Order R-333-F of the New Mexico Oil Conservation Commission.

It is the Commission's position that the shut-in pressure previously measured and used for the 1963 annual deliverability test was abnormally low and does not accurately reflect the average reservoir pressure. We have therefore corrected the shut-in pressure used in the deliverability calculation by averaging its pressure with the deadweight pressures measured on the offset wells listed below.

WELL	LOCATION	PRESSURE
Delhi-Taylor Prichard #2	H-1-30N-9W	873
Pubco Petroleum State #5	H-36-31N-9W	789
EPNG Turner State #2	A-2-30N-9W	~~[illegible]~~ 724
Pubco State #6	L-36-31N-9W	708
Union Texas Johnston #9	H-35-31N-9W	782

Gas supplement number NW ~~8193~~ 7492 is being issued this date correcting your gas allowable effective August 1, 1964. The corrected deliverability for your well as recalculated is 8913 MCFPD. Revised Form C-122-A is attached.

If you have any question regarding the above action or find errors in the deliverability recalculation please contact this office.

Yours very truly,

Emery C. Arnold

Emery C. Arnold
Supervisor, District #3

PUBCO PETROLEUM CO.
RECEIVED
AUG 1 1964
AZTEC, NEW MEXICO

cc: OCC, Santa Fe
Transporter, EPNG, Farmington

no. 8A

Form C-122-A
Revised April 20, 1955

NEW MEXICO OIL CONSERVATION COMMISSION

GAS WELL TEST DATA SHEET - - SAN JUAN BASIN

(TO BE USED FOR FRUITLAND, PICTURED CLIFFS, MESAVERDE, & ALL DAKOTA EXCEPT BARKER DOME STORAGE AREA)

Pool **Blanco** Formation **Mesaverde** County **San Juan**

Purchasing Pipeline **El Paso Natural Gas Company** Date Test Filed **5-1-63**

Operator **PUBCO PETROLEUM CORP.** Lease **State** Well No. **6**

Unit **L** Sec. **36** Twp. **31N** Rge. **9W** Pay Zone: From **4493** To **5191**

Casing: OD **5** WT. **15** Set At **5200** Tubing: OD **2** WT. **4.7** T. Perf. **4949**

Produced Through: Casing **X** Tubing ____ Gas Gravity: Measured **.663** Estimated ____

Date of Flow Test: From **3-30-63** To **4-7-63** * Date S.I.P. Measured **4-14-63**

Meter Run Size **4** Orifice Size **3.000** Type Chart **Sq. Rt.** Type Taps **Flange**

OBSERVED DATA

Flowing casing pressure (Dwt)	575	psig + 12 =	587	psia	(a)
Flowing tubing pressure (Dwt)	662	psig + 12 =	674	psia	(b)
Flowing meter pressure (Dwt)	550	psig + 12 =	562	psia	(c)
Flowing meter pressure (meter reading when Dwt. measurement taken:					
Normal chart reading		psig + 12 =		psia	(d)
Square root chart reading (7.5)^2 x spring constant	10	=	568	psia	(d)
Meter error (c) - (d) or (d) - (c)	±	=	-1	psi	(e)
Friction loss, Flowing column to meter: (b) - (c) Flow through tubing: (a) - (c) Flow through casing		=	25	psi	(f)
Seven day average static meter pressure (from meter chart):					
Normal chart average reading		psig + 12 =		psia	(g)
Square root chart average reading (7.65)^2 x sp. const.	10	=	585	psia	(g)
Corrected seven day avge. meter press. (p_f) (g) + (e)		=	584	psia	(h)
P_t = (h) + (f)		=	609	psia	(i)
Wellhead casing shut-in pressure (Dwt)	696	psig + 12 =	708	psia	(j)
Wellhead tubing shut-in pressure (Dwt)	696	psig + 12 =	708	psia	(k)
P_c = (j) or (k) whichever well flowed through		=	708	psia	(l)
Flowing Temp. (Meter Run)	77 °F + 460	=	537	°Abs	(m)
P_d = ½ P_c = ½ (l)		=	566	psia	(n)

FLOW RATE CALCULATION

Q = 6974 (integrated) X ($\sqrt{(c)}$ 562 = 23.70654 / $\sqrt{(d)}$ 563 23.72762 = .99911) = 6968 MCF/da

DELIVERABILITY CALCULATION

D = Q 6968 $\left[\dfrac{(P_c^2 - P_d^2) = 180,908}{(P_c^2 - P_w^2) = 56,344}\right]^n$ $(3.2107)^{.75}$ = 2.399 = 16,716 MCF/da.

216,225 / 155,705 1.2791 = 8913

"D" at 512 - 9407

SUMMARY

P_c	708	775	psia
Q	6968	6968	Mcf/day
P_w	587	667	psia
P_d	566	620	psia
D	16,716	8913	Mcf day

* This is date of [illegible]

Company **PUBCO PETROLEUM CORP.**
By **H. E. Maxwell, Jr.**
Title **Mgr. Aztec District**
Witnessed by **Glen O. Rhodes**
Company **PUBCO PETROLEUM CORP.**

RECEIVED

No. 4A

Form C-122-A
Revised April 20, 1955

NEW MEXICO OIL CONSERVATION COMMISSION
GAS WELL TEST DATA SHEET - - SAN JUAN BASIN

(TO BE USED FOR FRUITLAND, PICTURED CLIFFS, MESAVERDE, & ALL DAKOTA
EXCEPT BARKER DOME STORAGE AREA)

Pool Blanco Formation Mesaverde County San Juan

Purchasing Pipeline El Paso Natural Gas Company Date Test Filed 5-1-63

Operator PUBCO PETROLEUM CORP. Lease State Well No. 6

Unit L Sec. 36 Twp. 31N Rge. 9W Pay Zone: From 4493 To 5191

Casing: OD 5 WT. 15 Set At 5200 Tubing: OD 2 WT. 4.7 T. Perf. 4949

Produced Through: Casing X Tubing Gas Gravity: Measured .663 Estimated

Date of Flow Test: From 3-30-63 To 4-7-63 * Date S.I.P. Measured 4-14-63

Meter Run Size 4 Orifice Size 3.000 Type Chart Sq. Rt. Type Taps Flange

OBSERVED DATA

Flowing casing pressure (Dwt)	575 psig + 12 =	587	psia	(a)
Flowing tubing pressure (Dwt)	662 psig + 12 =	674	psia	(b)
Flowing meter pressure (Dwt)	550 psig + 12 =	562	psia	(c)
Flowing meter pressure (meter reading when Dwt. measurement taken:				
Normal chart reading	psig + 12 =		psia	(d)
Square root chart reading (7.5)^2 x spring constant 10	=	563	psia	(d)
Meter error (c) - (d) or (d) - (c) ±	=	-1	psi	(e)
Friction loss, Flowing column to meter:				
(b) - (c) Flow through tubing: (a) - (c) Flow through casing	=	25	psi	(f)
Seven day average static meter pressure (from meter chart):				
Normal chart average reading	psig + 12 =		psia	(g)
Square root chart average reading (7.65)^2 x sp. const. 10	=	585	psia	(g)
Corrected seven day avge. meter press. (p_f) (g) + (e)	=	584	psia	(h)
P_t = (h) + (f)	=	609	psia	(i)
Wellhead casing shut-in pressure (Dwt)	696 psig + 12 =	708	psia	(j)
Wellhead tubing shut-in pressure (Dwt)	696 psig + 12 =	708	psia	(k)
P_c = (j) or (k) whichever well flowed through	=	708	psia	(l)
Flowing Temp. (Meter Run)	77 °F + 460 =	537	°Abs	(m)
P_d = ½ P_c = ½ (l)	=	566	psia	(n)

FLOW RATE CALCULATION

Q = 6974 (integrated) X ($\sqrt{(c)}$ 562 = 23.70654 / $\sqrt{(d)}$ 563 = 23.72762 = .99911) = 6968 MCF/da

DELIVERABILITY CALCULATION

D = Q 6968 $\left[\frac{P_c^2 - P_d^2 = 180,903}{P_c^2 - P_w^2 = 56,344}\right]^n$ $(3.2107)^{.75}$ = 2.399 = 16,716 MCF/da.

216,225
155,705 1.2791 = 8913

"D" at 512 - 9407

SUMMARY

P_c	708	775	psia
Q	6968	6968	Mcf/day
P_w	587	667	psia
P_d	566	620	psia
D	16,716	8913	Mcf/day

Company PUBCO PETROLEUM CORP.
By H. E. Maxwell, Jr.
Title Mgr. Aztec District
Witnessed by Glen O. Rhodes
Company PUBCO PETROLEUM CORP.

RECEIVED MAY 2 1963 OIL CON. COM. DIST. 3

* This is date of completion test.
• Meter error correction factor

REMARKS OR FRICTION CALCULATIONS

GL	(1-e^{-s})	(F$_c$Q)^2	(F$_c$Q)^2 (1-e^{-s}) / R^2	Pt^2 (Column i)	P$_t^2$ + R^2	P$_w$
3-41	.21	349.842	74.039	370.881	444,920	667

6

Phone DAvis 5-2395

TEMPERATURE ★ **B&R SERVICE, INC.** ★ SURVEYS ★ ★

BOX 1048 - FARMINGTON, NEW MEXICO

Pressure Survey

COMPANY PUBCO PETROLEUM CORP.

LEASE STATE

WELL #6

FIELD

LOCATION

COUNTY SAN JUAN

STATE NEW MEXICO

DATE 9-4-64 TO 9-11-64

SHUT-IN

ELEVATION

DATUM -700

ZERO POINT MASTER VALVE

TBG PRESSURE

CASING PRESSURE

TBG DEPTH

CASING SET

P.B.T.D

PACKER SET

CASING PERF

MAX TEMP 168°F

FLUID LEVEL

RUN 7 DAY BUILD-UP PRESSURE @ 4949'

DEPTH		PRESSURE	GRADIENT	Calculated Surface Pressure*
4949'	(0 HR. 11:30 A.M. 9-4-64)	708 PSIG		646
	1 HOUR	710		647
	2 HOUR	711		648
	3 HOUR	712		649
	4 HOUR	713		650
	8 HOUR	714		651
	10 HOUR	715		652
	15 HOUR	717		654
	20 HOUR	718		655
	35 HOUR	719		656
	45 HOUR	720		657
	55 HOUR	722		658
	95 HOUR	722		658
	96 HOUR	722		658
	167 HOUR	722		658

WELL SHUT IN 30 MINUTES BEFORE)0) HOUR.

*Surface pressure calculated using U.S.B.M. formula as presented in Monograph 7. Surface pressure measured with DWT [illegible] 659 psia [illegible].

No. 7

DELIVERABILITY FORMULA

$$D = Q\left[\frac{(P_c^2 - P_d^2)}{(P_c^2 - P_w^2)}\right]^n$$

Where:

D = Deliverability Mcfd at the deliverability pressure, (P_d), (at Standard Conditions of 15.025 psia and 60°F).

Q = Daily flow rate in Mcfd, at wellhead pressure (P_w).

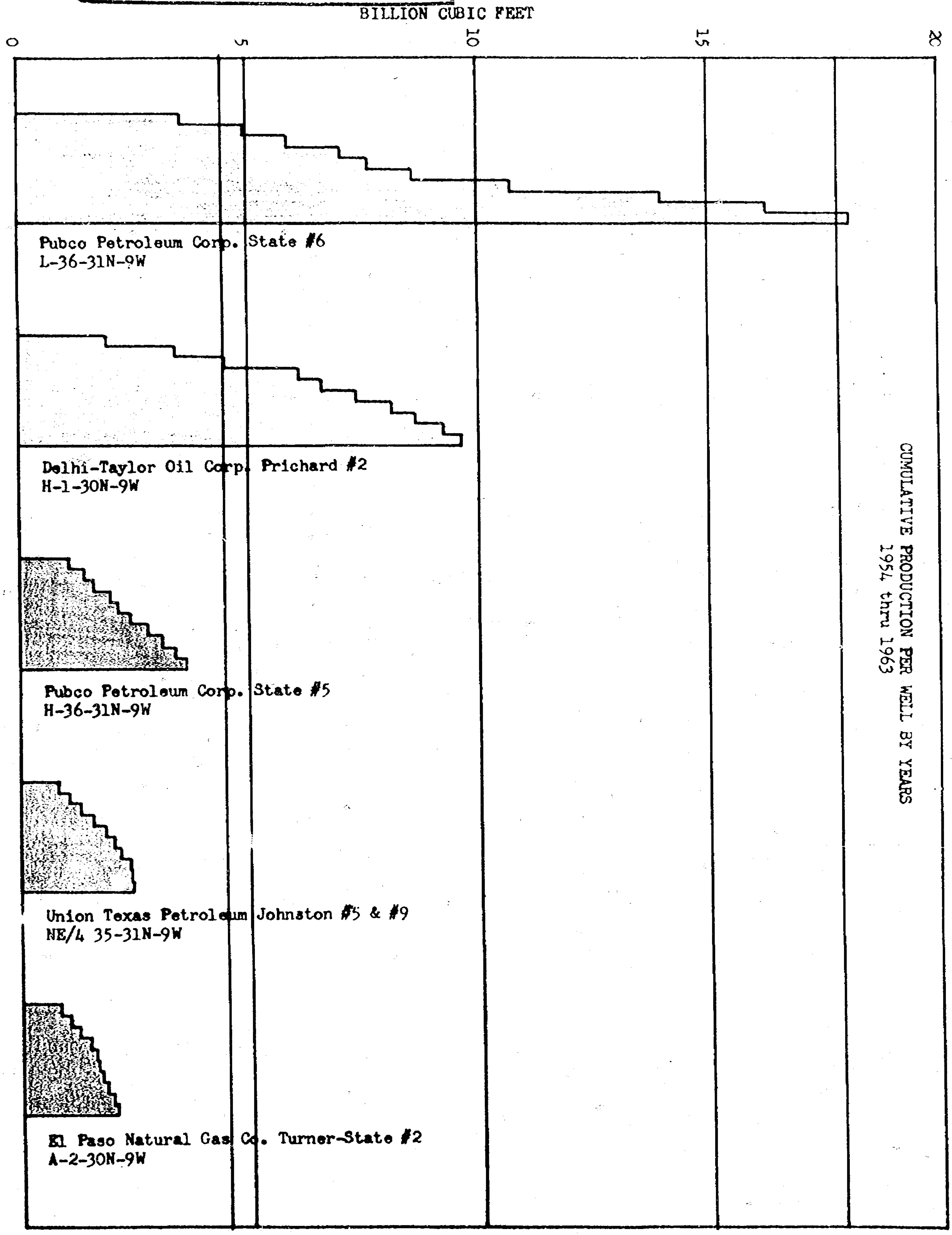
P_c = 7-day shut-in wellhead pressure, psia, determined in accordance with Section 2 of Chapter II.

P_d = Deliverability pressure, psia, as defined above.

P_w = Average static wellhead working pressure, as determined from 7-day flow period, psia, and calculated from New Mexico Oil Conservation Commission "Pressure Loss Due to Friction" Tables for San Juan Basin.

n = Average pool slope of back pressure curve.

BEFORE THE
OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
Exhibit No. 2
Case No. 3105



AUTHORITIES

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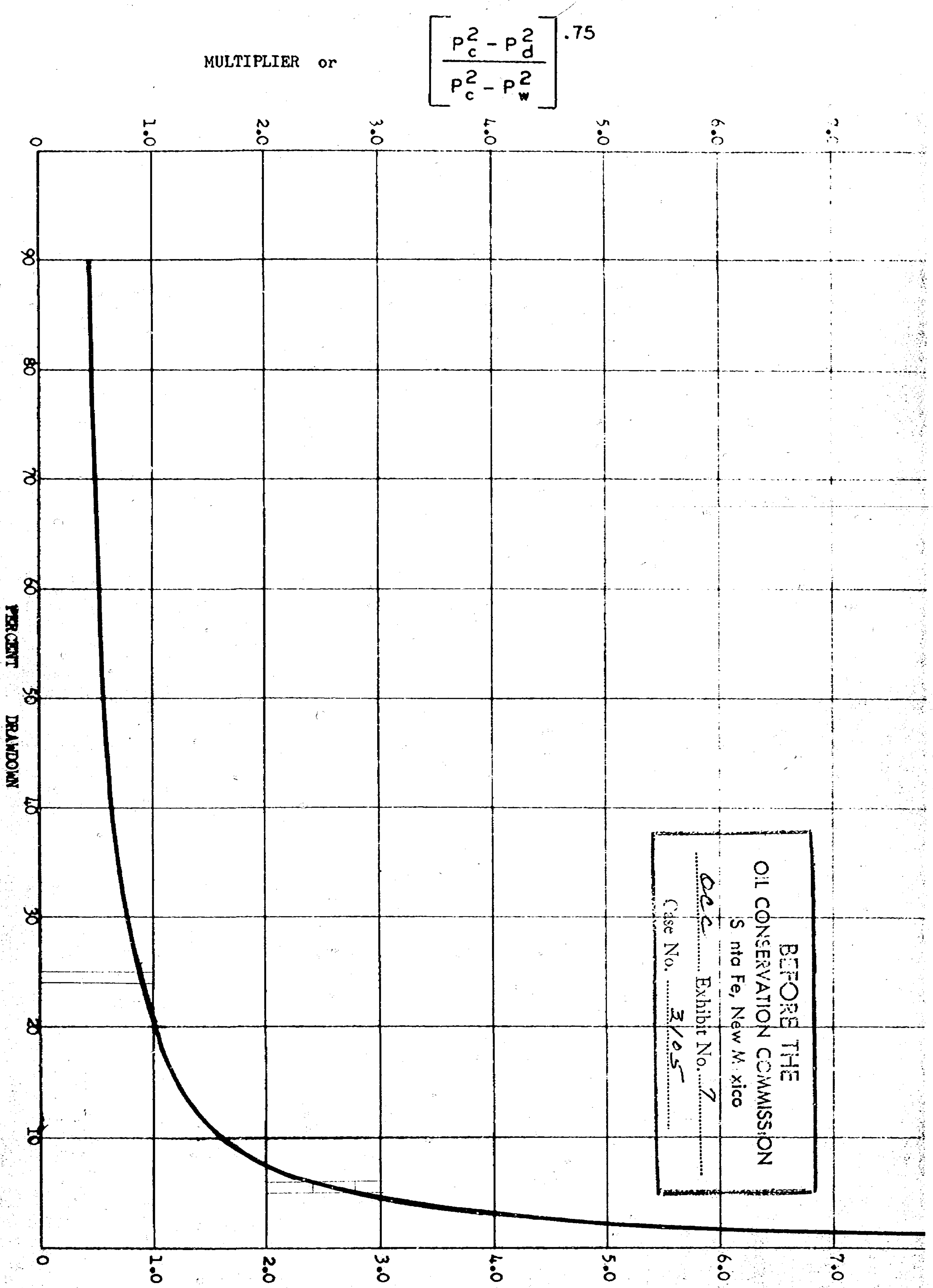
2.	Craft and Hawkins, APPLIED PETROLEUM RESERVOIR ENGINEERING	31
3.	John M. Campbell, OIL PROPERTY EVALUATION	146
4.	Katz, et al., HANDBOOK OF NATURAL GAS ENGINEERING	422, 436, 462
5.	Rawlins and Schellhardt, BACK-PRESSURE DATA ON NATURAL GAS WELLS AND THEIR APPLICATION TO PRODUCTION PRACTICES, MONOGRAPH 7 OF THE U. S. BUREAU OF MINES	12



MULTIPLIER or $\left[\frac{P_c^2 - P_d^2}{P_c^2 - P_w^2}\right]^{.75}$
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
PERCENT DRAWDOWN
90
80
70
60
50
40
30
20
10

No. 7

DELIVERABILITY FORMULA

$$D = Q \left[\frac{(P_c^2 - P_d^2)}{(P_c^2 - P_w^2)} \right]^n$$

Where:

D = Deliverability Mcfd at the deliverability pressure, (P_d), (at Standard Conditions of 15.025 psia and 60°F).

Q = Daily flow rate in Mcfd, at wellhead pressure (P_w).

P_c = 7-day shut-in wellhead pressure, psia, determined in accordance with Section 2 of Chapter II.

P_d = Deliverability pressure, psia, as defined above.

P_w = Average static wellhead working pressure, as determined from 7-day flow period, psia, and calculated from New Mexico Oil Conservation Commission "Pressure Loss Due to Friction" Tables for San Juan Basin.

n = Average pool slope of back pressure curves.