CASE 3283: Hearing called by OCC to consider adoption of "MANUAL of BACK-PRESSURE TESTING OF GAS WELLS

CASE NO.
3283

Application,
Transcripts,
Small Exhibits
ETC.

Northern Natural Gas Company
Post Office Box 160
Hobbs, New Mexico
July 23, 1965

Mr. Elvis A. Utz
Gas Engineer
New Mexico Oil Conservation Commission
Post Office Box 2088
Santa Fe, New Mexico

Re: Corrections To Proposed Gas Well
Back-Pressure Test Manual

Dear Mr. Utz:

Attached are several pages from the final copy of the proposed Back-Pressure Test Manual. Corrections to be made are noted on each page in red and the following comments are offered regarding these corrections:

Page III-2 - Line 3. easing should read casing.

Page VI-5 - Step 19. AOF = absolute open flow.

Page VI-5 - Third line from last. back-pressure should be hyphenated

Page VI-7 - The results of the various steps in the calculation of absolute open flow shown on the Form C-122 were left blank for this example but were filled in for the other examples. For the sake of consistency, it is believed that these blanks should be filled in. The value for each step has been filled in.

Page VI-15 - Step 14-A d. 2016.2-207 = 1809.2.

Page VI-30 - Line 3. Page III-14.

Page VI-44 - Step 2. b. $R = 74 + 460 = 534$ R.

Very truly yours,

C. W. Rach

C. W. Rach
Production Evaluation Engineer

CWR:pk

cc: Mr. D. H. Rainey
Mr. G. L. Tribble
file

top of the producing section, the casing diameter and the length from this point to the bottom of the tubing should be considered in making friction calculations. For uncased hole below the base of the tubing or casing shoe, friction calculations may be ignored.

II. MULTIPOINT BACK-PRESSURE TEST PROCEDURES

A multipoint back-pressure test shall be taken for the purpose of determining the absolute open flow and exponent "n" from the plot of the wellhead equation:

$$Q = C (P_c^2 - P_w^2)^n$$

A. STABILIZED MULTIPOINT TEST

1. Shut-in Pressure

a. Wells with a pipeline connection shall be produced for a sufficient length of time at a flow rate large enough to clear the well bore of accumulated liquids prior to the shut-in period. If the well bore cannot be cleared of accumulated liquids while producing into a pipeline, the well shall be blown to the atmosphere to remove these liquids.

b. Wells without pipeline connections shall be blown to the atmosphere to remove accumulated liquids.

c. The well shall be shut in until the rate of pressure buildup is less than 1/10 of 1 per cent of the previously recorded pressure, psig, in 30 minutes. This pressure shall be recorded.

2. Flow Tests

a. After recording the shut-in pressure, a series of at least four stabilized flow rates and the pressures corresponding to each flow rate shall be taken (see paragraph g. below). Any shut-in time between flow rates shall be held to a minimum. These rates shall be run in the increasing flow-rate sequence. In the case of high liquid ratio wells or unusual temperature conditions, a decreasing flow-rate sequence may be used if the increasing sequence method did not result in point alignment. If the decreasing sequence method is used, a statement giving the reasons why the use of such method was necessary, together with a copy of the data taken by the increasing sequence method, shall be furnished to the New Mexico Oil Conservation Commission. If experience has shown that the use of the decreasing sequence method is necessary for an accurate test, a test by the increasing sequence method will not be required.

STEP 18. (Cont'd.)

The numerical value of the exponent, n, is the cotangent of the angle formed by the back pressure curve and the horizontal axis of the log-log plot.

The most accurate method to determine "n" is to find the difference of the logrithms of two values of Q which are exactly one vertical cycle apart. Exponent "n" is found as follows:

Q_1 (where $P_c^2 - P_w^2$ is 2250) = 9400 Mcfd

Q_2 (where $P_c^2 - P_w^2$ is 225) = 1590 Mcfd

Log 9400 (Q_1) = 3.97313

Log 1590 (Q_2) = 3.20140

n = 0.77173

n = 0.772

STEP 19.

The value of absolute open flow should be checked by substituting test data into the following formula. If a test data point does not fall on the curve as drawn, then any convenient value of Q and ($P_c^2 - P_w^2$) from the curve should be used.

$$AOF = Q \left[\frac{P_c^2}{P_c^2 - P_w^2} \right]^n$$

where: open flow

AOF = absolute potential.
Q = rate of flow from test data point or from back-pressure curve.
P_c = wellhead shut in pressure.
P_w = static column wellhead pressure.
n = exponent of back-pressure curve.

NOTE: Where Q is taken from the back-pressure curve, ($P_c^2 - P_w^2$) is read directly from the curve.

Substituting values in the equation (2nd flow rate)

$$AOF = 2590 \text{ Mcfd} \left[\frac{3523.9}{3523.9 - 3098.1} \right]^{.772}$$

$AOF = 2590 (8.276)^{.772}$
AOF = 2590 (5.112)
AOF = 13, 240 Mcfd

AOF from back-pressure curve is 13, 250 Mcfd which is in good agreement. Although the figure 13, 250 Mcfd as read from the curve cannot be used, it is a good method for checking the calculations.

NEW MEXICO OIL CONSERVATION COMMSSION

MULTIPOINT AND ONE POINT BACK PRESSURE TEST FOR GAS WELL

Form C-122
Revised 9-1-65

'65 JUL 26 AM 7 :

MAIN OFFICE OCC

Type Test: ☐ Initial ☒ Annual ☐ Special				Test Date: 11-10-64	
Company: Test Example No. 1		Connection: Blowe Gas Co.			
Pool: Monument		Formation: McKee		Unit: Letter D	
Completion Date: 2-4-58	Total Depth: 8293	Plug Back TD:	Elevation:	Farm or Lease Name: H. I. Test	
Csg. Size: 7" / Wt.: 23 / d: 6.366 / Set At: 8293		Perforations: From 8112 To 8148		Well No.: 1	
Tbg. Size: 2-3/8" / Wt.: 4.7 / d: 1.995 / Set At: 8130		Perforations: From Open To Ended		Unit: D / Sec.: 30 / Twp.: 19-S / Rge.: 36-E	
Type Well – Single – Bradenhead – G.G. or G.O. Multiple: Single		Packer Set At: 8100		County: Lea	
Producing Thru: Tbg.	Reservoir Temp. °F: 155 @ 8130'	Mean Annual Temp. °F: 60	Baro. Press. – P_a: 13.2	State: New Mexico	

L	H	Gg	% CO_2	% N_2	% H_2S	Prover	Meter Run	Taps
8130	8130	0.625	2.0	3.0	0.0		4"	Pipe

	FLOW DATA				TUBING DATA		CASING DATA		
NO.	Prover Line Size X Orifice Size	Press. p.s.i.g.	Diff. h_w	Temp. °F	Press. p.s.i.g.	Temp. °F	Press. p.s.i.g.	Temp. °F	Duration of Flow
SI					1864.0		Pkr		72
1.	4x1.75	721.0	8.3	66	1772.0	74			2
2.	4x1.75	729.0	17.5	56	1698.0	74			2
3.	4x1.75	744.0	29.3	54	1608.0	74			2
4.	4x1.75	759.0	41.5	55	1512.0	74			2
5.									

RATE OF FLOW CALCULATIONS

NO.	Coefficient (24 Hour)	$\sqrt{h_w P_m}$	Pressure P_m	Flow Temp. Factor Ft.	Gravity Factor Fg	Super Compress. Factor, Fpv	Rate of Flow Q, Mcfd
1	16.80	78.06	734.2	.9943	1.265	1.059	1747
2	16.80	114.0	742.2	1.004	1.265	1.065	2590
3	16.80	149.0	757.2	1.006	1.265	1.066	3396
4	16.80	179.0	772.2	1.005	1.265	1.068	4083
5							

NO.	P_t	Temp. °R	T_r	Z
1	1.09	526	1.49	0.891
2	1.10	516	1.46	0.882
3	1.12	514	1.46	0.880
4	1.15	515	1.46	0.877
5				

Gas Liquid Hydrocarbon Ratio 193 Mcf/bbl.
A.P.I. Gravity of Liquid Hydrocarbons 50.2 Deg.
Specific Gravity Separator Gas 0.625 XXXXXXXXX
Specific Gravity Flowing Fluid XXXXX 0.641
Critical Pressure 674 P.S.I.A. 673 P.S.I.A.
Critical Temperature 353 R 360 R

P_c 1877.2 P_c^2 3523.9

NO	P_t^2	P_w	P_w^2	$P_c^2 - P_w^2$
1	3186.9		3264.1	259.8
2	2928.2		3098.1	425.8
3	2628.3		2922.5	601.4
4	2326.2		2753.4	770.5
5				

(1) $\frac{P_c^2}{P_c^2 - P_w^2} = 8.276$ (2) $\left[\frac{P_c^2}{P_c^2 - P_w^2}\right]^n = 5.112$

AOF = Q $\left[\frac{P_c^2}{P_c^2 - P_w^2}\right]^n = 13,240$

Absolute Open Flow 13,240 Mcfd @ 15.025 Angle of Slope θ _____ Slope, n .772

Remarks: _____

Approved By Commission:	Conducted By:	Calculated By:	Checked By:

STEP 13-A. (Cont'd.)

r. Multiply final values of M x N
206 x 473.628 = 97,567 (Line 17)

s. Subtract M x N (Line 17) from $\sum$ (M x N) (Line 18, Column 1)
195,425 - 97,567 = 97,858 (Line 18)

STEP 14-A.

Make first trial calculation for the pressure at H = 0 (Line 1, Column 4)

a. GH = 0

b. 37.5 GH = 0

c. Estimate M by dividing N (Line 16, Column 3) into $\sum$ (M x N) (Line 18, Column 3)
M = 97,858/473.628 = 207 (Line 15, Column 4)

d. Subtract M from P_1 (H = 4065)
2016.2 - 207 = 1809.2 (Line 4)

e. P_r = 1809.2/673 = 2.69 (Line 5)

f. T = 74 + 460 = 534 (Line 6)

g. T_r = 534/360 = 1.48 (Line 7)

h. Z = 0.775 (Line 8)

i. P/Z = 2334.5 (Line 9)

j. P/TZ = 4.3717 (Line 10)

k. I_c = 1000/4.3717 = 228.744 (Line 14)

l. N = 235.078 + 228.744 = 463.822 (Line 16)

m. Compute M by dividing $\sum$ (M x N) (Line 18, Column 3) by N (Line 16, Column 4)
M = 97,858/463.822 = 211
When M has been estimated correctly, the value determined under this item will be equal to that determined under item (c).

n. Enter M = 211 on Line 15, Column 5 and repeat the calculations (d) through (m).
M = 210

o. Multiply final values of M and N
210 x 465.053 = 97,661 (Line 17)

TEST EXAMPLE NO. 4

CALCULATION OF DELIVERABILITY (D) USING THE ONE-POINT BACK-PRESSURE TEST
(Refer to Testing Procedure, page III14)
III-14

The calculations for Deliverability are the same as for the absolute open flow except that a deliverability pressure, P_d, is used instead of atmospheric pressure. The deliverability pressure is defined by the New Mexico Oil Conservation Commission as a percent of the shut-in wellhead pressure. The exact percent is determined at the time deliverability is adopted in a field's special pool rules and is not a calculated value. For this example, P_d is used as 80% of P_c.

NOTE: A copy of the latest back-pressure curve must be submitted with Form C-122-C. The data in this example is the same as in Example 3 and Steps 1 and 2 are also the same.

STEP 3.

Calculate the deliverability using the following equation:

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

where:

- D = deliverability of the well at back-pressure P_d
- Q = rate of flow from test data point (1350 Mcfd)
- P_c = wellhead shut-in pressure (999.2 psia)
- P_d = deliverability pressure (80% of P_c)
- P_w = static column wellhead pressure (casing if flowing through tubing, tubing if flowing through casing)
- n = exponent of back-pressure curve (0.931 as determined from the latest back-pressure test)

ALL SQUARED PRESSURE IN THOUSANDS

$$D = 1350 \left[\frac{(999.2)^2 - (.80 \times 999.2)^2}{(999.2)^2 - (855.2)^2} \right]^{0.931}$$

$$D = 1350\,(1.346)^{.931}$$

$$D = 1350\,(1.319)$$

$$D = 1781 \text{ Mcfd}$$

STEP 2.

a. Enter "0" rate of flow on Line 1. (Line references are indicated in parenthesis following each step.)

b. T_w = Wellhead temperature, R = 460 = 534 R (Line 2).
T_s = Bottom-hole temperature, R = 155 + 460 = 615 R (Line 3).
The bottom-hole temperature should be measured or estimated from reliable data on other wells in the area.

c. $T = (T_w + T_s)/2 = (534 + 615)/2 = 575$ R (Line 4).

STEP 3. (First Trial)
Estimate effective compressibility factor. In this example Z was estimated to be 0.860 (Line 5).

STEP 4.

a. $TZ = 575 \times 0.860 = 495$ (Line 6).

b. $GH/TZ = 5211/(495) = 10.527$ (Line 7).

c. For $GH/TZ = 10.527$ read e^s in Table XIV. $e^s = 1.484$ (Line 8).

STEP 5.

a. Enter wellhead shut-in pressure (P_c) = 1878 (Line 10).

b. $P_c^2 = (1878)^2/1000 = 3526.9$ (Line 11).

c. $e^s P_c^2 = (1.484)\ (3526.9) = 5233.9$ (Line 18).

STEP 6.
Lines 12 through 17 are not used in the static column calculation.

STEP 7.

a. $P_f = \sqrt{e^s P_c^2} = \sqrt{5233.9\ (1000)} = 2288$ (Line 19).

b. $P = (P_c + P_f)/2 = (1878 + 2288)/2 = 2083$ (Line 20).

c. $P_r = P/P_{cr} = 2083/673 = 3.10$ (Line 21).

d. $T_r = T/T_{cr} = 575/360 = 1.60$ (Line 22).

STEP 8.
Enter in Line 23 the compressibility factor from Table XI corresponding to a P_r of 3.10 and a T_r of 1.60. In this example, Z = 0.822 (Line 23).

DRAFT
JMD/esr
Sept. 7, 1965

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

CF Subj. _____

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

CASE No. 3283

Order No. R-2964

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION COMMISSION ON ITS OWN MOTION TO CONSIDER THE ADOPTION OF A NEW "MANUAL OF BACK-PRESSURE TESTING OF NATURAL GAS WELLS" FOR THE STATE OF NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on August 11, 1965, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this ____ day of September, 1965 the Commission, a quorum being present, having considered the testimony, the record, and the recommendations of the Examiner, 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 an Industry Committee appointed by the Commission has prepared a new "Manual for Back-Pressure Testing of Natural Gas Wells" and recommends the adoption of said manual.

(3) That said manual is patterned after the "Manual of Back-Pressure Testing of Gas Wells" published by the Interstate Oil Compact Commission.

(4) That adoption of the proposed "Manual for Back-Pressure Testing of Natural Gas Wells" will enable the Commission to more efficiently and effectively administer the laws of the State of New Mexico and the Commission's Rules and Regulations concerning the prevention of waste and the protection of correlative rights as related to natural gas production.

(5) That certain forms should be amended and certain new forms adopted by the Commission to facilitate adoption of the proposed manual.

(6) That certain rules and regulations of the Commission should be amended to facilitate adoption of the proposed manual.

IT IS THEREFORE ORDERED:

(1) That the "Manual for Back-Pressure Testing of Natural Gas Wells," contained in the record of this case as OCC Exhibit No. 1, is hereby adopted by the Commission.

(2) That Commission Forms C-122 and C-122-C are hereby amended to conform with Exhibits A and B of this order.

(3) That new Commission Forms C-122-D, C-122-E, C-122-F, and C-122-G, as shown in Exhibits C, D, E, and F of this order, are hereby adopted.

(4) That Rule 1100-D of the Commission Rules and Regulations is hereby amended as follows:

(a) By striking the phrase "Form C-122 Multi-Point Back Pressure Test for Gas Wells" and interlineating in lieu thereof the phrase "Form C-122 Multi-point and One Point Back Pressure Test for Gas Wells."

(b) By striking the phrase "C-122-C One-Point Back Pressure Test for Gas Wells" and interlineating in lieu thereof the phrase "Form C-122-C Deliverability Test Report."

(c) By adding the phrase "C-122-D Worksheet for Calculation of Static Column Wellhead Pressure (P_w)."

(d) By adding the phrase "C-122-E Worksheet for Stepwise Calculation of (Surface) (Subsurface) Pressure (P_c & P_w) (P_f & P_s)."

(e) By adding the phrase "C-122-F Worksheet for Calculation of Wellhead Pressures (P_c or P_w) from Known Bottomhole Pressure (P_f or P_s)."

(f) By adding the phrase "C-122-G Worksheet for Calculation of Static Column Pressure at Gas Liquid Interface."

(5) That Rule 1122 of the Commission Rules and Regulations is hereby amended to read in its entirety as follows:

"RULE 1122. MULTIPOINT AND ONE POINT BACK PRESSURE TEST FOR GAS WELLS (Form C-122)
GAS WELL TEST DATA SHEET - SAN JUAN BASIN (Form C-122-A)
INITIAL POTENTIAL TEST DATA SHEET (Form C-122-B)
DELIVERABILITY TEST REPORT (Form C-122-C)
WORKSHEET FOR CALCULATION OF STATIC COLUMN WELLHEAD PRESSURE (P_w) (Form C-122-D)
WORKSHEET FOR STEPWISE CALCULATION OF (SURFACE) (SUBSURFACE) PRESSURE $\frac{(P_c+P_w)(P_c+P_s)}{\Delta}$ (Form C-122-E)
WORKSHEET FOR CALCULATION OF WELLHEAD PRESSURES (P_c or P_w) FROM KNOWN BOTTOMHOLE PRESSURE $\frac{(P_f \sim P_s)}{\Delta}$ (Form C-122-F)
WORKSHEET FOR CALCULATION OF STATIC COLUMN PRESSURE AT GAS LIQUID INTERFACE (Form C-122-G)

The above forms shall be submitted in DUPLICATE to the appropriate District Office of the Commission in accordance with the provisions of the "Manual for Back-Pressure Testing of Natural Gas Wells," Rule 401 of the Commission Rules and Regulations, and applicable special pool rules and proration orders."

(6) That this order shall become (Dan amended) effective January 1, 1966.

(7) 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.

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO

September 16, 1965

COPY

Mr. Dave Rainey
El Paso Natural Gas Company
P. O. Box 1492
El Paso, Texas

Dear Dave:

Enclosed herewith is Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965, a copy of which was mailed to you.

Will you please insert this copy in the order which you received, destroy the former Page 3, and acknowledge receipt of this substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr
Enclosure

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO

September 16, 1965

COPY

Mr. Joe Ramey
Supervisor, District 1
Oil Conservation Commission
P. O. Box 1980
Hobbs, New Mexico

Dear Joe:

Enclosed herewith is Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965, a copy of which was mailed to you.

Will you please insert this copy in the order which you received, destroy the former Page 3, and acknowledge receipt of this substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr
Enclosure

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO

COPY

September 16, 1965

Mr. M. L. Armstrong
Supervisor, District 2
Oil Conservation Commission
Drawer DD
Artesia, New Mexico

Dear Mose:

Enclosed herewith is Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965, a copy of which was mailed to you.

Will you please insert this copy in the order which you received, destroy the former Page 3, and acknowledge receipt of this substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr
Enclosure

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO

September 16, 1965

Mr. Emery Arnold
Supervisor, District 3
Oil Conservation Commission
1000 Rio Brazos Road
Aztec, New Mexico

Dear Emery:

Enclosed herewith is Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965, a copy of which was mailed to you.

Will you please insert this copy in the order which you received, destroy the former Page 3, and acknowledge receipt of this substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr
Enclosure

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

State of New Mexico
Oil Conservation Commission

LAND COMMISSIONER
GUYTON B. HAYS
MEMBER

P. O. BOX 2088
SANTA FE

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

September 13, 1965

Mr. Dave Rainey
El Paso Natural Gas Company
Post Office Box 1492
El Paso, Texas

Re: Case No. 3283
Order No. R-2964
Applicant:

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 x
Aztec OCC x
OTHER

to change the name of C-122 to "Multipoint and One Point Back Pressure Test for Gas Well," to change the name of C-122-C to "Deliverability Test Report" to add C-122-D, "Worksheet for Calculation of Static Column wellhead Pressure (Pw)" to add C-122-E "Worksheet for Stepwise Calculation of (Surface) (Subsurface) Pressure," to add C-122-F "Worksheet for Calculation of Wellhead Pressures from Known Bottomhole Pressure," and to add C-122-G, "Worksheet for Calculation of Static Column Pressure at Gas Liquid Interface."

also amend Rule 1122 Caption to include all of the above forms. Change the body of the rule to read in its entirety as follows: ~~"Four copies of the~~ "The above forms shall be submitted in duplicate to the appropriate District Office of the Commission in accordance with the provisions of the "Manual for Back-Pressure Testing of Natural Gas Wells," and Rules 401 and applicable special pool rules and proration orders."

OIL CONSERVATION COMMISSION
SANTA FE, NEW MEXICO

Date 9/1/65

CASE NO. 3283 HEARING DATE 9am 8/11/65
DSN @ SF

My recommendations for an order in the above numbered case(s) are as follows:

Enter an order adopting the new "Manual for Back-Pressure Testing of Natural Gas Wells" as depicted in O.C.C. Exhibit No. 1 ~~of~~ in Case 3283.

Find that adoption of said manual, patterned after the Interstate Oil Compact Commission "Manual of Back-Pressure Testing of Gas Wells," will be in the interest of more efficient administration of the conservation laws as they affect natural gas production, thereby preventing waste and protecting correlative rights.

Make the adoption of the new manual effective at 7:00 o'clock am January 1, 1966.

Staff Member

and adopt forms amend. Also ~~adopt~~ forms C-122 & C-122-C, C122D, C-122-E C-122-F C-122G and attach to orders as Exhibits A, B, C, D, E, & F. Amend Rule 1100 D to include

NEW MEXICO OIL CONSERVATION COMMISSION

EXAMINER HEARING

SANTA FE, NEW MEXICO

REGISTER

HEARING DATE AUGUST 11, 1965 TIME: 9 A.M.

NAME:	REPRESENTING:	LOCATION:
Nina DuBasme	R.W. Byram & Co	Santa Fe - Austin
Granville Dutton	Sun Oil Co	Dallas
Booker Kelly	White Gilbert Koch & Kelly	Santa Fe

NEW MEXICO OIL CONSERVATION COMMISSION

EXAMINER HEARING

SANTA FE, NEW MEXICO

REGISTER

HEARING DATE AUGUST 11, 1965 TIME: 9 A.M.

NAME:	REPRESENTING:	LOCATION:
William Singley	Skelly Oil	Hobbs
Jerry R Hall	Skelly Oil	Hobbs
Greg Duecc	Pan Am	Fort Worth
Wayne E Smith	"	Denver
Ronald Mandz	Skelly Oil Co	Tulsa
George W. Selinger	"	"
Wallace Sutherland	USGS	Roswell
L.E. Thomas	Amerada	Midland
H L Tribble	Northern Nat. Gas	Dumas
C. W. Roach	Northern Natural Gas Co.	Hobbs
Foster Morrell	Self	Roswell, N. Mex.
R C Galloway	"	"
George W. Eaton	Pan Am	Farmington, N.M.
Jason Kellahin	Kellahin & Fox	Santa Fe
A W Laney	EPNG	El Paso, Tex
Richard S. Morris	Seth, Montgomery, Federici & Andrews	Santa Fe
Frank E. Ditty	State Engr. Office	Santa Fe

STATE OF NEW MEXICO)
) ss
COUNTY OF BERNALILLO)

I, ADA DEARNLEY, Court Reporter and Notary Public, do hereby certify that the foregoing and attached transcript of proceedings before the New Mexico Oil Conservation Commission at Santa Fe, New Mexico, 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 1st day of September, 1965.

Ada Dearnley
Notary Public - Court Reporter

My Commission Expires:

June 19, 1967.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 3283, heard by me on 8/11, 1965.

..... Examiner
New Mexico Oil Conservation Commission

in trying to adapt the I.O.C.C. Manual to conditions in New Mexico.

In regard to the number of copies to be printed, I think that can be determined by a survey letter which we haven't sent out. It would have been premature to send it out prior to the hearing, to second-guess the Commission.

I certainly want to thank the members of the committee and Mr. Utz as the advisor, and particularly Mr. Rainey for serving as chairman of the committee.

MR. NUTTER: Thank you. Does anyone have anything further they wish to offer in Case 3283? The case will be taken under advisement.

* * * *

Q And in all probability that should give sufficient time for printing and circulating?

A I would think so, yes, sir.

MR. UTZ: Does the committee have any opinion as to the number of copies that should be printed?

A We have not specifically discussed that in the committee. My own personal feeling is that most of the operators in the State of New Mexico will be buying one or more copies of this Manual, and I would think something in the order of four to five hundred copies should be initially printed. I understand, however, that the Commission has sent an inquiry letter to -- or if they haven't already done, proposes to send an inquiry letter to the various companies as to the number of copies they think they will be wanting; and I presume that the results of that survey will be pretty well determinative as to how many copies should be made.

MR. UTZ: That's all I have.

MR. NUTTER: Any other questions of Mr. Rainey? He may be excused.

(Witness excused.)

MR. NUTTER: Mr. Porter, did you have anything to say with regard to the work of the committee?

MR. PORTER: I would like to thank Mr. Rainey and the other members of the committee for their diligent efforts

that will be used in making the actual calculations have been changed slightly.

Q That's what I'm trying to get at. Does the committee recommend that we change our procedure of calculating friction on the C-122-A to conform with the friction calculations in this proposed Manual?

A I would recommend that that be done, yes, sir.

MR. UTZ: Thank you.

BY MR. NUTTER:

Q Do you have any suggested date that this Manual should be adopted for the effective date of it?

A Mr. Nutter, I have no idea as to the elements which might be involved as far as getting the Manual printed and available for the use of industry, but I would suggest the first of some month in the not too distant future when the Manual can be printed and available.

Q Well, we have, particularly in the Northwest we have an annual testing season for deliverability tests.

A Yes.

Q Will there be any significant change here that might make it more appropriate to adopt it for a given year and not to have the two testing procedures overlapping?

A With that idea in mind, I would suggest then January 1st, 1966, be the effective date of the Manual.

is that recommendation in connection with the general rules change?

A There was no recommendation as to any change on C-122-A.

Q Didn't you recommend that the change be made in the general rules to incorporate these new friction calculation forms?

A Yes, that is correct.

Q That will be in the general rules order?

A That will be in the general rules. The rule under Rules of Testing in Northwest New Mexico as embodied in Order R-333-F and any subsequent amendments thereto are mentioned in the Procedure Section as special pool rules; and testing up there would be in accordance with procedures as they now exist. There's no recommendation as to the changes in that.

MR. NUTTER: There's no necessity for changing 333-F then?

A No, sir.

Q (By Mr. Utz) Would not your recommendation change the general rule Order 1126 or be tantamount to suggesting a change in the testing procedure up there with regard to friction calculations?

A It's not the committee's recommendation that any changes be made in that testing procedure. Now the tables

unconnected gas well testing procedure contained in this Back Pressure Testing Manual?

A Yes, sir. The committee examined all existing rules and regulations of the State in regard to the testing of gas wells and incorporated them as appropriate in the Procedure Section, which is Section 3 of the proposed Manual.

Q Now the existing Rule 401 is the one that requires the back pressure testing of wells and also the testing of unconnected wells, is that correct?

A Yes.

Q So the amendment to Rule 401 that you had proposed before, that it be --

A I am proposing that 401 be left as it is, and we merely amended the title of the Manual to conform to the caption in 401.

Q And this will take care of the connected as well as the unconnected wells?

A Yes.

MR. NUTTER: Are there any questions of Mr. Rainey?

MR. UTZ: I have one.

MR. NUTTER: Mr. Utz.

BY MR. UTZ:

Q In regard to your recommendation about C-122-A, which is the deliverability test form for Northwest New Mexico,

acknowledge the diligent and fine work of all the members of the committee and to compliment them on their pursuit of this task over slightly less than a year's period of time in completing the work. I would further recommend the adoption of the proposed Back Pressure Test Manual for the State of New Mexico.

MR. DURRETT: If the Examiner please, I move the introduction of Exhibit 1.

(Whereupon, O.C.C. Exhibit No. 1 offered in evidence.)

MR. DURRETT: That will conclude the Commission's case. Mr. Rainey is available for cross examination.

MR. NUTTER: Exhibit 1 will be admitted in evidence in this case.

(Whereupon, O.C.C. Exhibit No. 1 received in evidence.)

CROSS EXAMINATION

BY MR. NUTTER:

Q Mr. Rainey, you'll recall about a year ago the Commission adopted a supplement to the Back Pressure Testing Manual, --

A Yes, sir.

Q -- to enable unconnected gas wells to be tested?

A Yes.

Q And the potential reported to the Commission. Is the

I believe those are the only necessary changes that the committee has found will be appropriate.

Q (By Mr. Durrett) Do you have a recommendation, Mr. Rainey, concerning orders requiring the testing of wells?

A Mr. Durrett, I would presume, because of the fact that we are adopting a title for this proposed Manual in accordance with State-wide Rule 401, that it would not actually be necessary to change any existing orders, and that any test requirements under individual pool rules would be complied with by testing in accordance with the procedures as outlined in the Manual for Back Pressure Testing in the State of New Mexico.

Q Is it your opinion and the opinion of your committee that the adoption of your proposed Manual and forms by the Commission will enable the Oil Conservation Commission to more efficiently administer the laws of the State of New Mexico pertaining to conservation of oil and gas?

A Yes, that's my opinion, and particularly as it pertains to the necessary testing of gas wells in the State of New Mexico.

Q Do you have any further remarks you would care to make to the Examiner or to the Commission on the record at this time?

A I would like at this point, Mr. Durrett, to

"...and shall be used to show back pressure data as required under the provisions of Rule 401 and any applicable special pool rules and proration orders."

Then "Forms C-122-A, C-122-B, C-122-C, C-122-D, C-122-E C-122-F, C-122-G shall be submitted according to applicable special pool rules and proration orders and in accordance with the applicable form as the specific test and calculations may require." The reason for that being that each of those additional forms are actually calculation work sheet forms, and the instructions thereon indicate to what use they are to be put, so that you would not submit each one of those forms each time any calculation was made. It would depend on the type of test you were taking and the manner in which you were calculating it.

MR. NUTTER: And the forms do have the instructions on them?

A Yes, they do. I might point out that the proposal of the committee is that the work sheets be submitted only in a work sheet form to the district office for the purpose of checking the calculations. They should not necessarily have to be typed and submitted in triplicate to the necessary offices; they need only be submitted to the District Office as work sheet copies so that the calculations of the test may be checked.

in parenthesis, or P subscript C and P subscript W, close parenthesis; and Form C-122-F, which is Work Sheet for Calculation of Wellhead Pressures, parenthesis, P subscript C, or P subscript W, close parenthesis, from Known Bottom Hole Pressure, parenthesis, P subscript F or P subscript S, close parenthesis; and Form C-122-G, Work Sheet for Calculation of Static Column Pressure at Gas Liquid Interface.

Those additions should be added to the caption of Rule 1122, and then the body of that rule which reads at present: "Form C-122 shall be submitted in TRIPLICATE to the Oil Conservation Commission at Santa Fe, New Mexico, and shall be used to show back pressure data as required under the provisions of Rule 401 and any applicable special pool rules and proration orders. Forms C-122-A, C-122-B, and C-122-C shall be submitted according to applicable special pool rules and proration orders."

MR. NUTTER: That's the way it reads now?

A Now, the way it reads now. The committee would recommend that that be changed to read: "Form C-122 shall be submitted in TRIPLICATE to the appropriate district office of the Oil Conservation Commission." I think that is the present practice at this time, that it is submitted to the district office rather than directly to Santa Fe.

And then with the remainder of that sentence to read:

Form C-122-G, be also adopted as they are proposed in this Manual.

MR. NUTTER: You would add Exhibit 24-A and 24-B?

A Right.

MR. NUTTER: Those are form numbers what again?

A C-122-D and printed on the back thereof, C-122-E; and Form C-122-F, and printed on the back thereof Form C-122-G.

MR. NUTTER: So because they are printed on the back side, we are getting four exhibits?

A That's correct.

MR. NUTTER: Four forms for two exhibits?

A That's correct. There are other changes which will be necessary in Order R-2761 insofar as it amends and adopts Rule 1122. As it reads in Order R-2761, Rule 1122 is captioned: "Multi-Point Back Pressure Test for Gas Wells (Form C-122), Gas Well Test Data Sheet - San Juan Basin (Form 122-A), Initial Potential Test Data Sheet (Form C-122-B), One-Point Back Pressure Test for Gas Wells (Form C-122-C)"; and the caption thereof should have added to it the titles of Form C-122-D, E, F, and G, which are: Form C-122-D is Work Sheet for Calculation of Static Column Wellhead Pressure, parenthesis, P sub W, parenthesis; C-122-E is Work Sh't for Stepwise Calculation, parenthesis, Subsurface, close parenthesis, or parenthesis, Surface, close parenthesis, Pressure, P subscript F, and P subscript S

of this order.

At the time of the adoption of this order, this Order 2761, the Back Pressure Test Manual Committee was in existence so that no changes were made in the old New Mexico Commission gas well test forms, with the recognition that there might be changes adopted by this committee or recommended by this committee. So I think it would be necessary to modify Order 2761 as to the exhibits that are attached thereto, Exhibits 22, 23, 24; and substitute therefor the Form C-122, C-122-C which are parts of the proposed Manual.

MR. NUTTER: Now Exhibits 22, 23, 24, your new forms are C-122, C-122-B, and C-122-C?

A Exhibit 23 is an Initial Potential Test Data Sheet which was a Pitot Tube Test Data Sheet. We have made no changes or no recommendations in that regard. So Exhibit 23 would remain as it is in 2761, but 22 and 24 would be changed.

MR. NUTTER: 22 and 24?

A Yes. Exhibit 22 of that order is Form C-122 and Exhibit 24 is Form C-122-C on which we have made changes or recommended changes.

I would also propose to complete that order that an exhibit -- well, we'll have to make it 24-A and 24-B, I guess, which is Form C-122-D, and printed on the back thereof Form C-122-E; and Form C-122-F and printed on the back thereof

adoption of your proposed Manual?

A Yes, sir, there will be a few changes which will be necessary both in the State-wide rules and in Order R-2761, which was an order which adopted new forms for the State of New Mexico effective January 1st, 1965.

State-wide Rule 401 provides that gas wells shall be tested in accordance with -- let me get the exact wording, with the New Mexico Oil Conservation Commission "Manual for Back-Pressure Testing of Natural Gas Wells." The title that the committee put on this Manual inadvertently does not exactly follow that wording, and I am proposing that we will change the title of the Manual to that title so that it can be used without the necessity of changing the State-wide rule.

Insofar as I have been able to determine, and the members of the committee have researched the thing also, there should be no necessary changes in the State-wide rules to effectuate the use of this Manual. As to Order R-2761, Paragraph 20 of the enactment of that order provides: "That the format of Commission Form C-122, Multi-Point Back Pressure Test for Gas Wells, Commission Form C-122-B, Initial Potential Test Data Sheet, and Commission Form C-122-C, One-Point Back Pressure Test for Gas Wells, as shown by Exhibits 22, 23 and 24 attached hereto and made a part hereof, be adopted." There have been minor modifications to those forms since the adoption

it was completely retyped, and a number of typographical errors were found, so I feel that the tables as they are proposed in the New Mexico Manual are even more accurate than the tables that can be found in the Compact Manual.

We have also advised the Compact Commission of the typographical errors that we have found so they can correct their Manual if necessary.

Q Am I correct that in essence your committee is recommending the adoption of the I.O.C.C. suggested Manual with minor modifications?

A Yes, sir. And I would like to present Exhibit 1 of the committee, which is the retyped version of the I.O.C.C. Manual with the necessary changes made in it.

MR. DURRETT: May we have that marked, please?

(Whereupon, O.C.C. Exhibit No. 1 marked for identification.)

A I might point out that there have been found a few typographical errors in this proposed Manual and they're marked in red in this copy, which is marked as Exhibit 1, and those corrections will be made before the Manual is printed.

Q (By Mr. Durrett) Now, Mr. Rainey, have you researched the Rules and Regulations of the New Mexico Oil Conservation Commission in order to determine if there are any changes that would be necessary in order to implement the

There were certain changes made in Section 4 of the I.O.C.C. Manual, which is Forms, and I'll discuss those in more detail in a moment. There were certain changes made in the Test Examples, which is Section 6 of the I.O.C.C. Manual, to conform to the procedures and calculation procedures and examples for the State of New Mexico; and there were changes made in a number of the tables in Section 7 of the I.O.C.C. Manual, in that the Compact Manual was based on pressure bases of 14.65, and the State of New Mexico has a pressure base of 15.025 psi, so those tables that have some pressure base factors in them had to be changed to conform to usage in New Mexico. Specifically, those are Table 1, Table 2, Table 5, Table 6, and let me see, I believe Table 15 and Table 16.

In each instance where tables were revised to make them conform to 15.025 pressure base, the member of the committee who was responsible for revising the table went back to an original data and recalculated the tables, rather than merely converting them from 14.65 to 15.025, to insure there was no error made in conversion and that there had been no error made in the original Compact tables.

I might also point out for information purposes that Table 11 of the Compact Manual, Compressibility Factors, was completely retyped; even though we used the table in the Manual

a number of engineers and men from industry and from state regulatory agencies from all over the United States; and adopted a manual for the use of testing of gas wells, based on the latest technological information and procedures available at that time. The manual, Back-Pressure Testing of Gas Wells in the State of New Mexico, was adopted in 1956 and had not been up-dated since that time, with a considerable advance in technology in testing of gas wells coming into being during that interim; so the idea of the appointment of this committee was to study the Interstate Oil Compact Commission manual to determine its feasibility for use in the State of New Mexico.

This committee whose names I read a moment ago examined the Interstate Oil Compact Commission manual in great detail and made minor necessary modifications to that manual so that it would be suitable for use in the State of New Mexico.

We have a copy this morning of the manual as it has been prepared by the committee, with changes that were necessary for its use in New Mexico. Principally the changes were made in Section 3 of the I.O.C.C. Manual, which is the Rules of Procedure for Testing Gas Wells; and these rules were changed to conform to established practices in the State of New Mexico.

appointed by Mr. Porter in late July of 1964. The first meeting was held on August 20th and 21st of 1964 here in Santa Fe.

The members of that committee who had served on it from time to time are Mr. C. E. Bowlin with Interstate Oil Compact Commission; T. M. Boyd with Consolidated Oil and Gas; C. R. Clement with Phillips Petroleum Company; Mr. R. L. Freeborn, Continental Oil Company; Mr. G. A. Hickson, El Paso Natural Gas Company; J. W. Meek with Pan American Petroleum Corporation; and Mr. L. S. Muenick with Southern Union Gas Company; C. W. Rach with Northern Natural Gas Company; Mr. L. W. Roger with Trans Western Pipeline Company; Mr. A. J. Evans with Amerada Petroleum Corporation; Mr. L. E. Thomas with Amerada Petroleum Corporation; G. L. Tribble with Northern Natural Gas Company; Mr. W. H. Williams with Consolidated Oil and Gas Company; and myself as chairman, with Mr. Elvis Utz of the Commission staff serving in an advisory capacity.

Q Am I correct, Mr. Rainey, that the purpose of this committee was to study the possibilities of adopting a Manual of Back-Pressure Testing of Gas Wells for the State of New Mexico?

A Yes, sir. In 1956 or 1957, as I recall it, the Interstate Oil Compact Commission appointed a committee to devise a Manual for Back-Pressure Testing of Gas Wells. That committee worked for approximately five years, and consisted of

Compact Commission.

If the Examiner please, Jim Durrett appearing on behalf of the Commission and its staff, and I will have one witness, Mr. Dave Rainey, I would like to request be sworn.

(Witness sworn.)

MR. NUTTER: Are there any other appearances in Case 3283? Mr. Durrett, proceed.

* * * * *

DAVID H. RAINEY

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

DIRECT EXAMINATION

BY MR. DURRETT:

Q Mr. Rainey, will you please state your full name and by whom you are employed?

A David H. Rainey. I'm employed by El Paso Natural Gas Company.

Q What is your position with El Paso Natural Gas Company?

A I'm assistant manager of the Proration Department. I am testifying here today as chairman of the Industry Committee concerning the Back-Pressure Testing of Gas Wells Manual for the State of New Mexico.

Q When was this committee formulated?

A This committee was an Industry Committee which was

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
August 11, 1965

EXAMINER HEARING

IN THE MATTER OF:

The hearing called by the Oil Conservation Commission on its own motion to consider the adoption of a new "Manual of Back-Pressure Testing of Gas Wells" in the State of New Mexico, said manual being an adaptation of the test manual recently adopted by the Interstate Oil Compact Commission. Modification of several existing gas well test forms and adoption of several new forms will also be considered.

Case No. 3283

BEFORE: Daniel S. Nutter, Examiner

TRANSCRIPT OF HEARING

MR. NUTTER: The hearing will come to order, please. The first case this morning will be Case 3283.

MR. DURRETT: In the matter of the hearing called by the Oil Conservation Commission on its own motion to consider the adoption of a new "Manual of Back-Pressure Testing of Gas Wells" in the State of New Mexico, said manual being an adaptation of the test manual recently adopted by the Interstate Oil

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

State of New Mexico
Oil Conservation Commission

LAND COMMISSIONER
GUYTON B. HAYS
MEMBER

P. O. BOX 2088
SANTA FE

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

October 4, 1965

Mr. Joe D. Ramey
Supervisor, District 1
Oil Conservation Commission
P. O. Box 1980
Hobbs, New Mexico

Dear Joe:

Reference is made to our letter of September 16, 1965, with which we enclosed Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965. We asked that you insert the revised Page 3 in your copy of the order, destroy the former Page 3, and acknowledge receipt of the substitution. A slight error required that Page 3 be done over.

Please acknowledge receipt of the above-referenced substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr

Received 9/17/65

OIL CONSERVATION COMMISSION
P. O. BOX 871
SANTA FE, NEW MEXICO

October 4, 1965

COPY

Mr. Joe D. Ramey
Supervisor, District 1
Oil Conservation Commission
P. O. Box 1980
Hobbs, New Mexico

Dear Joe:

Reference is made to our letter of September 16, 1965, with which we enclosed Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965. We asked that you insert the revised Page 3 in your copy of the order, destroy the former Page 3, and acknowledge receipt of the substitution. A slight error required that Page 3 be done over.

Please acknowledge receipt of the above-referenced substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO

September 16, 1965

Mr. Joe Ramey
Supervisor, District 1
Oil Conservation Commission
P. O. Box 1980
Hobbs, New Mexico

Dear Joe:

Enclosed herewith is Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965, a copy of which was mailed to you.

Will you please insert this copy in the order which you received, destroy the former Page 3, and acknowledge receipt of this substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr
Enclosure

R. W. BYRAM & COMPANY

Consulting Geologists • Petroleum Engineers
Specialized Oil & Gas Reports on Texas, New Mexico and Louisiana

PHONE GReenwood 8-2591
DRAWER M,
CAPITOL STATION
AUSTIN, TEXAS 78711

October 15, 1965

Mr. Daniel S. Nutter
Chief Engineer
Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico

Dear Mr. Nutter:

This will acknowledge receipt of the revised page 3 to Order No. R-2964 entered by the Commission on September 13, 1965.

The rule book supplement received by you within the past two weeks should reflect the corrected information on this page.

Thank you for sending it and I am sorry not to have acknowledged it before now.

Very truly yours,

R. W. BYRAM & COMPANY

Berta

(Mrs.) Berta S. Vore

BSV:mos

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO

October 4, 1965

COPY

Mr. R. W. Byram
R. W. Byram & Company
Drawer M - Capitol Station
Austin, Texas

Dear Mr. Byram:

Reference is made to our letter of September 16, 1965, with which we enclosed Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965. We asked that you insert the revised Page 3 in your copy of the order, destroy the former Page 3, and acknowledge receipt of the substitution. A slight error required that Page 3 be done over.

Please acknowledge receipt of the above-referenced substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr

El Paso Natural Gas Company

El Paso, Texas 79999

'65 OCT 4 AM 8

September 30, 1965

Mr. Daniel S. Nutter
New Mexico Oil Conservation Commission
P. O. Box 2088
Santa Fe, New Mexico

Dear Dan:

This is to acknowledge with thanks your letter of September 16, 1965, enclosing a revised Page 3 for Order No. R-2964.

Very truly yours,

D. H. Rainey
Assistant Manager
Gas Proration Operations

DHR:mm

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

State of New Mexico
Oil Conservation Commission

LAND COMMISSIONER
GUYTON B. HAYS
MEMBER

P. O. BOX 2088
SANTA FE

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

September 16, 1965

RECEIVED
SEP 17 1965
O. C. C.
ARTESIA, OFFICE

Mr. M. L. Armstrong
Supervisor, District 2
Oil Conservation Commission
Drawer DD
Artesia, New Mexico

Dear Mose:

Enclosed herewith is Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965, a copy of which was mailed to you.

Will you please insert this copy in the order which you received, destroy the former Page 3, and acknowledge receipt of this substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr
Enclosure

Return to Dan
Thanks for this correction
B.G.

GOVERNOR
JACK M. CAMPBELL
CHAIRMAN

LAND COMMISSIONER
GUYTON B. HAYS
MEMBER

State of New Mexico
Oil Conservation Commission

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

P. O. BOX 2088
SANTA FE

September 16, 1965

Mr. Emery Arnold
Supervisor, District 3
Oil Conservation Commission
1000 Rio Brazos Road
Aztec, New Mexico

Dear Emery:

Enclosed herewith is Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965, a copy of which was mailed to you.

Will you please insert this copy in the order which you received, destroy the former Page 3, and acknowledge receipt of this substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr
Enclosure

RECEIVED
SEP 20 1965
OIL CON. COM.
DIST. 3

to Dan Nutter,
Receipt acknowledged
Emery Arnold

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO

September 16, 1965

COPY

Mr. Emery Arnold
Supervisor, District 3
Oil Conservation Commission
1000 Rio Brazos Road
Aztec, New Mexico

Dear Emery:

Enclosed herewith is Page 3 (revised) of Order No. R-2964 entered by the Commission on September 13, 1965, a copy of which was mailed to you.

Will you please insert this copy in the order which you received, destroy the former Page 3, and acknowledge receipt of this substitution.

Very truly yours,

DANIEL S. NUTTER
Chief Engineer

DSN/esr
Enclosure

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION COMMISSION ON ITS OWN MOTION TO CONSIDER THE ADOPTION OF A NEW "MANUAL OF BACK-PRESSURE TESTING OF NATURAL GAS WELLS" FOR THE STATE OF NEW MEXICO.

CASE No. 3283
Order No. R-2964

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 o'clock a.m. on August 11, 1965, at Santa Fe, New Mexico, before Examiner Daniel S. Nutter.

NOW, on this 13th day of September, 1965, the Commission, a quorum being present, having considered the testimony, the record, and the recommendations of the Examiner, 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 an Industry Committee appointed by the Commission has prepared a new "Manual for Back-Pressure Testing of Natural Gas Wells" and recommends the adoption of said manual.

(3) That said manual is patterned after the "Manual of Back-Pressure Testing of Gas Wells" published by the Interstate Oil Compact Commission.

(4) That adoption of the proposed "Manual for Back-Pressure Testing of Natural Gas Wells" will enable the Commission to more efficiently and effectively administer the laws of the State of New Mexico and the Commission's Rules and Regulations concerning the prevention of waste and the protection of correlative rights as related to natural gas production.

(5) That certain forms should be amended and certain new forms adopted by the Commission to facilitate adoption of the proposed manual.

(6) That certain rules and regulations of the Commission should be amended to facilitate adoption of the proposed manual.

IT IS THEREFORE ORDERED:

(1) That the "Manual for Back-Pressure Testing of Natural Gas Wells," contained in the record of this case as OCC Exhibit No. 1, is hereby adopted by the Commission.

(2) That Commission Forms C-122 and C-122-C are hereby amended to conform with Exhibits A and B of this order.

(3) That new Commission Forms C-122-D, C-122-E, C-122-F, and C-122-G, as shown in Exhibits C, D, E, and F of this order, are hereby adopted.

(4) That Rule 1100-D of the Commission Rules and Regulations is hereby amended as follows:

(a) By striking the phrase "Form C-122 Multi-Point Back Pressure Test for Gas Wells" and interlineating in lieu thereof the phrase "Form C-122 Multi-point and One Point Back Pressure Test for Gas Well."

(b) By striking the phrase "C-122-C One-Point Back Pressure Test for Gas Wells" and interlineating in lieu thereof the phrase "Form C-122-C Deliverability Test Report."

(c) By adding the phrase "C-122-D Worksheet for Calculation of Static Column Wellhead Pressure (P_w)."

(d) By adding the phrase "C-122-E Worksheet for Stepwise Calculation of (Surface) (Subsurface) Pressure (P_c & P_w) (P_f & P_s)."

(e) By adding the phrase "C-122-F Worksheet for Calculation of Wellhead Pressures (P_c or P_w) from Known Bottomhole Pressure (P_f or P_s)."

(f) By adding the phrase "C-122-G Worksheet for Calculation of Static Column Pressure at Gas Liquid Interface."

(5) That Rule 1122 of the Commission Rules and Regulations is hereby amended to read in its entirety as follows:

"RULE 1122. MULTIPOINT AND ONE POINT BACK PRESSURE TEST FOR GAS WELL (Form C-122)
GAS WELL TEST DATA SHEET - SAN JUAN BASIN (Form C-122-A)
INITIAL POTENTIAL TEST DATA SHEET (Form C-122-B)
DELIVERABILITY TEST REPORT (Form C-122-C)
WORKSHEET FOR CALCULATION OF STATIC COLUMN WELLHEAD PRESSURE (P_w) (Form C-122-D)
WORKSHEET FOR STEPWISE CALCULATION OF (SURFACE) (SUBSURFACE) PRESSURE (P_c & P_w) (P_f & P_s) (Form C-122-E)
WORKSHEET FOR CALCULATION OF WELLHEAD PRESSURES (P_c or P_w) FROM KNOWN BOTTOMHOLE PRESSURE (P_f or P_s) (Form C-122-F)
WORKSHEET FOR CALCULATION OF STATIC COLUMN PRESSURE AT GAS LIQUID INTERFACE (Form C-122-G)

The above forms shall be submitted to the appropriate District Office of the Commission in accordance with the provisions of the "Manual for Back-Pressure Testing of Natural Gas Wells," Rule 401 of the Commission Rules and Regulations, and applicable special pool rules and proration orders. These forms shall be submitted in DUPLICATE except Form C-122-A which shall be submitted in TRIPLICATE."

(6) That this order shall become effective January 1, 1966.

(7) 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, Chairman

GUYTON B. HAYS, Member

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

esr/

NEW MEXICO OIL CONSERVATION COMMSSION

MULTIPOINT AND ONE POINT BACK PRESSURE TEST FOR GAS WELL

Form C-122
Revised 9-1-65

Type Test ☐ Initial ☐ Annual ☐ Special						Test Date			
Company				Connection					
Pool				Formation				Unit	
Completion Date		Total Depth		Plug Back TD		Elevation		Farm or Lease Name	
Csg. Size	Wt.	d	Set At	Perforations: From	To			Well No.	
Tbg. Size	Wt.	d	Set At	Perforations: From	To			Unit Sec. Twp. Rge.	
Type Well – Single – Bradenhead – G.G. or G.O. Multiple				Packer Set At				County	
Producing Thru		Reservoir Temp. °F		Mean Annual Temp. °F		Baro. Press. – P_a		State	
L	H	Gg	% CO_2	% N_2	% H_2S	Prover	Meter Run	Taps	

	FLOW DATA					TUBING DATA		CASING DATA		
NO.	Prover Line Size	X Orifice Size	Press. p.s.i.g.	Diff. h_w	Temp. °F	Press. p.s.i.g.	Temp. °F	Press. p.s.i.g.	Temp. °F	Duration of Flow
SI										
1.										
2.										
3.										
4.										
5.										

RATE OF FLOW CALCULATIONS

NO.	Coefficient (24 Hour)	$\sqrt{h_w P_m}$	Pressure P_m	Flow Temp. Factor Ft.	Gravity Factor Fg	Super Compress. Factor, Fpv	Rate of Flow Q, Mcfd
1							
2							
3.							
4.							
5.							

NO.	P_t	Temp. °R	T_t	Z
1.				
2.				
3.				
4.				
5.				

Gas Liquid Hydrocarbon Ratio _____ Mcf/bbl.
A.P.I. Gravity of Liquid Hydrocarbons _____ Deg.
Specific Gravity Separator Gas _____ XXXXXXXXXX
Specific Gravity Flowing Fluid XXXXX _____
Critical Pressure _____ P.S.I.A. _____ P.S.I.A.
Critical Temperature _____ R _____ R

P_c _____ P_c^2 _____

NO	P_t^2	P_w	P_w^2	$P_c^2 - P_w^2$
1				
2				
3				
4				
5				

(1) $\frac{P_c^2}{P_c^2 - P_w^2} =$ _____ (2) $\left[\frac{P_c^2}{P_c^2 - P_w^2}\right]^n =$ _____

AOF = Q $\left[\frac{P_c^2}{P_c^2 - P_w^2}\right]^n =$ _____

Absolute Open Flow _____ Mcfd @ 15.025 Angle of Slope θ _____ Slope, n _____

Remarks: _____

Approved By Commission:	Conducted By:	Calculated By:	Checked By:

Exhibit A
Order No. R-2964

NEW MEXICO OIL CONSERVATION COMMISSION
DELIVERABILITY TEST REPORT

Form C-122-C
Revised 9-1-65

Type Test ☐ Initial ☐ Annual ☐ Special					Test Date			
Company			Connection					
Pool			Formation				Unit	
Completion	Total Depth		Plug Back TD		Elevation		Farm or Lease Name	
Csg. Size / Wt. / d / Set At			Perforations: From To				Well No.	
Tbg. Size / Wt. / d / Set At			Perforations: From To				Unit Sec. Twp. Rge.	
Type Well – Single – Bradenhead – G.G. or G.O. Multiple			Packer Set At				County	
Producing Thru	Reservoir Temp. °F		Mean Annual Temp. °F		Baro. Press. – P_a		State	
L / H	Gg.		% CO_2	% N_2	% H_2S	Prover	Meter Run	Taps

	FLOW DATA					TUBING DATA		CASING DATA		
NO.	Prover Line Size	X Choke Orifice Size	Press. p.s.i.g.	Diff. h_w	Temp. °F	Press. p.s.i.g.	Temp. °F	Press. p.s.i.g.	Temp. °F	Duration of Flow
SI										
1.										

NO.	Coefficient (24-Hour)	$\sqrt{h_w P_m}$	Pressure P_m	Flow Temp. Factor Ft	Gravity Factor Fg	Super Compress. Factor Fpv	Rate of Flow Q, Mcfd
1.							

NO.	P_t	Temp. R.	T_t	Z

P_d _____
P_d^2 _____
P_c _____ P_a^2 _____

Gas Liquid Hydrocarbon Ratio _____ Mcf/bbl.
A.P.I. Gravity of Liquid Hydrocarbons _____ Deg.
Specific Gravity Separator Gas _____ XXXXXXXXXX
Specific Gravity Flowing Fluid XXXXX _____
Critical Pressure _____ p.s.i.a. _____ p.s.i.a.
Critical Temperature _____ R _____ R
Pf _____ Pf^2 _____

NO.	P_t	P_t^2	$P_c^2 - P_t^2$	P_w	P_w^2	$P_c^2 - P_w^2$	P_s	P_s^2	$P_f^2 - P_s^2$

$$\left[\frac{P_c^2 - P_d^2}{P_c^2 - P_w^2}\right] = \left[\quad\right] = \_\_\_\_\_$$

$$\text{Log}\left[\frac{P_c^2 - P_d^2}{P_c^2 - P_d^2}\right] = \_\_\_\_\_$$

$$\left[\frac{P_c^2 - P_d^2}{P_c^2 - P_w^2}\right]^n = \_\_\_\_\_$$

$$n \text{ Log}\left[\frac{P_c^2 - P_d^2}{P_c^2 - P_w^2}\right] = \_\_\_\_\_$$

$$\text{Deliv.} = Q\left[\frac{P_c^2 - P_d^2}{P_c^2 - P_w^2}\right]^n$$

Deliv. _____ Mcfd
n _____
(Source of n)

Commission _____
Company _____
Others _____

Exhibit B
Order No. R-2964

WORKSHEET FOR CALCULATION OF STATIC COLUMN WELLHEAD PRESSURE (P_w)

Form C-122D
Adopted 9-1-65

COMPANY _____ LEASE _____ WELL NO. _____ DATE _____

LOCATION: Unit _____ Section _____ Township _____ Range _____

L _____ H _____ L/H _____ G _____ % CO_2 _____ % N_2 _____ % H_2S _____

d _____ F_r _____ GH _____ P_{cr} _____ (TABLE IX & X) T_{cr} _____ (TABLE IX & X)

LINE										
1 Q_m										
2 T_w (W.H. °R)										
3 T_s (B.H. °R)										
4 $T = (\frac{T_w + T_s}{2})$										
5 Z (Est.)										
6 TZ										
7 GH/TZ										
8 e^S (Table XIV)										
9 $1-e^{-S}$ (Table XIV)										
10 P_t										
11 $P_t^2/1000$										
12 F_r (Table XV)										
13 $F_c = F_r$ TZ										
14 $F_c Q_m$										
15 $L/H (F_c Q_m)^2$										
16 $F_w = L/H (F_c Q_m)^2 (1-e^{-S})$										
17 $P_w^2 = P_t^2 + F_w$										
18 $P_s^2 = e^S P_w^2$										
19 P_s										
20 $P = (\frac{P_t + P_s}{2})$										
21 $P_r = (P/P_{cr})$										
22 $T_r = (T/T_{cr})$										
23 Z (Table XI)										

One copy to be filed in District Office (Work copy acceptable)

Exhibit C
Order No. R-2964

Exhibit D
Order No. R-2964

WORK SHEET FOR STEPWISE CALCULATION (SUBSURFACE) (SURFACE) PRESSURE (P_f & P_s) (P_c & P_w)

Form C-122E
Adopted 9-1-65

COMPANY _____ LEASE _____ WELL NO. _____ DATE _____

LOCATION: Unit _____ Section _____ Township _____ Range _____

L _____ H _____ L/H _____ G _____ % CO_2 _____ % N_2 _____ % H_2S _____

d _____ F_r _____ Q_m _____ M^2cfd $(L/H)(F_rQ_m)^2$ _____ P_{cr} _____ (TABLE IX & X) T_{cr} _____ (TABLE IX & X)

LINE	ITEM	SOURCE	1	2	3	4	5	6	7	8	9	10
1	H											
2	GH											
3	37.5GH											
4	P_c or P_n											
5	P_r											
6	T											
7	T_r											
8	Z											
9	P/Z P/Z	$\bar{4}\div\bar{8}$										
10	P/TZ	$\bar{9}\div\bar{6}$										
11	$(P/TZ)^2/1000$	$(\bar{10})^2/1000$										
12	$L/H(F_rQ_m)^2$											
13		$\bar{11}+\bar{12}$										
14	I_n	$\bar{10}\div\bar{13}$										
15	$M=P_n-P_{n-1}$											
16	$N=I_n+I_{n-1}$											
17	M x N	$\bar{15}\times\bar{16}$										
18	Σ(M x N)	$\Sigma\bar{17}$										

One copy to be filed in District Office (work copy acceptable)

WORK SHEET FOR CALCULATION OF WELLHEAD PRESSURES (P_c or P_w)

FROM KNOWN BOTTOM HOLE PRESSURE (P_f or P_s)

Form C-122F
Adopted 9-1-65

COMPANY _____ LEASE _____ WELL NO. _____ DATE _____

LOCATION: Unit _____ Section _____ Township _____ Range _____

L _____ H _____ L/H _____ G _____ % CO_2 _____ % N_2 _____ % H_2S _____

GH _____ P_{cr} _____ (TABLE IX & X) T_{cr} _____ (TABLE IX & X)

LINE		1	2	3	4	5	6	7	8
1	T_w(W.H. °R)								
2	T_s(B.H. °R)								
3	$T=(\frac{T_w + T_s}{2})$								
4	Z (Est.)								
5	TZ								
6	GH/TZ								
7	e^S(Table XIV)								
8	P_f or P_s								
9	P_f^2 or P_s^2								
10	$P_c^2 = P_f^2/e^S$ or $P_w^2 = P_s^2/e^S$								
11	P_c or P_w								
12	$P=(\frac{P_w + P_s}{2})$ or $(\frac{P_c + P_f}{2})$								
13	$P_r = (P/P_{cr})$								
14	$T_r = (T/T_{cr})$								
15	Z (Table XI)								

One copy to be filed in District Office (Work copy acceptable)

Exhibit E
Order No. R-2964

Exhibit F
Order No. R-2964

WORKSHEET FOR CALCULATION OF STATIC COLUMN PRESSURE AT GAS LIQUID INTERFACE

Form C-122G
Adopted 9-1-65

COMPANY _____ LEASE _____ WELL NO. _____ DATE _____

L _____ H _____ L/H _____ G _____ % CO_2 _____ % N_2 _____ % H_2S _____

d _____ F_r _____ GH _____ P_{cr} _____ (TABLE IX & X) T_{cr} _____ (TABLE IX & X)

LINE											
1	Q_m										
2	T_w (W.H. °R)										
3	T_s (BH °R)										
4	$T = (\frac{T_w + T_s}{2})$										
5	Z (Est.)										
6	TZ										
7	GH/TZ										
8	e^S (Table XIV)										
9	$1 - e^{-S}$ (Table XIV)										
10	P_c										
11	P_c^2										
12	F_r (Table XV)										
13	$F_c = F_r TZ$										
14	$F_c Q_m$										
15	$L/H (F_c Q_m)^2$										
16	$F_w = L/H(F_c Q_m)^2 (1-e^{-S})$										
17	$P_w^2 = P_t^2 + F_w$										
18	$P_f^2 = e^S P_c^2$										
19	P_f										
20	$P = (\frac{P_c + P_f}{2})$										
21	$F_r = \frac{P}{P_{cr}}$										
22	$T_r = \frac{T}{T_{cr}}$										
23	Z (Table XI)										

One copy to be filed in District Office (Work copy acceptable)

(1)

3283

SUPPLEMENT I

TO

MANUAL FOR

BACK PRESSURE TEST FOR NATURAL GAS WELLS

STATE OF NEW MEXICO

THE TESTING PROCEDURE OUTLINED HEREIN IS TO BE USED FOR TESTING UNCONNECTED GAS WELLS AS REQUIRED BY COMMISSION RULE 104 D_I and RULE 401, AS AMENDED MAY 25, 1964

SUPPLEMENT I

NEW MEXICO OIL CONSERVATION COMMISSION PROCEDURE
FOR TESTING UNCONNECTED GAS WELLS

Rules 104 D I and 401 of the Commission Rules and Regulations require that unconnected gas wells be tested to determine their potential within 30 days following the installation of a Christmas tree and the results of such tests ~~filed~~ reported to the Commission on Form C-122 within 10 days following the completion of the tests.

applicable to a given area or pool,

~~Unless specific test~~ The following procedures are to be used in so ~~testing~~ any unconnected gas well. It is anticipated that by the use of the Constant Time Multi-point Test with four one-hour flows, the loss of gas will be held to a minimum and good test results still obtained. ~~The~~ The pre-test flow to clear the well-bore of accumulated liquids should also, in the ~~same~~ interest of conservation, be closely watched and held to ~~the~~ absolute minimum ~~after the~~ to required ~~the~~ to achieve ~~the desired endpoint~~ clean-out.

More extensive testing of an unconnected gas well than that outlined herein ~~will~~ is not ~~be~~ permitted except upon written authority from the appropriate District Office of the Commission.

Date

A. L. Porter, Jr.
Secretary-Director

SUPPLEMENT I

NEW MEXICO OIL CONSERVATION COMMISSION PROCEDURE
FOR TESTING UNCONNECTED GAS WELLS

Rules 104 D I and 401 of the Commission Rules and Regulations require that unconnected gas wells be tested to determine their potential within 30 days following the installation of a christmas tree and the results of such tests reported to the Commission on Form C-122 within 10 days following the completion of the tests. The following procedures are to be complied with in so testing any unconnected gas well. More extensive testing of an unconnected gas well may be conducted only upon application authority from the appropriate District Office of the Commission

Test Procedure

Constant Time Multipoint Test for Unconnected Wells

A. Shut-in Pressure

1. The well shall be flowed to the atmosphere for a sufficient length of time to clear the well-bore of accumulated liquids.

2. The well shall be shut-in until the rate of pressure build-up is less than 1/10 of one percent over a 30-minute period. Pressures, psig, shall be recorded.

B. Flow Tests

1. After recording the shut-in pressure, ~~a series of~~ taken a series of 1-hour flow rates and the pressures corresponding to each flow rate shall be taken. Any shut-in time between flow rates shall be held to a minimum. These rates shall be run in an increasing flow-rate sequence. In the case of high liquid ratio wells or unusual temperature conditions, a decreasing flow-rate sequence may be used if the increasing sequence method did not result in the alignment of points. If the decreasing sequence method is used, a statement giving the reasons why the use of such method was necessary, together with a copy of the data taken by the increasing sequence method, shall be furnish

the Commission. If previous testing in a given area has shown that the decreasing sequence method is necessary for an accurate test, a test by the increasing sequence method will not be required.

It shall be noted that the flow ~~periods~~ for this test are limited to one hour for each rate of flow. Longer flow periods ~~for~~ of unconnected well shall not be made without special permission from the Commission

2. The lowest flow rate shall be a rate sufficient to keep the well clear of all liquids

3. One criterion as to the acceptability of the test is a good spread of data points. In order to assure a good spread of points, the wellhead flowing pressure, psig, at the lowest ~~rate of~~ flow rate should ~~not~~ be no more than 95 per cent of the well's shut-in pressure, psig, and at the highest flow rate should be no more than 75 per cent of the well's shut-in pressure, psig. If ~~the~~

accurate data must be obtained in accordance with the foregoing provisions, an explanation ~~of~~ shall be furnished the Commission.

4. All flow rate measurements shall be obtained by the use of an orifice meter, critical flow prover, positive choke, or other authorized metering device in good operating condition. When an orifice meter is used as the metering device, the meter shall be calibrated and the diameters of the orifice plate and meter run verified as to size, condition and compliance with acceptance standards. The differential pen shall be zeroed before starting the test.

5. The ~~initial~~ barometric pressure shall be ~~determined~~ recorded as 13.2 psia in Southeast New Mexico and 12.0 psia in Northwest New Mexico.

6. The specific gravity of the separator gas and of the produced liquid shall be determined and recorded.

7. At the end of each flow rate the following information shall be recorded:

(a) Flowing wellhead pressure

(b) Static calculated wellhead pressure if it can be obtained
(c) Rate of liquid production
(d) Flowing wellhead temperature
(e) All data pertinent to the gas metering devices

C. Calculations

1. General

A wellhead absolute open flow as determined from the wellhead equation, $Q = C(P_c^2 - P_w^2)^n$, is normally found to be the equivalent to the bottom-hole absolute open flow as determined from the bottom-hole equation, $Q = C(P_f^2 - P_s^2)^n$, where the wellhead shut-in pressure of the well in a given reservoir is below 2000 psig. Under this condition, either a wellhead absolute open flow or a bottom-hole absolute open flow is acceptable.

2. Bottom-hole Calculations

(a) Bottom-hole pressures shall be calculated to a datum at the mid-point of the producing section open to flow. The point of entry into the tubing may be used as the datum if it is not more than 100 feet above or

below the midpoint of the producing section open to flow.

(b) Under all shut-in conditions and under flowing conditions, when the static column wellhead pressures can be obtained, the bottom-hole pressures shall be calculated as shown in Calculation Example No. 6, Page 28 of the Commission Manual for Back Pressure Test for Natural Gas Wells.

(c) When only the flowing wellhead pressures can be obtained, the bottom-hole pressures shall be calculated as shown in Calculation Example No. 5, Page 25 of the Manual.

(d) When the bottom-hole pressures are recorded by use of a properly calibrated bottom-hole pressure bomb and corrected to the proper datum, these pressures may be used in the bottom-hole formula.

(e) When liquid accumulation in the well bore during the shut-in period appreciably effects the wellhead shut-in pressure, the calculation of the bottom hole pressure shall be made as shown in Calculation Example No. 7, Page 34 of the Manual

3. Wellhead Calculations

(a) The static column wellhead pressure must be obtained if possible.

(b) When only the flowing wellhead pressure can be obtained, the static column wellhead pressure shall be calculated as shown in Calculation Example No. 5, Page 25 of the manual.

(c) When liquid accumulation in the well bore during the shut-in period appreciably affects the wellhead shut-in pressure, appropriate correction of the surface pressure shall be made. This correction shall be made in the manner shown in Calculation Example No. 7, Page 34 of the Manual, or, at the option of the operator, by using a bottom-hole pressure bomb and correcting to wellhead conditions as shown in Case II of Calculation Example No. 6, Page 28 of the Manual.

D. Reports

Upon the completion of the test, the calculations should be shown on Commission

Form C-122. Three copies of this form and the back pressure curve described below shall be submitted to Commission

E. Plotting

(1) The points for the back-pressure curve shall be accurately and neatly plotted on equal-scale log-log paper (3-inch cycles are recommended) and a straight line drawn through the best average of three or more points. When no reasonable relationship can be established among three or more points, the well will be retested.

(2) The cotangent of the angle this line makes with the volume (horizontal) coordinate is the exponent "n" which is used in the back pressure equation. The exponent "n" shall always be calculated as shown in Calculation Example No. 1, Page 9 of the Manual.

(3) If the exponent "n" calculates out to be greater than 1.000 or less than 0.500, the well shall be retested.

(4) If, after retesting the well, no ~~reasonable~~ reasonable alignment can be established among three or more points, then a

straight line shall be drawn through the best average of three or more points of the retest and exponent "n" calculated as described above.

(a) If the exponent "n" is greater than 1.000, a straight line with an exponent value of 1.000 shall be drawn through the point corresponding to the highest rate of flow which was. used in establishing the line whose value was more than 1.000.

(b) If the exponent "n" is less than 0.500, a straight line with an exponent value of 0.500 shall be drawn through the point corresponding to the lowest rate of flow which was used in establishing the line whose value was less than 0.500.

(5) The constant time data points are ordinarily used only to determine the value of the exponent "n". Usually the back-pressure curve is drawn through the stabilized data point and parallel to the line established by the constant time data points. This establishes a Stabilized Absolute Open Flow. The back-pressure curve for this test

shall be drawn through the one-hour constant-time points. The One-hour Absolute Open Flow may then be determined from this back-pressure curve or calculated as shown in Calculation Example No. 1, Page 7 of the Back Pressure Test Manual.

Attach Exhibits