CASE NO. 941

PROPOSED REVISION OF

ORDER NO. R-333-B

GAS WELL TESTING RULES AND PROCEDURES

FOR SAN JUAN BASIN AREA

AUGUST 17, 1955 HEARING

GAS WELL TESTING RULES AND PROCEDURES FOR SAN JUAN BASIN AREA

SECTION A. TYPE OF GAS WELL TESTS REQUIRED:

I. THE INITIAL DELIVERABILITY AND SHUT-IN PRESSURE TESTS FOR NEWLY COMPLETED GAS WELLS.

(A) Immediately upon completion of each gas well in San Juan Basin, a shut-in pressure test of at least 7-days duration shall be made.

(B) Within 45 days after a well is connected to a gas transportation facility the well shall be tested in accordance with Section B, sub-section I, paragraph (A) of this order.

(C) Any tests accomplished for information purposes prior to pipeline connection shall not be recognized as an official test for the establishment of allowables.

II. ANNUAL DELIVERABILITY AND SHUT-IN PRESSURE TESTS:

Annual deliverability and shut-in pressure tests of all producing gas wells are required to be made during the period from April 1 through October 31 of each year.

All wells connected to a pipeline system between November 1 and December 31, of any calendar year shall be tested during the following annual testing period. All wells connected to a pipeline system between January 1 and April 1 of any calendar year shall be tested during the testing period of that calendar year.

III. SCHEDULE OF TESTS.

(A) ANNUAL DELIVERABILITY TESTS.

On or before February 15 of each year, the pipeline companies receiving gas from wells to be tested shall, in cooperation with respective operators, submit a testing schedule for the annual deliverability and shut-in pressure tests for all wells connected to their respective pipeline systems as of February 1 of the year for which the schedule is applicable; such test schedules shall be filed promptly with the Commission for approval, and if approved, the Commission shall furnish each operator,

as identified by lists of names and addresses furnished by the respective pipeline companies, with a copy of such schedule as approved by the Commission, or a part thereof pertinent to such operator's wells, on or before March 15, of each year.

Such schedules shall be filed with the Commission for each Gas Pool as designated by the New Mexico Oil Conservation Commission listing under the heading of each pool the operator, lease, well number and location of each well. Should the pipeline company elect to file schedules by areas then the above listed information shall be listed under the heading of each area in the order listed above.

All wells connected to a pipeline system during the period of February 1 to October 31, both inclusive, of any year shall be scheduled for testing during the testing period for that particular year. Then and in that event the pipeline in cooperation with the operator shall notify the Commission in writing at least (10) ten days before the commencement of the conditioning period for any tests.

In event changes for substantial reasons are necessary in the annual test schedule, the Commission shall be notified (10) ten days before tests are scheduled to commence.

(B) DELIVERABILITY RETESTS.

An operator may retest the deliverability of a well at any time for substantial reason by the notification to the Commission (10) ten days before the retest is scheduled to commence. Such retest shall be subject to the approval of the Commission, and conducted in conformance with Section B, Subsection I paragraph (B) of this Order. The Commission may require the retesting of any well at its discretion by the notification of the operator to schedule such retest.

It shall be required that for all wells which are reworked or recompleted, a deliverability retest must be made within forty-five (45) days following the completion of the workover.

IV. WHO MAY WITNESS 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 pipeline company taking gas from an offset operator, or a representative of a pipeline company taking gas from the well under test.

Deliverability tests required hereinabove in Subsection I and II of this section shall determine the calculated deliverability of each gas well, which shall be reported to the Commission by converting actual deliverability against existing line pressures to the calculated deliverability at a pressure equal to fifty (50) percent of the shut-in pressure of each well in the manner hereinafter specified below. Such calculated deliverability so determined, and hereinafter so referred to, shall not be considered as the actual deliverability of any well into a gas transportation facility, but shall be used by the Commission as an index to determine the well's ability to produce at assumed wellhead working pressures, as compared to other wells in the pool under like conditions.

SECTION B. PROCEDURES FOR TESTS:

The several known gas producing formations of the San Juan Basin represent a variety of testing situations, and each is treated separately.

I. MESAVERDE FORMATION:

(A) INITIAL DELIVERABILITY AND SHUT-IN PRESSURE TEST.

1. Within (45) forty-five days after a newly completed well is connected to a gas transportation facility the operator shall accomplish a deliverability and shut-in pressure test in conformance with Section B, subsection I, paragraph (B) of this order.

2. In the event that testing a newly completed well in accordance with paragraph 1 above, is impractical, the operator may accomplish a deliverability and shut-in pressure test in the following manner:

a. A seven or eight day production chart may be used as a basis for determining the wells deliverability providing the chart so used is

preceded by at least (14) fourteen days continuous production. The well shall produce unrestricted through either the casing or tubing, but not both, into a pipeline during these periods.

b. A shut-in pressure of at least seven days duration shall be taken.

c. The average daily static meter pressure shall be determined in accordance with Section B, subsection I, Paragraph (B). This pressure shall be used as P_t in calculating P_w for the Deliverability Calculation.

d. The daily average rate of flow shall be determined in accordance with Section B, Subsection I, Paragraph (B), of this order.

e. The static wellhead working pressure (P_w) shall be determined in accordance with Section B, subsection I, paragraph (B), of this order.

f. The deliverability of the well shall be determined by using the data determined in paragraphs a through f, above, in the deliverability formula in accordance with Section B, subsection I, paragraph (B), of this order.

g. The data and calculations for the above paragraphs a through f shall be reported to the Commission upon Form C-122-A and filed in triplicate with the

Commission within the forty-five day period after connection of the well. Form C-122-A shall be signed by the operator or an agent designated by the operator. ~~The production~~ chart or a photocopy thereof shall be filed attached to the C-122-A.

(B) THE ANNUAL DELIVERABILITY AND SHUT-IN PRESSURE TESTS:

These tests shall be taken by unrestrictedly producing the well into the pipeline through either the casing or tubing, but not both. The daily flowing rate shall be determined from an average of seven (7) consecutive producing days, following a minimum conditioning period of fourteen (14) consecutive days production. The first seven (7) days of said conditioning period shall have not more than one (1) interruption, which interruption shall be no longer than 36 hours continuous duration. The eighth to fourteenth days, inclusive, of said conditioning period shall have no interruptions whatsoever. All such production during the fourteen (14) day conditioning period plus the seven (7) day deliverability test period shall be at static wellhead working pressures not in excess of seventy-five (75) per cent of the previous annual seven (7) day shut-in pressure of such well if such previous annual shut-in pressure information is available; otherwise, the seven (7) day initial deliverability shut-in pressure of such well shall be used.

In the event that 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 the Form C-122-A. The request shall state the reasons for the necessity for the exception.

The static wellhead working pressure (P_w) of any well under test shall be determined to be the calculated seven (7) day average tubing pressure if the well is flowing through the casing; or the calculated seven (7) day average 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 procedure as set out in New Mexico Oil

Conservation Commission manual entitled "Method of Calculating Pressure Loss Due to Friction in Gas Well Flow Strings". This manual is more specifically known as release 4-G-9-FLT-NW, a copy of which is attached hereto and made a part hereof.

To obtain the shut-in pressure of a well under test the well shall be shut-in immediately after the seven (7) day deliverability test for the full period of seven (7) consecutive days. Such shut-in pressure shall be measured within the next succeeding twenty-four (24) hours following the seven (7) day shut-in period aforesaid. The seven (7) day shut-in pressure shall be measured on the string through which the well flowed during the conditioning and seven (7) day flow period.

All wellhead pressures as well as the flowing meter pressure tests which are to be taken during the seven (7) day deliverability test period, as required hereinabove, shall be taken with a dead-weight gauge. The dead-weight readings taken shall be recorded on the flow chart in psia. The time and point on chart flowing pressure curve at which these readings are taken shall be indicated with an arrow.

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 seven day deliverability test period. Corrections shall be made for pressure base, measured flowing temperature, specific gravity and supercompressibility (superexpansibility), provided however, that if the specific gravity of gas from any well under test is not available, then and in that event an estimated specific gravity may be assumed therefor, based upon that of gas from nearby wells, the specific gravity of which has been actually determined by measurement.

The seven (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 seven (7) day flow period chart (test chart #3). The pressure so calculated shall be used in calculating the wellhead working pressure, determining supercompressibility factors and calculating flow volumes.

The seven (7) day flow period volume shall be calculated from the integrated reading as determined from the flow period orifice meter chart. (Chart #3). The volume so calculated shall be divided by the number of testing days on the chart to determine the average daily flow period rate of flow. The flow chart shall have legibly recorded a minimum of seven (7) days and a maximum of eight (8) 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 seven (7) or eight (8) 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 average integrated flow period rate of flow shall be corrected for meter error by the multiplication of a correction factor determined by dividing the square root of the chart flowing meter pressure psia into the square root of the dead-weight flowing meter pressure psia.

The daily volume of flow as determined from the flow period chart (Test Chart #3) integrator readings shall be calculated by applying the Basic Orifice meter formula.

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

where:

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

C' = The 24 hour basic orifice meter flow factor as taken from New Mexico Oil Conservation Commission release "4G-12-BPT State" and 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 New Mexico Oil Conservation

Commission release No. "4 G-12-BPT-State". The four tables in said release are based on "gas measure committee report No. 2" (Revised 1948) of the American Gas Association, New York 17, New York. A copy of said New Mexico Oil Conservation Commission release is attached hereto and made a part hereof.

The daily flow period average corrected flowing meter pressure, psig, shall be used to determine the supercompressibility factor. Correction shall be made for supercompressibility (deviation from Boyle's law) for flowing meter pressures in excess of 100 psig by the use of Simplified Supercompressibility Tables, compiled from C. N. G. A. Bulletins TS-402 and TS-461, published by John P. Squier Company, Dallas, Texas. These tables have been reproduced by specific permission from John P. Squier Company a copy of which is attached hereto and made a part hereof.

When supercompressibility (superexpansibility) correction is made for a gas containing either nitrogen or carbon dioxide in excess of 2 per cent, the super-compressibility factors of such gas shall be determined by the use of the above mentioned TS-402 and Table 5 for pressure 100-500 psig ~~and~~ TS-461 ~~and Table 2~~ 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 New Mexico Oil Conservation Commission release "4-G-12-BPT-State", may be approved for determining the daily flow period rates of flow upon a showing that such tables are appropriate and necessary.

Deliverability pressure, as used herein for Mesaverde production, is a defined pressure applied to each well and used in the process of comparing the abilities of wells in this formation to produce at wellhead working pressures equal to fifty (50) per cent, of the seven (7) day shut-in pressure of the respective individual wells.

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:

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

WHERE:

D = Deliverability at the deliverability pressure, (P_d) MCF/da. (at Standard Condition of 15.025 psia and 60°F).

Q = Daily flow rate in MCF/da. at wellhead pressure (P_w)

P_c = 7-day shut-in casing (or tubing) wellhead pressure, psia.

P_d = Deliverability pressure; half of the individual well 7-day shut-in pressure, P_c, psia.

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. (Casing pressure if flowing through the tubing, or tubing pressure if flowing through the casing).

n = Average pool slope of back pressure curve (0.75) for Mesaverde wells).

Any test hereinabove provided for will be considered unacceptable if the average flow rate for the final 7 day deliverability test is 25 per cent in excess of any consecutive 7-day average of the preceding two weeks. A "deliverability test" not meeting this requirement shall be retested.

The annual deliverability and shut-in pressure tests as required hereinabove shall be reported upon commission Form C-122-A and filed in triplicate, with the Commission within the month next after completion of such tests. Form C-122-A shall be signed by the operator or agent designated as the operator.

All charts relative to annual deliverability tests shall be identified by the words "Test Chart No. 1" (2, 3, 4, etc.), and any or all charts or photostats thereof shall be made available to the Commission upon its request.

II. PICTURED CLIFFS FORMATION:

(A) INITIAL DELIVERABILITY AND SHUT-IN PRESSURE TEST:

Same as prescribed for Mesaverde formation; see Section B, subsection I, Paragraph (A).

(B) ANNUAL DELIVERABILITY AND SHUT-IN PRESSURE TESTS:

In all respects the deliverability and shut-in pressure tests of wells in the Pictured Cliffs formation shall be made in conformity with the procedures set out in Section B, Subsection I, paragraph (B) of the Mesaverde formation procedures, except that in the back pressure formula, the exponent "n" shall have the value of point eighty-five (.85).

III. FRUITLAND FORMATION:

(A) All initial and annual deliverability and shut-in pressure tests of gas wells producing from the Fruitland formation shall be identical in all respects to those requirements and procedures hereinabove set out and required for the Pictured Cliffs formation in Section B, Subsection II, paragraphs (A) and (B).

IV. THE DAKOTA FORMATION:

All tests of Dakota wells shall be in conformity with requirements and procedures provided hereinabove for the Mesaverde formation, except as follows:

(A) BARKER DOME - DAKOTA: (Storage Area)

1. INITIAL OPEN FLOW POTENTIAL TEST:

An average "pool slope", based upon bottom-hole conditions, shall be established by the Commission after consideration of data to be provided by the operators; these data shall be based upon tests taken in conformity with the conventional back pressure method, indicated in Commission Rule 401. This "slope" shall be applied to each well in the Barker-Dome Dakota Area, as if such slope were the actual performance back pressure slope of each such well, in the following manner:

This back pressure slope so established shall be plotted through a point predetermined by one stabilized flow rate at a static wellhead working pressure not in excess of seventy-five (75) per cent of the seven (7) day shut-in pressure of such well.

The flowing rates (Q) shall be corrected for pressure base, measured flowing temperature, specific gravity and supercompressibility, by the use of methods

of calculation and tables hereinabove referred to and approved in Section B, Subsection I, paragraph (B), of the Mesaverde procedures.

A seven (7) day shut-in pressure test shall be made for each well in the Barker Dome-Dakota Area, provided however, that where the shut-in period exceeds seven days such fact shall be reported to the Commission.

The values of the seven (7) day shut-in pressure (P_c) and the working wellhead pressure (P_w) shall be corrected to bottom hole conditions.

A schedule of tests shall be prepared by the transporter and approved by the Commission, and reports of such tests shall be signed by the operator or his designated agent and duly filed with the Commission, on Form C-122, the regular statewide form.

2. ANNUAL OPEN FLOW POTENTIAL TEST:

This test shall be made of all wells producing from the Barker Dome-Dakota Storage Area by obtaining seven (7) day shut-in pressures of all Dakota wells, converting the same to bottom hole pressures (P_f) computing the squares of such bottom hole pressures, (P_f^2) and applying the same to the original average "pool slope" to obtain an adjusted open flow. If so desired as an alternate method an adjusted open flow may be computed from the following equation:

$$O_{f_2} = O_{f_1}\left[\frac{\left(P_{f_2}\right)^2}{\left(P_{f_1}\right)^2}\right]^n$$

WHERE:

O_{f_2} = Adjusted absolute open flow.

O_{f_1} = Original absolute open flow.

P_{f_2} = New bottom hole shut-in (psia.)

P_{f_1} = Old bottom hole shut-in (psia.)

n = Slope of back pressure curve.

Tests of all wells in the Barker Dome-Dakota storage area shall be made during the period of April 1 through October 31 of each year and reports made to the Commission within the next succeeding month after test is made.

V. PENNSYLVANIAN FORMATION:

All tests of wells producing from the Pennsylvanian formation of the San Juan Basin Area shall be as follows:

(A) INITIAL OPEN FLOW POTENTIAL TEST:

Immediately after completion of each new well an absolute open flow shall be determined by the conventional back-pressure method indicated by Rule 401 of the Commission's Rules and Regulations.

Seven day shut-in pressures will be used in all cases, and, if for any reason the shut-in period exceeds seven days, then, the actual shut-in time shall be reported.

(B) ANNUAL OPEN FLOW POTENTIAL TEST:

This test shall be made of all wells producing from the Pennsylvanian formation of the San Juan Basin area, and such tests shall conform in all respects with the procedure set out next above under initial open flow potential test or in the alternative, by obtaining a seven day shut-in pressure of each well and converting the same to bottom hole pressure (P_f). The square of the bottom hole pressure (P_f^2) will be computed and applied to the original back pressure curve and an adjusted absolute open flow will be obtained.

If shut-in pressure time is in excess of seven (7) days, then the actual shut-in time shall be reported.

There is no objection to the use of an adjusted absolute open flow calculated from the equation as set out hereinabove under Dakota formation, Section B, Subsection IV, paragraph (A) - subparagraph 2.

All tests hereunder shall be made during the period from April 1 through October 31 of each year, and reported to the Commission upon regular Form C-122 during the month succeeding the month in which the tests are made.

NEW MEXICO OIL CONSERVATION COMMISSION

Form C-122
8-8-55

MULTI-POINT BACK PRESSURE TEST FOR GAS WELLS

Pool _____ Formation _____ County _____

Initial _____ Annual _____ Special _____ Date of Test _____

Company _____ Lease _____ Well No. _____

Unit _____ Sec. _____ Twp. _____ Rge. _____ Purchaser _____

Casing _____ Wt. _____ I.D. _____ Set at _____ Perf. _____ To _____

Tubing _____ Wt. _____ I.D. _____ Set at _____ Perf. _____ To _____

Gas Pay: From _____ To _____ L _____ xG _____ -GL _____ Bar.Press. _____

Producing Thru: Casing _____ Tubing _____ Type Well _____
Single-Bradenhead-G. G. or G.O. Dual

Date of Completion: _____ Packer _____ Reservoir Temp. _____

OBSERVED DATA

Tested Through (Prover) (Choke) (Meter) Type Taps _____

	Flow Data					Tubing Data		Casing Data		
No.	(Prover) (Line) Size	(Choke) (Orifice) Size	Press. psig	Diff. h_w	Temp. °F.	Press. psig	Temp. °F.	Press. psig	Temp. °F.	Duration of Flow Hr.
SI										
1.										
2.										
3.										
4.										
5.										

FLOW CALCULATIONS

No.	Coefficient (24-Hour)	$\sqrt{h_w p_f}$	Pressure psia	Flow Temp. Factor F_t	Gravity Factor F_g	Compress. Factor F_{pv}	Rate of Flow Q-MCFPD @ 15.025 psia
1.							
2.							
3.							
4.							
5.							

PRESSURE CALCULATIONS

Gas Liquid Hydrocarbon Ratio _____ Mcf/bbl.
Gravity of Liquid Hydrocarbons _____ deg.
F_c _____ $(1-e^{-s})$ _____

Specific Gravity Separator Gas _____
Specific Gravity Flowing Fluid _____
P_c _____ P_c^2 _____

No.	P_w / P_t (psia)	P_t^2	F_cQ	$(F_cQ)^2$	$\frac{(F_cQ)^2}{(1-e^{-s})}$	P_w^2	$P_c^2-P_w^2$	Cal. P_w	$\frac{P_w}{P_c}$
1.									
2.									
3.									
4.									
5.									

Absolute Potential: _____ MCFPD; n _____

COMPANY _____

ADDRESS _____

AGENT and TITLE _____

WITNESSED _____

COMPANY _____

REMARKS

INSTRUCTIONS

This form is to be used for reporting multi-point back pressure tests on gas wells in the State, except those on which special orders are applicable. Three copies of this form and the back pressure curve shall be filed with the Commission at Box 871, Santa Fe.

The log log paper used for plotting the back pressure curve shall be of at least three inch cycles.

NOMENCLATURE

Q = Actual rate of flow at end of flow period at W. H. working pressure (P_w). MCF/da. @ 15.025 psia and 60° F.

P_c = 72 hour wellhead shut-in casing (or tubing) pressure whichever is greater. psia

P_w = Static wellhead working pressure as determined at the end of flow period. (Casing if flowing thru tubing, tubing if flowing thru casing.) psia

P_t = Flowing wellhead pressure (tubing if flowing through tubing, casing if flowing through casing.) psia

P_f = Meter pressure, psia.

h_w = Differential meter pressure, inches water.

F_g = Gravity correction factor.

F_t = Flowing temperature correction factor.

F_{pv} = Supercompressability factor.

n = Slope of back pressure curve.

Note: If P_w cannot be taken because of manner of completion or condition of well, then P_w must be calculated by adding the pressure drop due to friction within the flow string to P_t.