CASE 5864: AGUA, INC. FOR THE AMENDMENT OF ORDER NO. R-5137, LEA COUNTY, NEW MEXICO

5864

Application

Transcripts.

Small Exhibits

ETC.

BEFORE THE
NEW MEXICO OIL CONSERVATION COMMISSION
Santa Fe, New Mexico
February 16, 1977

EXAMINER HEARING

IN THE MATTER OF:

Application of Agua, Inc. for the amendment of Order No. R-5137, Lea County, New Mexico. CASE 5864

BEFORE: Richard L. Stamets, Examiner

TRANSCRIPT OF HEARING

A P P E A R A N C E S

For the New Mexico Oil Conservation Commission: Lynn Teschendorf, Esq.
Legal Counsel for the Commission
State Land Office Building
Santa Fe, New Mexico

For the Applicant: James T. Jennings, Esq.
JENNINGS, CHRISTY & COPPLE
Attorneys at Law
P. O. Box 1180
Roswell, New Mexico

I N D E X

EXHIBIT INDEX

MR. STAMETS: We will call next Case 5864.

MS. TESCHENDORF: Case 5864, application of Agua, Inc. for the amendment of Order No. R-5137, Lea County, New Mexico.

MR. JENNINGS: I'm James T. Jennings of Jennings, Christy and Copple, Roswell, appearing on behalf of the applicant, Agua, and I have one witness, Mr. Abbott.

(THEREUPON, the witness was duly sworn.)

W. G. ABBOTT

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

DIRECT EXAMINATION

BY MR. JENNINGS:

Q. Would you please state your name, place of residence and occupation?

A. I'm W. G. Abbott, I work for Agua, Incorporated and I'm manager of the Hobbs office.

Q. Mr. Abbott, have you appeared before this Commission on many times and had your qualifications accepted?

A. Yes, sir.

MR. JENNINGS: Are the witness' qualifications acceptable?

MR. STAMETS: They are.

Q. (Mr. Jennings continuing.) Mr. Abbott, are you

familiar with the application in this matter?

A. Yes, sir.

Q. Would you briefly state the nature of the application?

A. Yes, well, I will go through the exhibits to bring everybody up-to-date, it has been a month or two.

Q. You are now referring to what has been marked as Exhibit One?

A. Yes, Exhibit One shows a map of the system. This is the Blinebry-Drinkard SWD system. There are four hundred and seventy-seven wells tied into this system and all of the water is disposed of in three disposal wells. The status of those wells are that the H-35 Well was shut in in September of '75. It has been shut in for over a year because of problems in this area with salt water flow in the salt section. When that well was shut in Agua laid a temporary line up the bar ditch and just covered it with dirt in diverting the produced water up to the SWD C-2. This well takes water by gravity. It has a capacity of three hundred and fifty to four hundred barrels per hour by gravity.

Then we came down and drilled the SWD A-22, that's the well in question. We thought that we could get a well that would take the water by gravity, which it will, but not at the quantities of water that we have to put in it which is around roughly three hundred barrels an hour so it is necessary to pump this well.

So that is the status of the wells. The H-35 is shut in and the C-2 takes water by gravity and the A-22 we have to pump the water in the well.

Q. Mr. Abbott, refer to what has been marked as Exhibit Number Two and identify that and tell what it is.

A. This was a letter to Mr. Ramey outlining the disposal problems in the Blinebry-Drinkard SWD System and asking him to increase the authorized pressure to dispose in the SWD A-22 of increased pressure up to fifteen hundred psi. That letter is dated November 15th.

Q. This was actually seeking administrative approval as provided in the original order?

A. Yes, sir.

Q. And refer to Exhibit Three and identify that, please?

A. Exhibit Three is the answer from Mr. Ramey on November 22nd stating that before the Commission could take any action on the request it would be necessary that you take adequate step rate injection tests on this well to determine the fracture pressure and it says when these tests are concluded submit to this office so a determination can be made.

Q. Were the tests conducted in accordance with the request?

A. Yes, sir, and that is outlined in Exhibit Four where we actually had to run a couple of tests but the first test was an abortive test. We couldn't get the pressure up to so-

called fracture pressure because the well was too good and we didn't have enough water available so we had to put the well back on injection until we pumped up the reservoir to a reasonable pressure and then we conducted this step rate fracture test.

Q. Are you referring now to Exhibit Number Five?

A. No, I'm still on Four. This test was run by Halliburton under our supervision and witnessed by the Conservation Commission personnel and you can see that it is a conclusive test, although we would have liked to have extended it a little longer. We again ran out of water because you are getting up to a rate that was pretty high and it indicates a fracture pressure of fourteen hundred and sixty-five psi. This was corrected for friction to fourteen, fifty. The only friction in this well since we have five and a half inch tubing in the well, there is not much friction going down the tubing but there was a little friction on the surface line. So that gives us a fracture pressure of fourteen, fifty.

Q. Now will you refer to Exhibit Five?

A. Exhibit Five just shows our drilling reports of the two fracture tests and you can see in the second test, the first test was run November 30th of '76 and we got up to a rate of seven barrels per minute injection and we only had a thousand psi on the tubing, so as I stated previously, we had to pump up the well for sometime and we came back and ran

another test on January 7th of '77 where at the end of the test we were putting in ten barrels per minute. This is a much greater rate than we will need at the disposal well but at that rate we did get the pressure on the tubing up to fifteen hundred and fifty pounds.

Q. Would you refer to what has been marked as Exhibit Six and tell what that is?

A. Exhibit Six is just a tabulation of the disposed water in the Blinebry-Drinkard SWD System, showing how the water has increased and also the number of wells connected to the system has increased. We are disposing of over three hundred thousand barrels per month.

Q. Do you anticipate that this will continue to increase, Mr. Abbott?

A. Yes, I think it will continue to increase.

Q. I note from the exhibit that the number of wells is increasing, however, not as rapidly as the barrels of water disposed of. Do you think the number of wells will increase?

A. I think they will, yes.

Q. Refer now to Exhibit Number Seven and identify that for the Examiner?

A. Exhibit Number Seven is a diagrammatic sketch of this SWD A-22. It shows the nine and five eighths inch surface pipe set at three hundred and twenty-one feet and the cement circulated and the seven inch casing set at thirty-eight,

sixty-five with the cement circulated. Then it shows the open-hole section we are disposing in of thirty-eight, sixty-five to forty-nine, sixty-five.

I want to point out that that is an eleven hundred foot section of open hole and I wonder if the fracture test on a disposal well like this if they mean much in that if a formation fractures it undoubtedly fractures in the San Andres section of that eleven hundred foot section. I don't think if it indicates a fracture on our fracture test that it means that we are going to fracture to the surface of the ground, we are fracturing in the San Andres.

An eleven hundred foot of section is a long section and I don't think you can compare a fracture test in this disposal zone of this depth, this length, you can't compare that with a fracture test run on a water injection well in a water flood where you have thirty to forty feet of section.

Q. Mr. Abbott, would you refer to Exhibit Number Eight?

A. Yes, Exhibit Eight, I furnished this. This is a step rate injection test paper written for a reservoir engineering school. I think it probably originated with the Conservation Commission but I thought it was important to include in here for other operators to read.

You notice on about the fifth page of this report, the test procedure. We used this test in that we pumped at various rates for an hour before we went to another rate and

that's very important that you have each step the same length in one of these step rate tests and I think it's a good test. I think the procedure might be changed to cut the time down to thirty minutes or forty-five minutes but we did conduct the test as written up in this procedure.

Q. This is the test that you actually conducted in this well?

A. No, this was a paper that was written telling us how to conduct the test and this is what we used in running the test.

Q. Mr. Abbott, I believe that this matter has been before the Commission on other occasions and at the last hearing you made a request to increase the pressure, allowable pressure that was set at eight hundred psi, is that correct?

A. Yes.

Q. Do you find it feasible to inject at this pressure?

A. No, we couldn't inject at this pressure, we couldn't get rid of the produced water at the eight hundred pound pressure.

Q. What pressure do you feel would be the top -- what was the maximum pressure that you feel you could effectively produce at in this?

A. Well, slightly below this fourteen, fifty fracture pressure.

Q. If the Commission allows the fourteen, fifty fracture

pressure do you think that you can adequately produce this water that you now have available, dispose of the water?

A. Yes, sir, I think if it's a reasonable pressure that is allowed by the Commission I think we can get the water in the well.

Q. Do you feel that this will in any way affect or impair the correlative rights of any of the other operators in the vicinity?

A. No, sir, I think we have to -- it's very necessary to dispose of the water in this area as in other areas and I think the best place to put the water is in the San Andres zone and I think it is necessary to dispose of the water.

Q. In the event that you are not allowed to dispose of the water at the increased pressure do you feel that it will result in waste?

A. Yes, sir.

MR. JENNINGS: At this time I would like to request that the testimony heretofore presented in Cases Number 5644 and 5592 be incorporated into the record of this Case.

MR. STAMETS: The records in those cases will be admitted.

MR. JENNINGS: We have no further testimony of this witness at this time but I would offer the exhibits.

Q. (Mr. Jennings continuing.) Mr. Abbott, was Exhibit Number One prepared by you or under your supervision?

A. Yes, sir.

Q. Were Exhibits Number Two and Three, letters received or addressed by you in the ordinary course of business, copies of those letters?

A. Yes, sir.

Q. Two, Three and Four?

A. Yes, sir.

Q. Exhibit Number Five, was that prepared by you or under your supervision?

A. Yes, sir.

Q. And also Six and Seven?

A. Yes.

Q. And Exhibit Number Eight is a technical paper?

A. That's right.

MR. JENNINGS: We would offer these exhibits.

MR. STAMETS: These exhibits will be admitted.

(THEREUPON, Applicant's EXhibits One through Eight were admitted into evidence.)

CROSS EXAMINATION

BY MR. STAMETS:

Q. Mr. Abbott, looking at your exhibits it would appear as though at fourteen hundred psi you would be able to inject four hundred and twenty barrels per hour. It would appear that this pressure would be below fracture pressure and would be

sufficient for your volumes at the present time, is this correct?

A. Yes, sir, I believe so.

Q. You would be satisfied with a fourteen hundred pound limit?

A. We would have to put the well back on a pump and see how it reacted but all indications are that should be enough pressure. It may be necessary that we acidize the well occasionally to keep that pressure down at a low level.

MR. STAMETS: Any other questions of the witness? He may be excused.

(THEREUPON, the witness was excused.)

MR. STAMETS: Anything further in this case? We will take the case under advisement.

REPORTER'S CERTIFICATE

I, SIDNEY F. MORRISH, a Certified Shorthand Reporter, do hereby certify that the foregoing and attached Transcript of Hearing before the New Mexico Oil Conservation Commission was reported by me, and the same is a true and correct record of the said proceedings to the best of my knowledge, skill and ability.

Sidney F. Morrish, C.S.R.

I do hereby certify that the foregoing is a complete record of the proceedings in the Examiner hearing of Case No. 5864, heard by me on 2-16, 1977.

Richard L. Stamets, Examiner
New Mexico Oil Conservation Commission

OIL CONSERVATION COMMISSION

STATE OF NEW MEXICO
P. O. BOX 2088 - SANTA FE
87501

DIRECTOR
JOE D. RAMEY

LAND COMMISSIONER
PHIL R. LUCERO

STATE GEOLOGIST
EMERY C. ARNOLD

March 16, 1977

Re: CASE NO. 5864
ORDER NO. R-5137-C

Mr. James Jennings
Jennings, Christy & Copple
Attorneys at Law
Post Office Box 1180
Roswell, New Mexico 88201

Applicant:

Agua, Inc.

Dear Sir:

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

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

Copy of order also sent to:

Hobbs OCC x
Artesia OCC x
Aztec OCC

Other

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

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

CASE NO. 5864
Order No. R-5137-C

APPLICATION OF AGUA, INC. FOR THE
AMENDMENT OF ORDER NO. R-5137, LEA
COUNTY, NEW MEXICO.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on February 16, 1977, at Santa Fe, New Mexico, before Examiner Richard L. Stamets.

NOW, on this 15th day of March, 1977, 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 by Commission Order No. R-5137, dated December 17, 1975, the applicant, Agua, Inc., was authorized to dispose of produced salt water into the San Andres formation through the open-hole interval from approximately 4,000 feet to 5,000 feet in its Blinebry-Drinkard SWD System Well No. A-22, located 817 feet from the North line and 965 feet from the East line of Section 22, Township 22 South, Range 37 East, NMPM, Lea County, New Mexico.

(3) That in order to ensure that the disposed water would remain confined to the San Andres formation and not migrate through fractures or otherwise into other formations, said Order No. R-5137 required that the aforesaid Well No. A-22 be equipped with a pop-off valve or acceptable substitute which would limit the wellhead injection pressure to no more than one hundred (100) psi.

(4) That by Commission Order No. R-5137-B, dated August 3, 1976, the applicant obtained authorization to increase said wellhead injection pressure limitation to eight hundred (800) psi.

(5) That the applicant now seeks the further amendment of said Order No. R-5137 to provide for a wellhead injection pressure limitation of up to 1500 psi.

(6) That the subject well is located within an area where vertical formation fracturing is suspected to exist.

(7) That formation fracturing occurs as the result of large volumes of fluid being injected into the formation at high pressure.

(8) That disposal of large volumes of water at 1500 psi as sought by the applicant may create vertical fractures in the formation or enlarge existing fractures, if they already exist, thereby permitting the disposal water to migrate into other formations, possibly resulting in the loss of underground reserves, thereby causing waste, or in injury to offsetting leases or properties.

(9) That insofar as the Commission can now determine, a surface wellhead injection pressure of approximately 1400 psi will not cause formation fracturing, and will not result in loss of underground reserves nor injury to offsetting leases or properties, nor otherwise cause waste or violate correlative rights.

(10) That the applicant's request for the amendment of Commission Order No. R-5137 to permit disposal of produced salt water in its Well No. A-22 at a surface injection pressure of up to 1500 psi should be denied, but said Order No. R-5137 should be further amended to permit such disposal at surface injection pressures up to 1400 psi, provided proper safeguards are taken that such pressure not be exceeded.

IT IS THEREFORE ORDERED:

(1) That the application of Agua, Inc., for the further amendment of Commission Order No. R-5137 to permit disposal of produced salt water into the San Andres formation through the open-hole interval from approximately 4,000 feet to 5,000 feet in its Blinebry-Drinkard SWD System Well No. A-22, located 817 feet from the North line and 965 feet from the East line of Section 22, Township 22 South, Range 37 East, NMPM,

Lea County, New Mexico, at a surface injection pressure of up to 1500 psi is hereby denied.

(2) That Order No. (2) of Commission Order No. R-5137 is hereby further amended to read in its entirety as follows:

"(2) That the injection well or system shall be equipped with a pop-off valve or acceptable substitute which will limit the wellhead injection pressure on the injection well to no more than fourteen hundred (1400) psi."

(3) 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

PHIL R. LUCERO, Chairman

EMERY C. ARNOLD, Member

JOE D. RAMEY, Member & Secretary

S E A L

dr/

AGUA, INC.
POST OFFICE BOX 1979
HOBBS, NEW MEXICO
88240

TELEPHONE: 505 393-6188

November 15, 1976

BEFORE EXAMINER STAMETS
OIL CONSERVATION COMMISSION
EXHIBIT NO. 2
CASE NO. 5864
Submitted by
Hearing Date

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

Attn: Joe D. Ramey

Re: Blinebry-Drinkard SWD System

Gentlemen:

The subject System currently collects and disposes of 11,351 barrels per day of waste water from 469 connected wells, representing a 70% increase in waste waters collected and disposed from a 23% increase in connected wells subsequent to the 1973 OPEC Oil Embargo. The engineering and physical efforts to efficiently handle and dispose of such increases in waste waters, in accordance with the rules and regulations of all concerned County, State and Federal regulatory bodies, has been extremely complicated by restrictions placed on AGUA's highest and best use of the disposal wells serving the System.

Disposal Well No. H-35, by letter directive dated August 22, 1975, was ordered to cease accepting waste waters by September 26, 1975, because of certain conditions alleged to exist in said well. Such allegations have been disproven by AGUA in the immediate past and can be physically disproven at any future point in time.

Waste waters reaching terminal storage at Disposal Well No. H-35 are currently being pumped through a "temporary" 6" PVC plastic line laid in the borrow ditch of County Road C-17 to Disposal Well No. C-2. Such 6" line has had its "temporary" (6-month) status renewed on two occasions. It is hoped the "temporary" permanence holds until such time as its need has expired and AGUA is required to take up the line.

Disposal Well No. A-22 was drilled on a site contiguous to wells which had experienced lost circulation problems when drilling through the San Andres formation. As chance would have it, Disposal Well No A-22 was drilled into and completed in such an unexpectedly tight portion of the main body of the San Andres that three sizeable acid treatments have not increased the well's acceptance of waste waters at an 800 psi surface injection pressure authorized by Order No. R-5137-B.

Emergency Order No. E-29 authorized disposal of waste waters in Disposal Well No. C-2 into the perforated interval from 4230' to 4320' until a time no later than October 15, 1976; and, on or before such time, the perforated interval 4230' to 4320' was to be effectively isolated from the acceptance of any and all waste waters. Such isolation of the perforated interval was in compliance with the wishes of Exxon Company, U. S. A.

The exigencies attendant to the required, proper handling and subsurface pressure disposal of approximately 230 barrels per hour of waste waters diverted to Disposal Well No. A-22, and the resultant 42 barrels per hour of waste waters reaching terminal storage facilities at Disposal Well No. H-35 for subsurface pressure disposal, dictates an AGUA request for administrative approval of and for the following:

(1) Increase to an authorized 1,500 psi for the pressure disposal of 5,520 barrels per day of waste waters into Disposal Well No. A-22.

Again, we realize the existing problem of water breakthrough in the salt section but cannot believe Disposal Wells A-22 and H-35 contributed to such breakthrough problem as first noticed in the latter part of 1959, nor in the additional breakthroughs that have been experienced since September, 1975.

Yours very truly.

AGUA, INC.

W. G. Abbott

W. G. Abbott
Manager

OIL CONSERVATION COMMISSION

STATE OF NEW MEXICO
P. O. BOX 2088 - SANTA FE
87501

DIRECTOR
JOE D. RAMEY

LAND COMMISSIONER
PHIL R. LUCERO

STATE GEOLOGIST
EMERY C. ARNOLD

November 22, 1976

BEFORE EXAMINER STAMETS
OIL CONSERVATION COMMISSION
EXHIBIT NO. 3
CASE NO. 5864
Submitted by
Hearing Date

Agua, Inc.
P. O. Box 1978
Hobbs, New Mexico 88240

Attn: Mr. William G. Abbott

Gentlemen:

I am in receipt of your letter of November 15, 1976, wherein you request an increase in the injection pressure for your disposal well No. A-22.

Before the Commission can take any action on this request, it will be necessary that you take adequate step rate injection tests on the well to determine the fracture pressure. When these tests are concluded and submitted to this office, a determination can then be made.

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

RECEIVED
NOV 23 1976
AGUA, INC.

AGUA, INC.
P. O. OFFICE BOX 1978
HOBBS, NEW MEXICO
88240
TELEPHONE: 505 393-6188

January 18 1977

BEFORE EXAMINER STAMETS
OIL CONSERVATION COMMISSION
EXHIBIT NO. 4
CASE NO. 5864
Submitted by
Hearing Date

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

Attn: Joe D. Ramey

Re: Step-rate Fracture Test
Blinebry-Drinkard
SWD Well A-22

Gentlemen:

Pursuant to your letter of November 22, 1976 requesting we conduct an adequate step-rate test to determine fracture pressure in our Blinebry-Drinkard Salt Water Disposal Well No. A-22, we are enclosing a curve showing the results of a step-rate injection test conducted by Halliburton Services on January 7, 1977.

A step-rate fracture test was attempted on November 30, 1976, however, the results were inconclusive due to insufficient water supply on location. Subsequent to this aborted test, periods of freezing weather severely reduced the amount of waste waters handled by the System and, conversely, caused many connected tank batteries to dump gas and oil into and effectively block the System's collection lines.

AGUA, INC., as Operator of the Blinebry-Drinkard Salt Water Disposal System, respectfully requests that the Commission take

action on our November 15, 1976 request to increase the injection pressure for our Disposal Well No. A-22.

Yours very truly,

AGUA, INC.

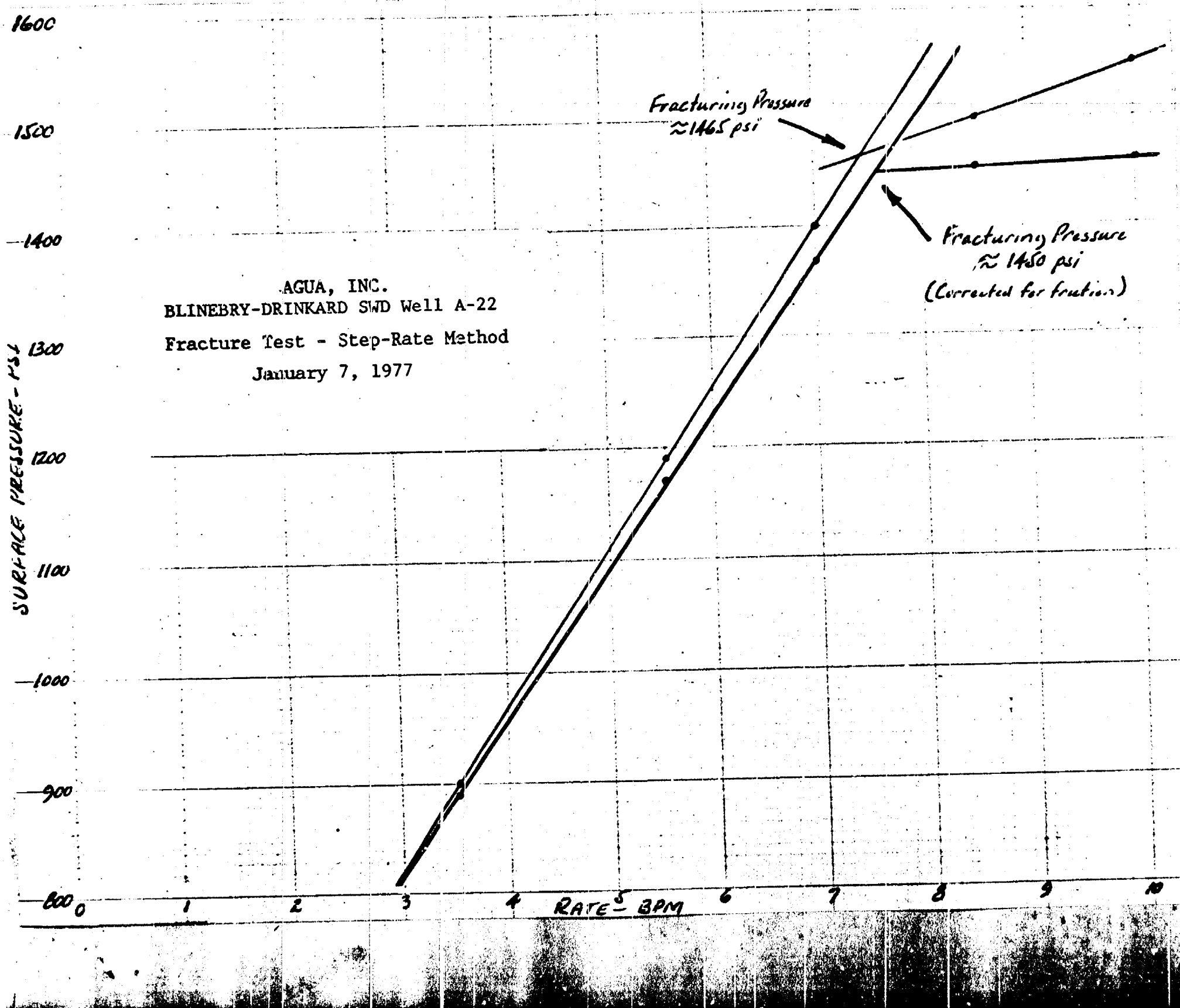
W. G. Abbott

W. G. Abbott
Manager

Attachments

cc: James Jennings
Jerry Sexton
File

AGUA, INC.
BLINEBRY-DRINKARD SWD Well A-22
Fracture Test - Step-Rate Method
January 7, 1977



AGUA, INC.

BLINEBRY-DRINKARD SALT WATER DISPOSAL WELL NO. A-22

FRACTURE TEST

11/30/76 8:30 A.M. Jarrel Services, Inc. arrived location and rigged up lubricator and bomb to tubing. Ran bomb down hole and tagged bottom or fill at 4135'.

Halliburton Services rigged up pump truck to redwood water tanks and loaded tubing with about 100 bbls. water at 4 BPM.
Started controlled injection at 10:10 A.M.

Time	Amount	PSI	Rate BPM	
10:10 A.M.	100 bbls.	200#	4.0	*Loaded tubing
10:45	1585 gals.	200#**	.5	**Dropped to 50#
11:45	2750 gals.	25#	1.0	
12:45 P.M.	5410 gals.	200#	2.0	
1:45	8800	400#	3.5	
2:45	13900	800#	5.5	
3:45-4:05	5383	1000#***	7.0	***ISI

4:05 P.M. End test because of low water level in redwoods. Rigged down trucks. Move off location.

Test witnessed by Jerry Sexton and Nathan Clegg with N.M.O.C.C.

BEFORE EXAMINER STAMETS
OIL CONSERVATION COMMISSION
EXHIBIT NO. 5
CASE NO. 5864
Submitted by
Hearing Date

1/7/77

FRACTURE TEST

Halliburton Services rigged up pump truck to redwood tanks and wellhead. Started pumping into tubing at controlled rate.
525# tbg. pressure at start of test.

Time	Tbg. at End of Rate	Rate BPM	
10:55 A.M.	900	3.5	
11:55 A.M.	1190	5.5	
12:55 P.M.	1400	7.0	
1:55 P.M.	1500	8.5	
2:55 P.M.	1550	10.0	
End Test 3:05 P.M.	1550	10.0	***ISI

End test because of low water level. Rigged down trucks. Move off of location.

Test witnessed by Nathan Clegg with N.M.O.C.C.

4:00 P.M. Tbg. dropped to 1100#. Started triplex pump back on automatic.

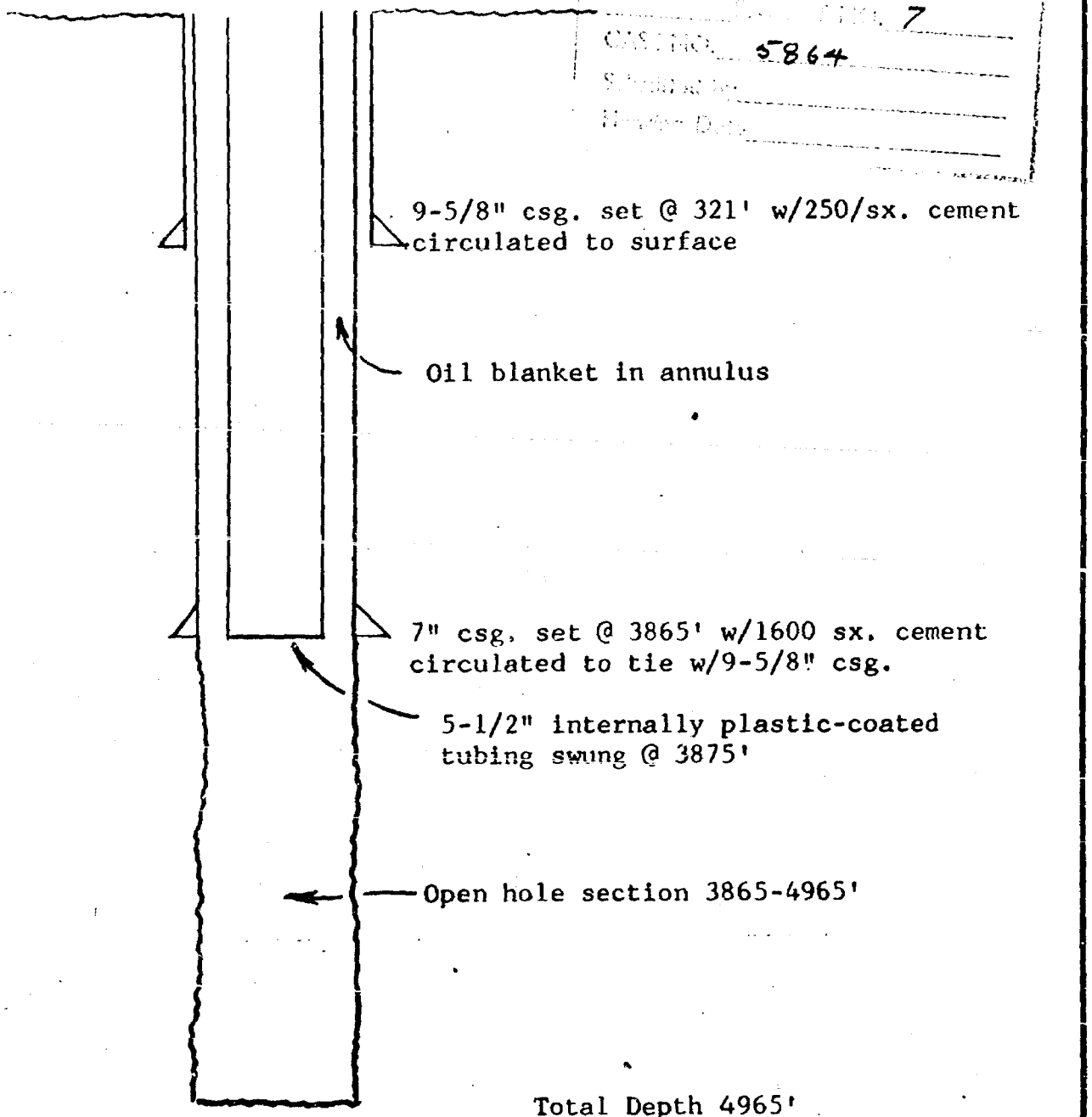
BLINEBRY-DRINKARD SWD SYSTEM

	MONTH	BBLS. DISPOSED	NO. WELLS CONNECTED TO SYSTEM
1976	Jan.	266,910	443
	Feb.	226,490	447
	Mar.	288,578	445
	Apr.	307,216	462
	May	314,401	466
	June	286,255	465
	July	300,099	471
	Aug.	318,171	465
	Sept.	356,722	469
	Oct.	357,465	469
	Nov.	335,666	475
	Dec.	332,700	477
1977	Jan.	321,271 *	477

* Disposed volume increased 20% during past 12-month period.

(7)

RECEIVED
OIL CONSERVATION DIVISION
1976 JUL 7
CASE NO. 5864



DIAGRAMMATIC SKETCH

Salt Water Disposal Well No. A-22
NE/4 NE/4 Section 22, T22S, R37E, Lea County, N.M.
BLINEBRY-DRINKARD SATL WATER DISPOSAL SYSTEM

DWN.	3/76	JVR

AGUA, INC.
HOBBS, NEW MEXICO

SCALE: None
DWG. NO. A-178

K-E HERCULENE® 70001

DICK

ABBOTT

FOR RADIOACTIVE TRACER SURVEY I TEST FOR THE LIFE OF THE FLOOD, AS THE RESERVOIR FILLS

RESERVOIR ENGINEERING SCHOOL

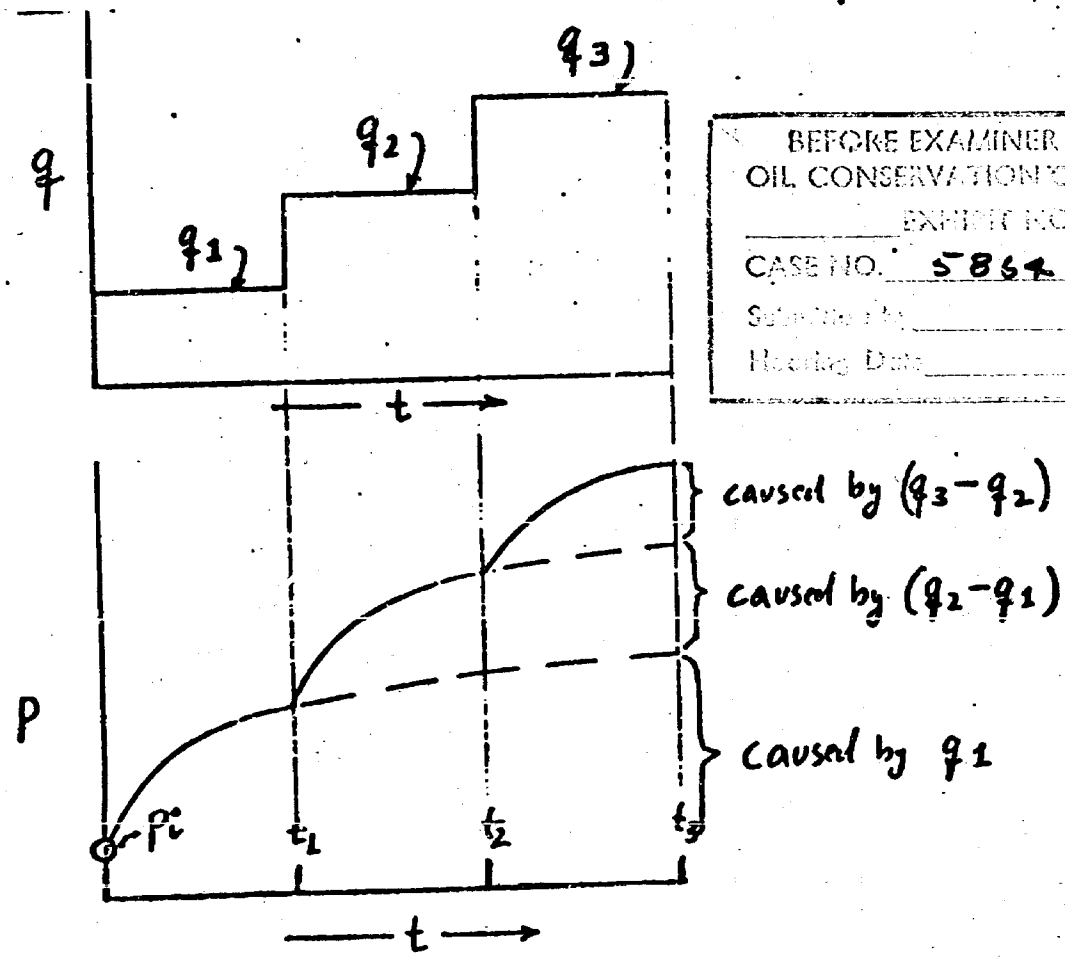
Step Rate Injectivity Tests

THE PARTING PRESSURE MAY INCREASE AS MUCH AS 500PSI

The main purpose of these tests is to find the maximum safe injection pressure that we can use without fracturing the formation. A recommended test procedure and typical data are given in the attached report.[1]

If we have good data, we can also calculate $k_w h$, skin, and effective well bore radius of the unfractured formation. This can be done with the aid of the so-called Odeh method.

The analysis method is based on the "principle of superposition" which is explained in the sketch below.



BEFORE EXAMINER STAMETS
OIL CONSERVATION COMMISSION
EXHIBIT NO. 8
CASE NO. 5864
Submitted by
Hearing Date

The first rate, q_1, sets up a typical transient pressure versus time curve. Then the second rate, q_2, generates a second such curve which is added or "superposed" on the first curve, and so on.

The "principle of superposition" and the Odeh method developed from it are explained for pressure drawdown tests in Sections 2.8 and 6.1 of the SPE Monograph.[2] We adapted the method (with very few minor changes) to step rate test analysis. There are four prerequisites that must be kept in mind: (1) Rates must have been constant in each step. (2) Accurate data must have been taken. (3) The analysis for $k_w h$ and skin can be applied only to the data taken below the frac pressure (as indicated on the standard step rate plot, such as shown in Figure 1 of the attached report). (4) The correct initial pressure, p_i, must be known. This pressure is simply the intercept of the standard step rate plot when the injection rate equals zero.

The method can best be illustrated by an example using data obtained in the Grubb No. 284 well of the San Miguelito field, Ventura County, California. (This well is labeled No. 2 in Figure 1 of the attached report.) The following information was available for this well before the step-rate test was made:

$\mu_w = 0.45$ cp, $B_w = 1.0$, $h = 270$ feet (from a radioactive tracer injectivity survey), $\phi = 0.186$, $c_t = 1.5 \times 10^{-5}$ psi^{-1} and $r_w = 0.25$ feet

A large number of accurate pressure versus time data were taken during the test. Only a few of these are listed in the first three columns of the following table:

t Hours	q B/D	p psi	Data Point	Step No. n	Odeh Sum*	$\frac{\Delta p}{q}$**
0	0	642	-	-	-	-
0.5	100	720	a	1	-.301	0.780
1.0	100	730	b	1	0	0.880
1.5	250	856	c	2	-0.110	0.856
2.0	250	874	d	2	0.120	0.928
2.25	750	1,143	e	3	-0.335	0.668
2.50	750	1,182	f	3	-0.112	0.720
3.00	750	1,216	g	3	0.124	0.765

*Odeh Sum $= [q_1 \log t + (q_2 - q_1)\log(t - t_1) + (q_3 - q_2)\log(t - t_2) + \ldots +$

$(q_n - q_{n-1})\log(t - t_{n-1})]/q_n$ (1)

**$(p - p_i)/q_n$ (2)

$p_i = 642$ psi

$t_1 = 1.0$ hour; $q_1 = 100$ B/D

$t_2 = 2.0$ hours; $q_2 = 250$ B/D

$t_3 = 3.0$ hours; $q_3 = 750$ B/D

Sample Calculations:

For data point a (Step 1):

$$\text{Odeh Sum} = q_1 (\log t)/q_1 = 100 (\log 0.5)/100 = -.301$$
$$(p - p_i)/q_1 = (720 - 642)/100 = 0.78$$

For data point g (Step 3):

$$\text{Odeh Sum} = [q_1 \log t + (q_2 - q_1)\log(t - t_1) + (q_3 - q_2) \log (t - t_2)]/q_3$$
$$= [100 \log 3 + (250 - 100)\log(3 - 1) + (750 - 250) \log (3 - 2)]/750$$
$$= 0.124$$

$$(p - p_i)/q_3 = (1,216 - 642)/750 = 0.765$$

The last two columns of the table were computed by Equations 1 and 2 as illustrated in the sample calculations above. The computed data were plotted in Figure 4. From this figure, we can obtain the desired answers by the Odeh method as follows:

$$k_w h = \frac{162.6\ \mu_w B_w}{m'} \tag{3}$$

$$S = 1.151 \left[\frac{b'}{m'} - \log \frac{k_w}{\phi \mu_w c_t r_w^2} + 3.23\right] \tag{4}$$

$$\text{and } r_w' = r_w e^{-s} \tag{5}$$

where m' = slope of Odeh plot
b' = intercept when Odeh Sum = 0
r_w' = effective well bore radius, feet

Note in Figure 4 that there is a sharp discontinuity between data points d and e. This is interpreted as being due to fracturing. This interpretation is the same as the one drawn from the standard plot for well No. 2 in Figure 1. The only real justification therefore for Figure 4 is that we can calculate $k_w h$, s, and r_w' for the well.

The solution of the Odeh method calculations is as follows:

From Figure 4 and Equation (3):

$$k_w h = 162.6 \times 0.45 \times 1.0/0.35 = 209 \text{ md ft}$$

$$k_w = 209/270 = 0.77 \text{ md}$$

From Figure 4 and Equation (4):

$$S = 1.151 \left[\frac{0.88}{0.35} - \log \frac{0.77}{0.186 \times 0.45 \times 1.5 \times 10^{-5} \times 0.0625} + 3.23\right]$$

$$S = -1.4$$

From Equation (5):

$$r_w' = 0.25\, e^{1.4} = 1.0 \text{ ft}$$

The above-described procedure is tedious and can be used only when we have a great amount of accurate data.

Recommended Analysis Procedure

The following analysis procedure uses only the data shown in the standard pressure vs rate graph (Figure 5). This procedure is based on D'Arcy's law for radial flow:

$$q = \frac{0.00707\, k_w h\, \Delta p}{\mu_w \ln (r_e/r_w)} \qquad (6)$$

Let $m = \Delta p/q$

$$\text{Then } k_w h = \frac{141\, \mu_w \left[\ln (r_e/r_w) + S\right]}{m} \qquad (7)$$

m is the slope of the curve shown in Figure 5. The radius r_e is the same as the "radius of investigation" described in the SPE Monograph.[2] Thus,

$$r_e = r_{inv} = \sqrt{0.00105\, k_w t/\phi \mu_w c_t} \qquad (8)$$

t - hours

Problem

What is the fracturing pressure for Grubb 284? Use the data of Figure 5 and the following additional information.

$k_w h$ = 234 md ft (from pressure fall-off test)
h = 270 ft (from radioactive injectivity profile)
t = 1 hour (per step)
ϕ = 0.186
μ_w = 0.45 cp
c_t = 1.5×10^{-5}
r_w = 0.25 ft

Hint: Use Equations (7) and (8) in the analysis.

STEP RATE INJECTIVITY TESTS FOR DETERMINING SAFE WATER INJECTION PRESSURES UNDER D'ARCY AND NON-D'ARCY FLOW CONDITIONS

OBJECT

Describe procedures for evaluating fracturing pressures in water injection wells under various flow conditions.

INTRODUCTION

Step rate injectivity tests have been used for many years to determine safe injection pressures in waterflood operations.[1,2] The word "safe" in this connection refers to the maximum injection pressure that can be used without parting or fracturing the formation. Early literature data referred only to D'Arcy type flow in certain fields having narrow ranges of permeability values.

Questions that have arisen in recent tests in a number of different fields include the following:

1. How should the wells be conditioned prior to a test?
2. How long should each injectivity step last?
3. What equipment is needed for rate control and for rate and pressure measurements?
4. How should data be analyzed under D'Arcy and non-D'Arcy flow conditions, and how can these types of flow conditions be recognized?
5. Will the step rate test damage the formation?

This report attempts to answer the above questions on the basis of recent field test experience.

CONCLUSIONS

1. Wells should be shut in before step rate testing so that the bottom-hole pressure is reduced to near the shut-in formation pressure.
2. Each step rate test should consist of a series of constant rate injections progressing from a low rate to a high rate. Each rate step in a given well should have exactly the same time duration. For low permeability formations ($K_{AIR} \approx 5$ md), each step should last one hour. Less time is required for higher permeability formations.
3. Rates should be controlled with flow rate regulators and monitored with turbine-type flowmeters. Pressures should be measured in the well with an Amerada-type device or a Sperry-Sun "Permagauge."
4. Both D'Arcy type and non-D'Arcy type flow conditions can be analyzed for indicated fracturing pressures by methods described and illustrated in this report. The non-D'Arcy flow conditions can be recognized from a characteristic concave curvature near the origin of a pressure versus rate plot.
5. No damage can conceivably result from step rate tests in old waterfloods as long as the injection pressures during the tests do not exceed injection pressures used earlier during the waterflood history. In new waterfloods, we should select a typical well for a test. In it we should use low and moderate injection rates until we definitely establish a fracturing pressure. Later tests should be designed so that they do not greatly exceed this pressure.

TEST PROCEDURE

The test well should be shut in long enough so that the bottom-hole pressure is near the shut-in formation pressure. The step rate injectivity test that follows consists of a series of constant rate injections with rates increasing from low to high in a stepwise fashion.

Recent field experience has shown that useful data are obtained by letting each step last 60 minutes in tight formations. Shorter time spans can be used in high permeability formations as shown in Table 1 of the Appendix. The time step duration is not critical. It only needs to be reasonably close to the recommended values shown; however, each step should last exactly as long as the preceding step.

In selecting rates for the test, one possible rule of thumb is to use 5, 10, 20, 40, 60, 80, and 95 percent of the maximum available rate. The above

schedule may be varied to suit the conditions of the test. For instance, it may be difficult to accurately control a very low rate, in which case the test may be started at a somewhat higher rate than shown above.

EQUIPMENT

Injection rates during the test should be controlled with a constant flow rate regulator. We have used regulators made by either one of the following companies:

1. Taylor Oil Tools
2. Fisher Governor Company
3. Fluid Packed Pump (Armco)

These regulators need to be tested before use. We have used all three makes and obtained useful data. There may be other makes that are equally suitable.

Flow rates should be measured with Halliburton turbine flowmeters and a Halliburton rate indicating meter. It is advisable to calibrate this equipment by timing flow into a 5-gallon container (B/D = 10,286 ÷ seconds to fill 5-gallon container).

Pressures should be measured with an Amerada-type down-hole pressure device or a Sperry-Sun "Permagauge." It is also advisable to observe and/or record pressures with a good quality surface gage or recorder.

DATA ANALYSIS

The pressure at the start of the test (at q = 0) and the pressures obtained at the end of each injection rate step should be plotted against injection rate as shown in Figures 1 and 2. The pressures shown in these figures are surface injection pressures. They were obtained by reading pressures recorded by an Amerada bomb at a 4,000-foot depth and correcting the readings to the surface elevation of the well.

When the data indicate that it takes less pressure for a unit rate change, we generally infer that fracturing has taken place. Figure 1 shows typical data. Note that Well No. 1 apparently fractured at a surface pressure of 1,325 psi. In Well No. 2, it appears that a fracture occurred first at a pressure of 1,030 psi and that a second and more severe fracture occurred at 1,860 psi.

Occasionally, pressure versus rate plots do not form a straight line but form a curve with a distinctive concave upward curvature near the origin as shown in Figure 2. The best reason we can give for this is a non-D'Arcy flow condition downstream from the pressure measuring device. This implies that there is probably an orifice-like obstruction causing turbulent flow. An added resistance is thus created which is proportional to the square of the injection rate (q). Note in Figure 2 that when pressure is replotted versus $(q + D'q^2)$, the graph becomes similar to the ones shown in Figure 1. The replotted data of Figure 2 indicate that fracturing probably occurred at a pressure of 1,330 psi. (More information on non-D'Arcy flow analysis methods is given in the Appendix.)

The step rate test data shown in Figures 1 and 2 were for a mature (5 years old) waterflood. Step rate data for a young (1 year old) waterflood are shown in Figure 3. The remarkable feature of the data shown in Figure 3 is that the fracturing pressure was only slightly above surface pressure in two wells (Nos. 6 and 7) and slightly below surface pressure in another well (No. 5). We have noted similar phenomena in another low pressure reservoir. It should be noted that in wells in which initial pressure is less than hydrostatic, as in Figure 3, the correct early rates (in the formation) are somewhat less than surface rates because of rising fluid levels in the wall. The data shown in Figures 1-3 are in general agreement with fracturing pressure versus formation pressure trends reported in the literature.[5]

WILL A STEP RATE TEST DAMAGE THE FORMATION?

When injection pressure is reduced below the indicated fracturing pressure, forces come into play that tend to heal the fracture and keep it closed.

What is happening is that the net effect of the overburden pressure becomes stronger than the force that tends to keep the fracture open. This mechanism is believed to make step rate injectivity testing possible. We have observed it in virtually every active injection well that we have tested.

A study of field records showed that injection pressures were in the 2,100-2,450 psi range in Wells 1, 2, and 3 preceding the step rate tests. This means that we were operating considerably above the fracturing pressures indicated in Figures 1 and 2. It is therefore not believed possible that the tests could have done any damage that might not have been done by the preceding injection. (We actually do not have any proof at this time that the earlier high pressure injection caused permanent damage.)

It appears safe to say in general that no new damage can be caused by step rate tests in old established waterfloods as long as the injection pressures during the tests do not exceed injection pressures that had been used earlier during the waterflood history. When injection is planned, however, in a virgin waterflood, it is advisable to proceed with caution. We should step rate test only one well at a time and use low and moderate injection rates until we definitely establish a fracturing pressure. Later tests should be designed so that they do not greatly exceed this pressure.

HOW ARE RESULTS OF STEP RATE TESTS RELATED TO RESULTS OF PRESSURE FALL-OFF TESTS?

Pressure fall-off test data can give us a clue as to whether we are operating above or below fracturing pressure. These data can be analyzed by the conventional methods originally explained by Horner and Van Everdingen.[3] Thus, if the calculated skin factor, s, is definitely negative, we can conclude that we probably have a fracture. One way to explore this matter further is to reduce the injection pressure for some time, say one month, and then run another pressure fall-off test. If s is then closer to zero, we can infer that the induced fracture tended to heal.

ODEH METHOD OF ANALYSIS

Step rate data taken during the early part of the test can be analyzed by a multiple-rate technique.[4] This so-called Odeh method gives $k_w h$ and skin factor values before fracturing, provided that good data are available. A computer program has been prepared by H. C. Walther for this technique.

REFERENCES

[1] Yuster, S. T., and Calhoun, J. C. Jr., "Pressure Parting," Prod. Monthly, V. 9, No. 4: 16-26 (February, 1945).

[2] Grandone, P., and Holleyman, J. B., "Injectivity Tests for Waterflooding Mid-Continent Oil Sands," World Oil, pp. 152-4,6,8, December, 1949.

[3] Matthews, C. S., and Russell, D. G., "Pressure Buildup and Flow Tests in Wells," SPE Monograph, V. 1, 1967.

[4] Odeh, A. S., and Jones, L. G., "Pressure Drawdown Analysis, Variable-Rate Case," Jour. Pet. Tech., pp. 960-964, August, 1965.

[5] Eaton, B. A., "Fracture Gradient Prediction and Its Application in Oilfield Operations," Jour. Pet. Tech., pp. 1353-1360, October, 1969.

APPENDIX

TABLE 1

Recommended Time for Each Injection Rate Step

Ave K_{AIR} Md	Recommended Minimum Time for Each Step, Minutes	Approx. Radius of Investigation[c] Ft
5	60	15
10 or larger	30	20 or larger

$$r_{inv} = \sqrt{\frac{.00105\, k_{rw} t}{\phi \mu_w c}} \qquad (1)$$

Assumed parameters: $\phi = .2$, $\mu_w = .7$ cp; $c = 1.5 \times 10^{-5}$ psi^{-1}. Estimated $k_{rw} = .05$ for $K_{AIR} = 5$ md, $k_{rw} = .10$ for $K_{AIR} = 10$-100 md; $k_{rw} = .15$ for $K_{AIR} > 100$ md.

NON-D'ARCY FLOW EVALUATION

The non-D'Arcy flow constant D is defined as follows:

$$s' = s + Dq \qquad (2)$$

Where:

s = Skin effect, dimensionless

s' = Apparent skin effect, dimensionless

q = Injection rate, B/D

D carries units of $(B/D)^{-1}$.

The s' term can be evaluated under non-D'Arcy flow conditions from step rate tests by the Odeh technique,[3,4] provided good field data are available. Thus,

$$s' = 1.151 \left[\frac{b'}{m'} - \log \frac{k_w}{\phi \mu_w c r_w^2} + 3.23 \right] \qquad (3)$$

Where:

b' = Intercept on Odeh plot of the step rate data

m' = Slope on Odeh plot of the step rate data

The resulting s' terms for the early steps before fracturing is indicated are plotted versus q. The slope of this plot is D, according to equation (2). Rearrangement of equation (2) to $s = s' - Dq$ permits calculation of s for the various steps of the step rate test. The resulting s values are then plotted versus injection pressure. The point at which s becomes greatly more negative is interpreted as the fracturing pressure.

This technique was applied to the test illustrated in Figure 2. Another somewhat less time-consuming method was also used, giving the same results for this well.

In the short-cut method, a factor of D' was evaluated by the solution of equations for data corresponding to q_1 and q_3 shown in Figure 2. Thus,

$$q_1 + D'q_1^2 = \frac{0.00708k_wh\Delta p_1}{\mu_w[\ln(r_e/r_w) + s]} \tag{4}$$

and

$$q_2 + D'q_2^2 = \frac{0.00708k_wh\Delta p_2}{\mu_w[\ln(r_e/r_w) + s]} \tag{5}$$

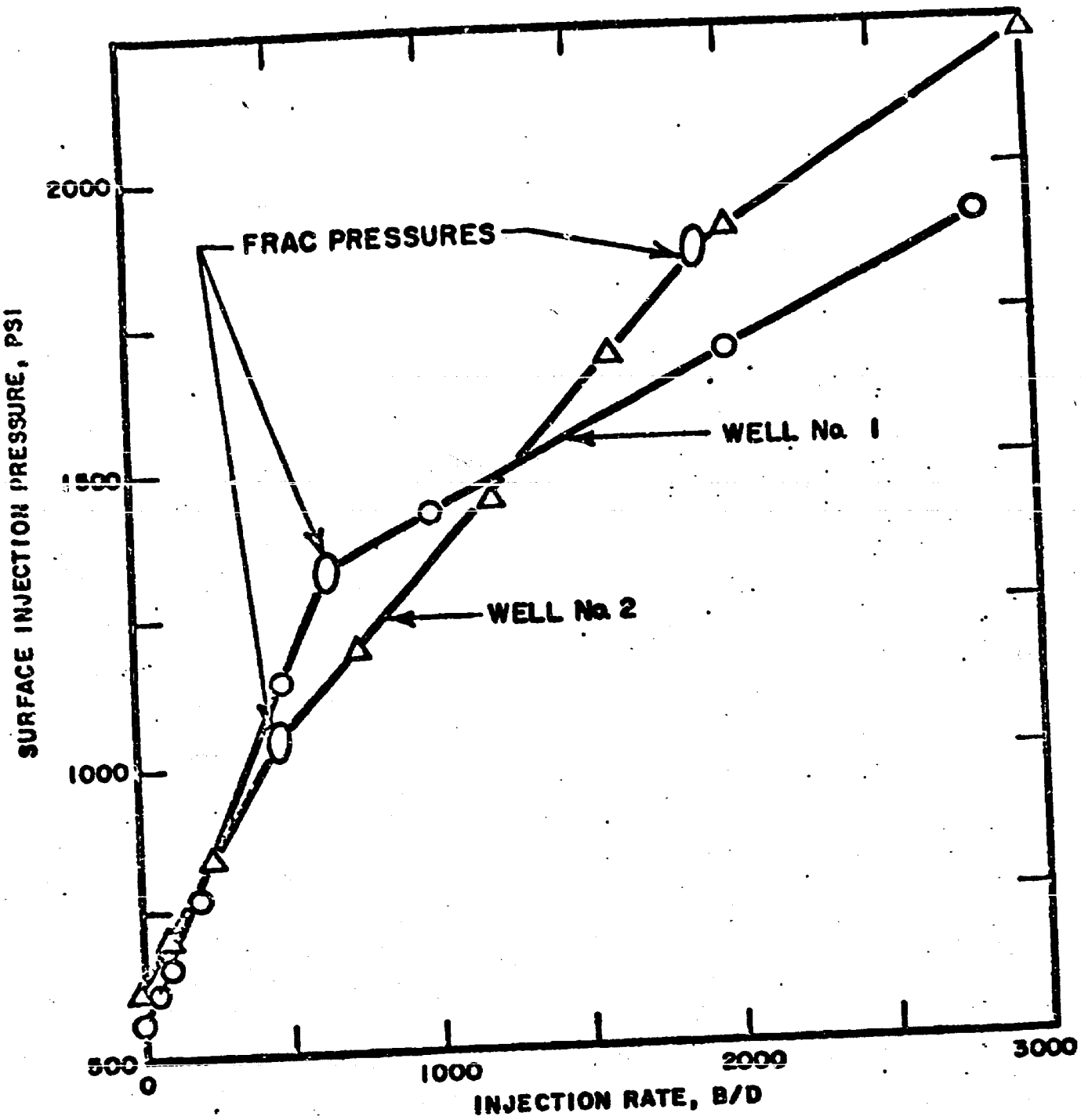
Thus,

$$D' = (\Delta p_1 q_2 - \Delta p_2 q_1)/(\Delta p_2 q_1^2 - \Delta p_1 q_2^2) \tag{6}$$

Note that D' carries the same units as D but is <u>not</u> the same as D. Thus,

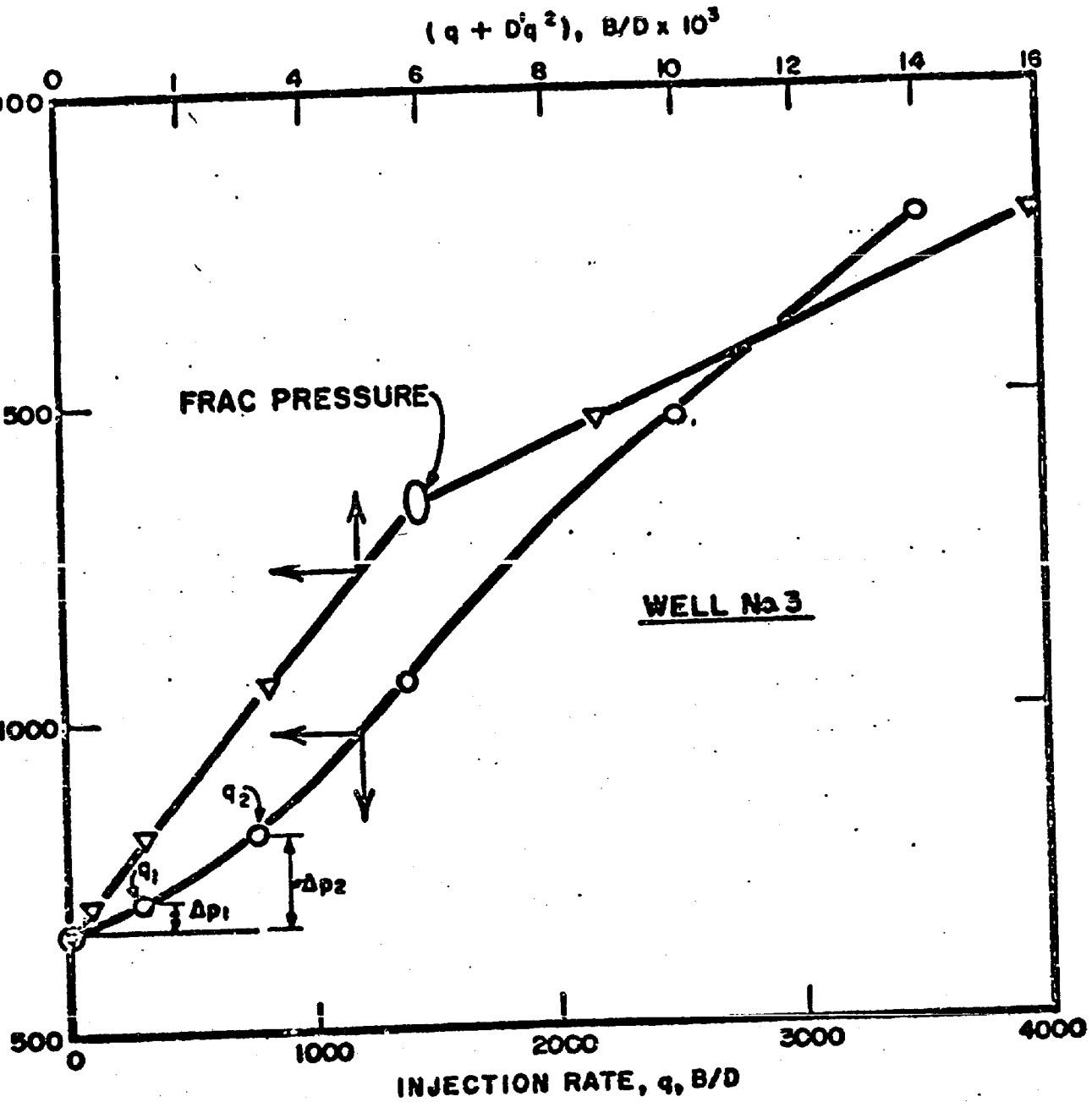
$$D' = D/[\ln(r_e/r_w) + s] \tag{7}$$

It was assumed here that r_e remained virtually constant before fracturing occurred. This is true for practical purposes if $q_2 >> q_1$. The first method described earlier is the preferred approach, but usable results may also be obtained in some cases by the short-cut method. In the latter method, p is finally plotted versus $q + D'q^2$, and the fracturing pressure is evaluated as illustrated in Figure 2.



ANALYSIS OF STEP RATE INJECTIVITY TEST DATA
NORMAL (D'ARCY) FLOW

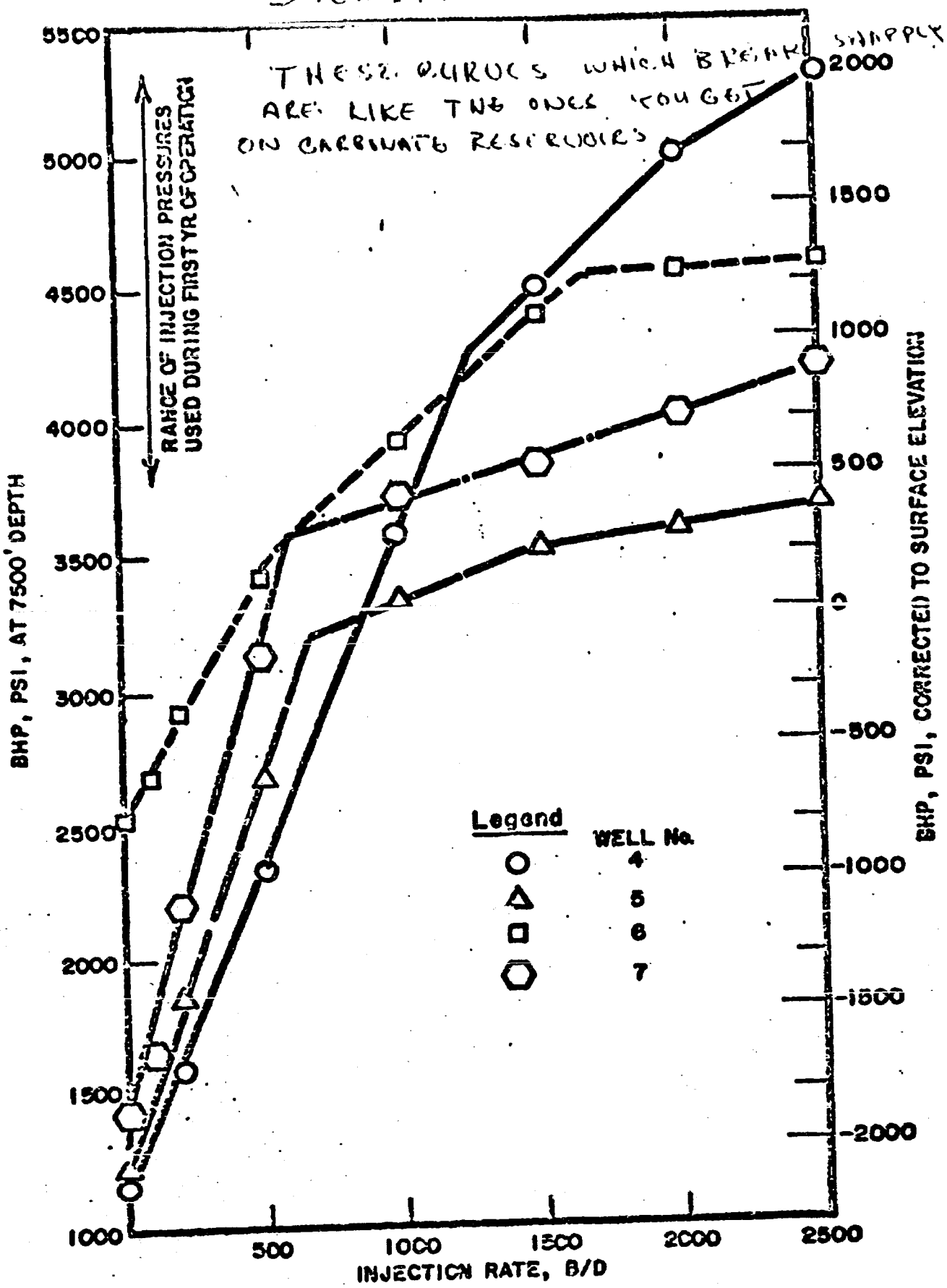
Fig. 1



ANALYSIS OF STEP RATE INJECTIVITY TEST DATA
NON-D'ARCY FLOW

Fig. 2

DICK. FROM THE TEST I HAVE RUN



STEP RATE TEST DATA FOR A YOUNG WATERFLOOD IN A 7500' DEEP SANDSTONE FORMATION

Fig. 3

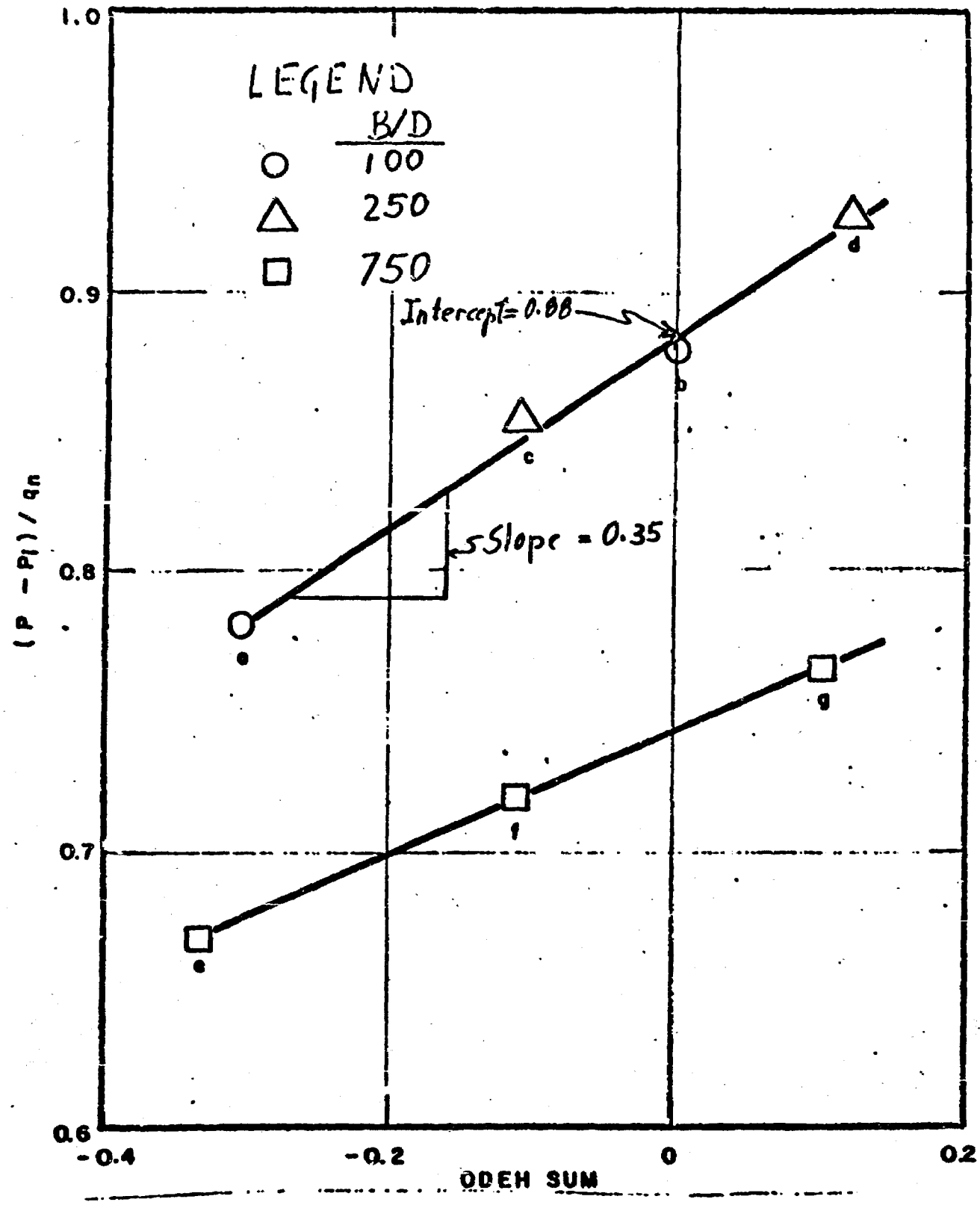
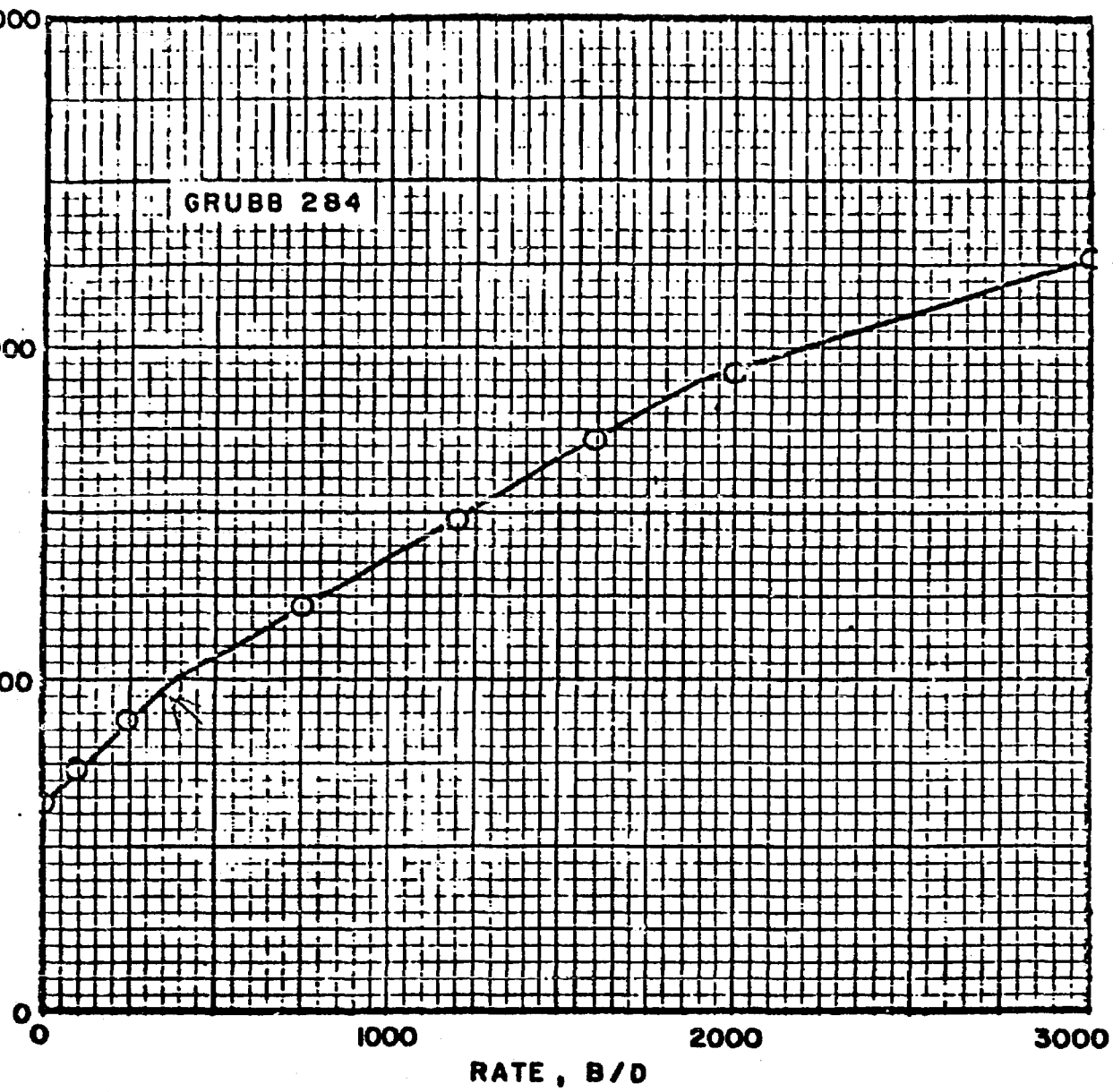

LEGEND
B/D
100
250
750
Intercept = 0.08
Slope = 0.35
a
b
c
d
e
f
g
1.0
0.9
0.8
0.7
0.6
(P - P1) / qn
-0.4
-0.2
0
0.2
ODEH SUM

Fig. 4

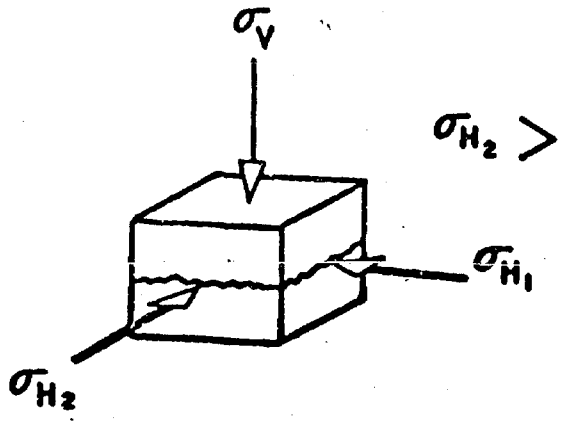


STEP-RATE INJECTIVITY TEST

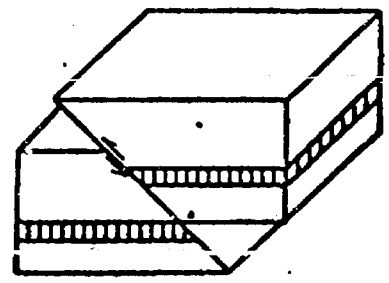
Fig. 5

PRINCIPAL STRESS AND FRACTURE ORIENTATION

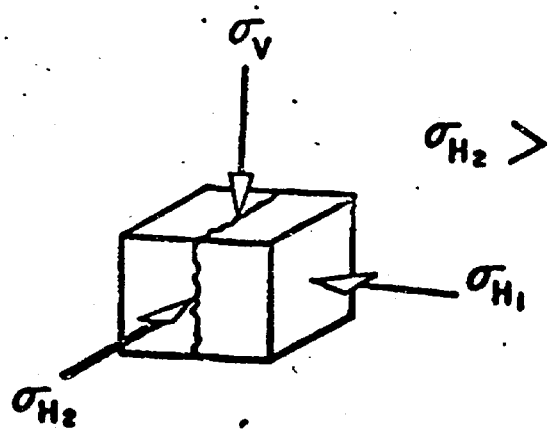
ROCKS FRACTURE IN A PLANE PERPENDICULAR
TO THE LEAST PRINCIPAL STRESS AS SHOWN



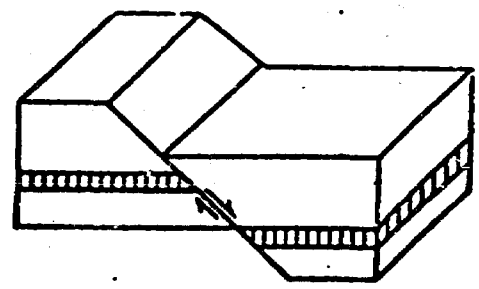
$\sigma_{H_2} > \sigma_{H_1} > \sigma_V$ - FRACTURE $\perp$ TO σ_V



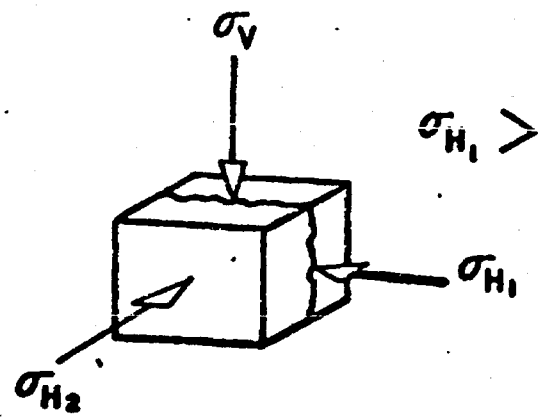
REVERSE, OR THRUST, FAULT



$\sigma_{H_2} > \sigma_V > \sigma_{H_1}$ - FRACTURE $\perp$ TO σ_{H_1}



NORMAL, OR TENSIONAL, FAULT



$\sigma_{H_1} > \sigma_V > \sigma_{H_2}$ - FRACTURE $\perp$ TO σ_{H_2}

Fig. 6

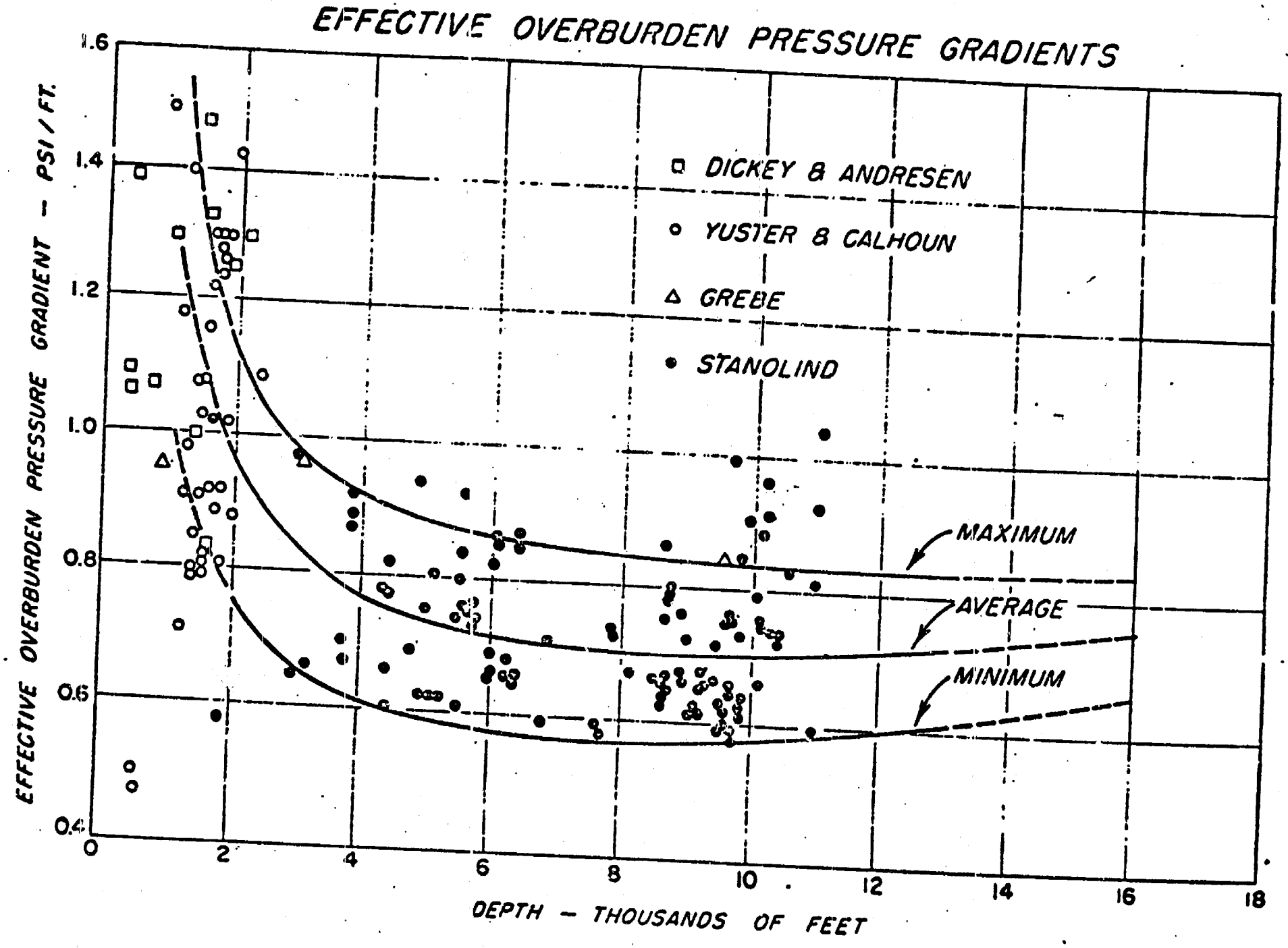

EFFECTIVE OVERBURDEN PRESSURE GRADIENTS
EFFECTIVE OVERBURDEN PRESSURE GRADIENT - PSI / FT.
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0
2
4
6
8
10
12
14
16
18
DEPTH - THOUSANDS OF FEET
DICKEY & ANDRESEN
YUSTER & CALHOUN
GREBE
STANOLIND
MAXIMUM
AVERAGE
MINIMUM

FIGURE N° 7

Docket No. 7-77

Dockets Nos. 8-77 and 9-77 are tentatively set for hearing on March 9 and March 23, 1977. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: EXAMINER HEARING - FRIDAY - FEBRUARY 11, 1977

9 A.M. - OIL CONSERVATION COMMISSION CONFERENCE ROOM, STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following case will be heard before Richard L. Stamets, Examiner, or Daniel S. Nutter, Alternate Examiner:

CASE 5872: In the matter of the hearing called by the Oil Conservation Commission on its own motion to consider the suspension of Rules 15(A) and 15(B) of the General Rules for Prorated Gas Pools as promulgated by Order No. R-1670, as amended, to permit overproduced wells to continue to produce gas during the present severe weather conditions without danger of being shut in for overproduction.

Docket No. 6-77

DOCKET: EXAMINER HEARING - WEDNESDAY - FEBRUARY 16, 1977

9 A.M. - OIL CONSERVATION COMMISSION CONFERENCE ROOM, STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

The following cases will be heard before Richard L. Stamets, Examiner, or Daniel S. Nutter, Alternate Examiner:

ALLOWABLE: (1) Consideration of the allowable production of gas for March, 1977, from seventeen prorated pools in Lea, Eddy, Chaves, and Roosevelt Counties, New Mexico.

(2) Consideration of the allowable production of gas for March, 1977, from four prorated pools in San Juan, Rio Arriba, and Sandoval Counties, New Mexico.

(3) Consideration of purchaser's nominations for the one-year period beginning April 1, 1977, for both of the above areas.

CASE 5856: Application of Amoco Production Company for an unorthodox gas well location, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Elliott Gas Com "F" 1-R Well No. 1A to be drilled 1244 feet from the South line and 820 feet from the East line of Section 33, Township 30 North, Range 9 West, Blanco Mesaverde Pool, San Juan County, New Mexico.

CASE 5857: Application of Union Oil Company of California for directional drilling, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to re-enter its Pipeline Deep Unit Federal Well No. 3, the surface location of which is 1980 feet from the North and East lines of Section 7, Township 19 South, Range 34 East, Lea County, New Mexico, and to directionally drill said well in a southerly or easterly direction and complete it in the Morrow formation at a point no closer than 330 feet to the outer boundary of the proration unit, the E/2 of said Section 7.

CASE 5858: Application of Union Oil Company of California for 320-acre spacing, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the adoption of 320-acre spacing and proration units for the North Quail Ridge-Morrow Gas Pool, Lea County, New Mexico. In the absence of objection, the Commission will adopt such 320-acre spacing.

CASE 5859: (This case will be continued and readvertised.)

Application of Caulkins Oil Company for downhole commingling, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks authority to commingle Basin-Dakota and Blanco-Mesaverde production in the wellbore of its Breech D Well No. 307 located in Unit M of Section 13, Township 26 North, Range 7 West, Rio Arriba County, New Mexico.

CASE 5860: Application of Rice Engineering & Operating, Inc. for salt water disposal, Lea County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the San Andres formation through the open hole interval from 4176 feet to 5500 feet of its Hobbs SWD Well No. P-16, located in Unit P of Section 16, Township 19 South, Range 38 East, Hobbs Field, Lea County, New Mexico.

CASE 5861: Application of Hanson Oil Corporation for a salt water disposal well, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks authority to dispose of produced salt water into the Delaware formation in the open hole interval from 1926 to 1978 feet in its Sulphate Sister Well No. 1, located in Unit E of Section 13, Township 25 South, Range 26 East, Eddy County, New Mexico.

CASE 5862: Application of Palmer Oil and Gas Company for an unorthodox gas well location, San Juan County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Federal 1 Well No. 1 located 1525 feet from the South line and 820 feet from the East line of Section 1, Township 31 North, Range 13 West, Blanco Mesaverde and Basin-Dakota Pools, San Juan County, New Mexico.

CASE 5863: Application of Amerada Hess Corporation for an unorthodox oil well location, Rio Arriba County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Jicarilla Apache "B" Well No. 16, completed as an oil well in the Dakota formation at a point 1850 feet from the South line and 1500 feet from the West line of Section 29, Township 25 North, Range 5 West, Rio Arriba County, New Mexico, said well having been projected as a Basin-Dakota gas well at a standard gas well location for said pool.

CASE 5864: Application of Agua, Inc. for the amendment of Order No. R-5137, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the further amendment of Order No. R-5137, which authorized the disposal of produced salt water into the San Andres formation through the open-hole interval from approximately 4000 feet to 5000 feet in applicant's Blinebry-Drinkard SWD System Well No. A-22, located in Unit A of Section 22, Township 22 South, Range 37 East, Blinebry-Drinkard-Langlie Mattix Area, Lea County, New Mexico. Said order, as amended, limited surface injection pressures to 800 psi, and applicant seeks its amendment to permit surface injection pressures up to 1500 psi.

CASE 5865: Application of Inexco Oil Co. for 320-acre spacing, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the adoption of 320-acre spacing and proration units for the West Tonto-Pennsylvanian Gas Pool, Lea County, New Mexico. In the absence of objection, the Commission will adopt such 320-acre spacing.

CASE 5866: Application of Union Texas Petroleum for an exception to casing and cementing requirements of Order No. R-111-A, Lea County, New Mexico. Applicant, in the above-styled cause, seeks an exception to the casing and cementing requirements of Order No. R-111-A to eliminate the salt protection string in a well it proposes to drill in Unit D of Section 33, Township 20 South, Range 34 East, Lynch Yates-Seven Rivers Pool, Lea County, New Mexico.

CASE 5867: Application of Texas Oil & Gas Corporation for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Wolfcamp and Pennsylvanian formations underlying the S/2 of Section 19, Township 21 South, Range 27 East, Burton Flat Field, Eddy County, New Mexico, to be dedicated to its Forrest Well No. 1 to be located in Unit N of said Section 19. Also to be considered will be the cost of completing said well and the allocation of the cost thereof, as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in completion of said well.

CASE 5820: (Continued from the February 2, 1977, Examiner Hearing.)

Application of Texas Oil & Gas Corporation for compulsory pooling, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks an order pooling all mineral interests in the Wolfcamp and Pennsylvanian formations underlying the W/2 of Section 4, Township 22 South, Range 26 East, Eddy County, New Mexico, to be dedicated to a well to be drilled at a standard location thereon. Also to be considered will be the cost of drilling and completing said well and the allocation of the cost thereof, as well as actual operating costs and charges for supervision. Also to be considered will be the designation of applicant as operator of the well and a charge for risk involved in drilling said well.

CASE 5868: Application of Harvey E. Yates Company for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Travis Deep Unit Well No. 1 to be drilled 1980 feet from the South line and 1684 feet from the West line of Section 18, Township 18 South, Range 29 East, Eddy County, New Mexico, the S/2 of said Section 18 to be dedicated to the well.

CASE 5846: (Continued and Readvertised)

Application of Harvey E. Yates Company for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Empire South Deep Unit Well No. 13 to be drilled 660 feet from the South line and 1432 feet from the West line of Section 30, Township 17 South, Range 29 East, South Empire Field, Eddy County, New Mexico, the S/2 of said Section 30 to be dedicated to the well.

CASE 5869: Application of Harvey E. Yates Company for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Big Boggy Well No. 1 to be drilled 990 feet from the South line and 2080 feet from the East line of Section 36, Township 17 South, Range 26 East, Atoka Pennsylvanian Gas Pool, Eddy County, New Mexico, the S/2 of said Section 36 to be dedicated to the well.

CASE 5870: Application of Harvey E. Yates Company for an unorthodox gas well location, Lea County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its South Maljamar Deep Unit Well No. 2 to be drilled 990 feet from the South line and 1980 feet from the West line of Section 30, Township 17 South, Range 32 East, Lea County, New Mexico, the S/2 of said Section 30 to be dedicated to the well.

CASE 5871: Application of Yates Petroleum Corporation for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Friendly Frenchman Well No. 1 to be drilled 1005 feet from the South line and 660 feet from the East line of Section 32, Township 16 South, Range 26 East, Eddy County, New Mexico, the S/2 of said Section 32 to be dedicated to the well.

CASE 5810: (Continued from the February 2, 1977, Examiner Hearing)

Application of Yates Petroleum Corporation for a dual completion, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion (conventional) of its Stonewall "EP" Com Well No. 1, located in Unit F of Section 30, Township 20 South, Range 28 East, Eddy County, New Mexico, to produce gas from the North Burton Flat-Wolfcamp Gas Pool and an undesignated Morrow gas pool.

CASE 5847: (Continued from the February 2, 1977, Examiner Hearing)

Application of Yates Petroleum Corporation for a dual completion, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the dual completion (conventional) of its Gossett "EU" Well No. 1, located in Unit K of Section 26, Township 17 South, Range 25 East, Eddy County, New Mexico, in such a manner as to produce gas from the Lower Wolfcamp or Upper Pennsylvanian and the Lower Pennsylvanian formations through the casing-tubing annulus and tubing, respectively.

CASE 5848: (Continued from the February 2, 1977, Examiner Hearing)

Application of Yates Petroleum Corporation for an unorthodox gas well location, Eddy County, New Mexico. Applicant, in the above-styled cause, seeks approval for the unorthodox location of its Pipkin HE Well No. 1 to be drilled 660 feet from the South and West lines of Section 4, Township 18 South, Range 25 East, Eddy County, New Mexico, the S/2 of said Section 4 to be dedicated to the well.

TELEPHONE: 505 393-6188

AGUA, INC.
POST OFFICE BOX 1978
HOBBS, NEW MEXICO
88240

January 18, 1977

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

Case 5864

Attn: Joe D. Ramey

Re: Step-rate Fracture Test
Blinebry-Drinkard
SWD Well A-22

Gentlemen:

Pursuant to your letter of November 22, 1976 requesting we conduct an adequate step-rate test to determine fracture pressure in our Blinebry-Drinkard Salt Water Disposal Well No. A-22, we are enclosing a curve showing the results of a step-rate injection test conducted by Halliburton Services on January 7, 1977.

A step-rate fracture test was attempted on November 30, 1976, however, the results were inconclusive due to insufficient water supply on location. Subsequent to this aborted test, periods of freezing weather severely reduced the amount of waste waters handled by the System and, conversely, caused many connected tank batteries to dump gas and oil into and effectively block the System's collection lines.

AGUA, INC., as Operator of the Blinebry-Drinkard Salt Water Disposal System, respectfully requests that the Commission take

action on our November 15, 1976 request to increase the injection pressure for our Disposal Well No. A-22.

Yours very truly,

AGUA, INC.

W. G. Abbott

W. G. Abbott
Manager

Attachments

cc: James Jennings
Jerry Sexton
File

HALLIBURTON SERVICES

January 17, 1977

Mr. J. V. Ryan
AGUA, INC.
P. O. Box 1978
Hobbs, New Mexico 88240

Re: Step-rate Pressure Test on BDSWD A-22

Val,

Attached you will find a graph of data obtained while running a second step-rate test on the above captioned disposal well on January 7, 1977. The data points used were obtained from surface gauges and represent the actual pressures encountered while pumping. Notice that two definite straight lines are apparent from a plot of the data. The intersection of these lines should be an approximate surface fracturing pressure. In this case, it appears that the formation begins fracturing at approximately 1450 PSI (Surface Pressure).

If I can be of further assistance, do not hesitate to call.

Sincerely,

James E. Sigmon

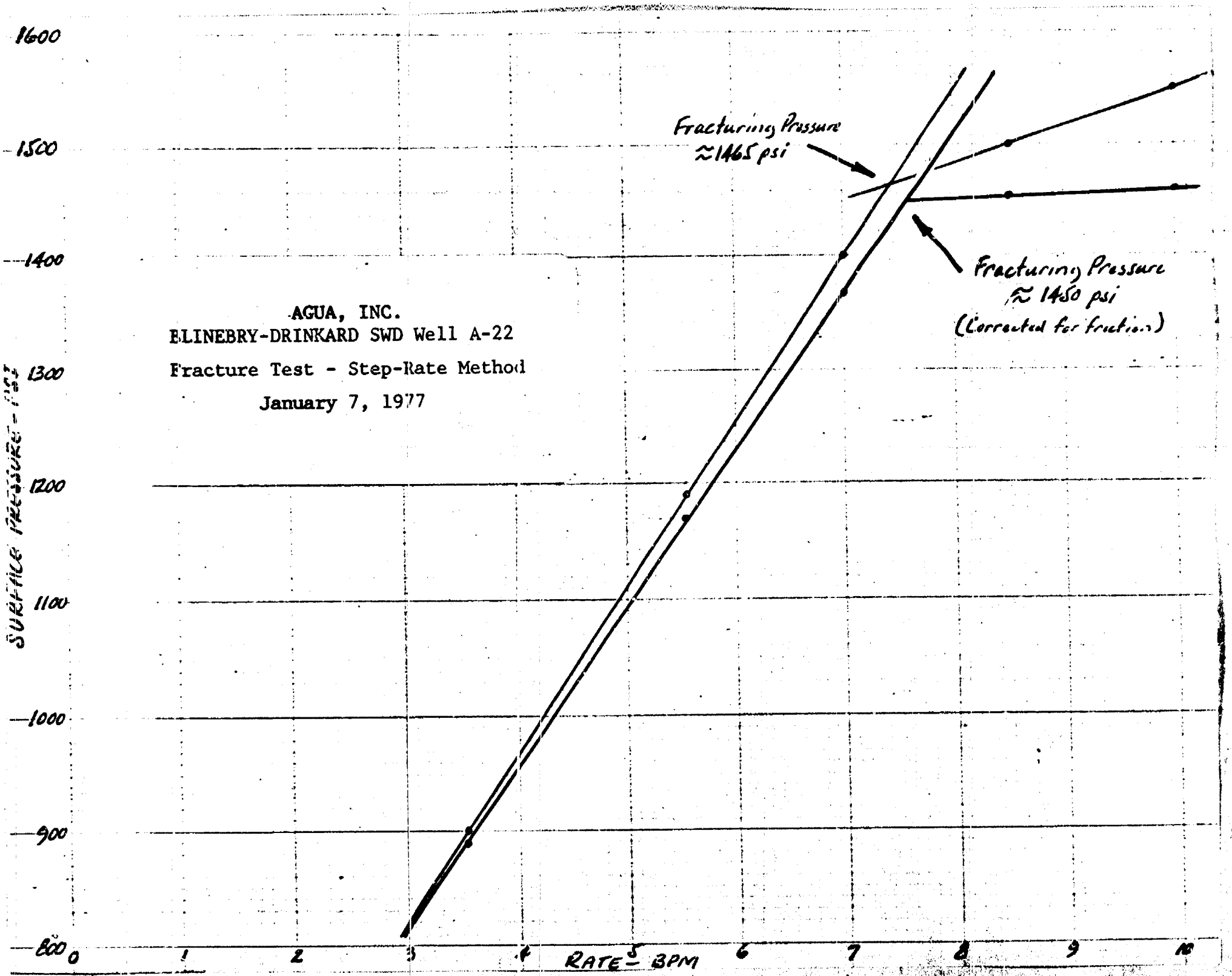
James E. Sigmon
Customer Contact
Hobbs, N.M.

JES/lt

cc: Earl Stanley
File

Attachment

AGUA, INC.
ELINEBRY-DRINKARD SWD Well A-22
Fracture Test - Step-Rate Method
January 7, 1977



AGUA, INC.

BLINEBRY-DRINKARD SALT WATER DISPOSAL WELL NO. A-22

FRACTURE TEST

11/30/76 — 8:30 A.M. Jarrel Services, Inc. arrived location and rigged up lubricator and bomb to tubing. Ran bomb down hole and tagged bottom or fill at 4135'.

Halliburton Services rigged up pump truck to redwood water tanks and loaded tubing with about 100 bbls. water at 4 BPM.
Started controlled injection at 10:10 A.M.

Time	Amount	PSI	Rate BPM	
10:10 A.M.	100 bbls.	200#	4.0	*Loaded tubing
10:45	1585 gals.	200#**	.5	**Dropped to 50#
11:45	2750 gals.	25#	1.0	
12:45 P.M.	5410 gals.	200#	2.0	
1:45	8800	400#	3.5	
2:45	13900	800#	5.5	
3:45-4:05	5383	1000#***	7.0	***ISI

4:05 P.M. End test because of low water level in redwoods. Rigged down trucks. Move off location.

Test witnessed by Jerry Sexton and Nathan Clegg with N.M.O.C.C.

FRACTURE TEST

1/7/77 — Halliburton Services rigged up pump truck to redwood tanks and wellhead. Started pumping into tubing at controlled rate.
525# tbg. pressure at start of test.

	Time	Tbg. at End of Rate	Rate BPM	
	10:55 A.M.	900	3.5	
	11:55 A.M.	1190	5.5	
	12:55 P.M.	1400	7.0	
	1:55 P.M.	1500	8.5	
	2:55 P.M.	1550	10.0	
End Test	3:05 P.M.	1550	10.0	***ISI

End test because of low water level. Rigged down trucks. Move off of location.

Test witnessed by Nathan Clegg with N.M.O.C.C.

4:00 P.M. Tbg. dropped to 1100#. Started triplex pump back on automatic.

OIL CONSERVATION COMMISSION
P. O. BOX 2088
SANTA FE, NEW MEXICO 87501

November 22, 1976

Case 5644

Agua, Inc.
P. O. Box 1978
Hobbs, New Mexico 88240

Attn: Mr. William G. Abbott

Gentlemen:

I am in receipt of your letter of November 15, 1976, wherein you request an increase in the injection pressure for your disposal well No. A-22.

Before the Commission can take any action on this request, it will be necessary that you take adequate step rate injection tests on the well to determine the fracture pressure. When these tests are concluded and submitted to this office, a determination can then be made.

Yours very truly,

JOE D. RAMEY
Director

JDR/fd

AGUA, INC.
POST OFFICE BOX 1978
HOBBS, NEW MEXICO
88240

TELEPHONE: 505 393-6186

November 15, 1976

Case 5644

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

Attn: Joe D. Ramey

Re: Blinebry-Drinkard SWD System

Gentlemen:

The subject System currently collects and disposes of 11,351 barrels per day of waste water from 469 connected wells, representing a 70% increase in waste waters collected and disposed from a 23% increase in connected wells subsequent to the 1973 OPEC Oil Embargo. The engineering and physical efforts to efficiently handle and dispose of such increases in waste waters, in accordance with the rules and regulations of all concerned, County, State and Federal regulatory bodies, has been extremely complicated by restrictions placed on AGUA's highest and best use of the disposal wells serving the System.

Disposal Well No. H-35, by letter directive dated August 22, 1975, was ordered to cease accepting waste waters by September 26, 1975, because of certain conditions alleged to exist in said well. Such allegations have been disproven by AGUA in the immediate past and can be physically disproven at any future point in time.

Waste waters reaching terminal storage at Disposal Well No. H-35 are currently being pumped through a "temporary" 6" PVC plastic line laid in the borrow ditch of County Road C-17 to Disposal Well No. C-2. Such 6" line has had its "temporary" (6-month) status renewed on two occasions. It is hoped the "temporary" permanence holds until such time as its need has expired and AGUA is required to take up the line.

Disposal Well No. A-22 was drilled on a site contiguous to wells which had experienced lost circulation problems when drilling through the San Andres formation. As chance would have it, Disposal Well No A-22 was drilled into and completed in such an unexpectedly tight portion of the main body of the San Andres that three sizeable acid treatments have not increased the well's acceptance of waste waters at an 800 psi surface injection pressure authorized by Order No. R-5137-B.

Emergency Order No. E-29 authorized disposal of waste waters in Disposal Well No. C-2 into the perforated interval from 4230' to 4320' until a time no later than October 15, 1976; and, on or before such time, the perforated interval 4230' to 4320' was to be effectively isolated from the acceptance of any and all waste waters. Such isolation of the perforated interval was in compliance with the wishes of Exxon Company, U. S. A.

The exigencies attendant to the required, proper handling and subsurface pressure disposal of approximately 230 barrels per hour of waste waters diverted to Disposal Well No. A-22, and the resultant 42 barrels per hour of waste waters reaching terminal storage facilities at Disposal Well No. H-35 for subsurface pressure disposal, dictates an AGUA request for administrative approval of and for the following:

(1) Increase to an authorized 1,500 psi for the pressure disposal of 5,520 barrels per day of waste waters into Disposal Well No. A-22.

Again, we realize the existing problem of water breakthrough in the salt section but cannot believe Disposal Wells A-22 and H-35 contributed to such breakthrough problem as first noticed in the latter part of 1959, nor in the additional breakthroughs that have been experienced since September, 1975.

Yours very truly.

AGUA, INC.

W. G. Abbott
Manager

DRAFT

BEFORE THE OIL CONSERVATION COMMISSION
OF THE STATE OF NEW MEXICO

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

CASE NO. 5864

Order No. R-5137-C

Application of Agua, Inc. for the amendment of Order No. R-5137, Lea County, New Mexico.

ORDER OF THE COMMISSION

BY THE COMMISSION:

This cause came on for hearing at 9 a.m. on February 16, 19 77, at Santa Fe, New Mexico, before Examiner R L S.

NOW, on this _____ day of _____, 19___, 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 by Commission Order No. R-5137, dated December 17, 1975, the applicant, Agua, Inc., was authorized to dispose of produced salt water into the San Andres formation through the open-hole interval from approximately 4,000 feet to 5,000 feet in its Blinebry-Drinkard SWD System Well No. A-22, located 817 feet from the North line and 965 feet from the East line of Section 22, Township 22 South, Range 37 East, NMPM, Lea County, New Mexico.

(3) That in order to ensure that the disposed water would remain confined to the San Andres formation and not migrate through fractures or otherwise into other formations, said Order No. R-5137 required that the aforesaid Well No. A-22 be equipped with a pop-off valve or acceptable substitute which would limit the wellhead injection pressure to no more than one hundred (100) psi.

(4) That by Commission Order No. R-5137-B, dated August 3, 1976, the applicant obtained authorization to increase said wellhead injection pressure limitation to eight hundred (800) psi.

(5) That the applicant now seeks the further amendment of said Order No. R-5137 to provide for a wellhead injection pressure limitation of up to ~~fifteen hundred~~ 1500 psi.

(6) That the subject well is located within an area where vertical formation fracturing is suspected to exist.

(7) That formation fracturing occurs as the result of large volumes of fluid being injected into the formation at high pressure.

(8) That disposal of large volumes of water at ~~1200~~ 1500 psi as sought by the applicant ~~would likely tend to~~ may create vertical fractures in the formation or ~~to~~ enlarge existing fractures, if they already exist, thereby permitting the disposal water to migrate into other formations, possibly resulting in the loss of underground reserves, thereby causing waste, or in injury to offsetting leases or properties.

(9) That insofar as the Commission can now determine, a surface wellhead injection pressure of approximately ~~800~~ 1400 psi will not cause formation fracturing, and will not result in loss of underground reserves nor injury to offsetting leases or properties, nor otherwise cause waste or violate correlative rights.

(10) That the applicant's request for the amendment of Commission Order No. R-5137 to permit disposal of produced salt water in its Well No. A-22 at a surface injection pressure ~~not to exceed 1200~~ up to 1500 psi should be denied, but said Order No. R-5137 should ~~be~~ be further amended to permit such disposal at surface injection pressures up to ~~800~~ 1200 psi, provided proper safeguards are taken that such pressure not be exceeded.

IT IS THEREFORE ORDERED:

(1) That the application of Agua, Inc., for the further amendment of Commission Order No. R-5137 to permit disposal of produced salt water into the San Andres formation through the open-hole interval from approximately 4,000 feet to 5,000 feet in its Blinebry-Drinkard SWD System Well No. A-22, located 817 feet from the North line and 965 feet from the East line of Section 22, Township 22 South, Range 37 East, NMPM, Lea County, New Mexico, at a surface injection pressure ~~not to exceed 1200~~ of up to 1500 psi is hereby denied.

(2) That Order No. (2) of Commission Order No. R-5137 is hereby amended to read in its entirety as follows:

"(2) That the injection well or system shall be equipped with a pop-off valve or acceptable substitute which will limit the wellhead injection pressure on the injection well to no more than ~~eight~~ fourteen ~~hundred (800)~~ hundred (1400) psi."

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

Docket No. 9-76

Dockets Nos. 10-76 and 11-76 are tentatively set for hearing on March 17 and March 31, 1976. Applications for hearing must be filed at least 22 days in advance of hearing date.

DOCKET: COMMISSION HEARING - WEDNESDAY - MARCH 10, 1976

OIL CONSERVATION COMMISSION - 9 A.M.
OIL CONSERVATION COMMISSION CONFERENCE ROOM
STATE LAND OFFICE BUILDING, SANTA FE, NEW MEXICO

CASE ~~5044~~: Application of Agua, Inc. for the amendment of Order No. R-5137, Lea County, New Mexico. Applicant, in the above-styled cause, seeks the further amendment of Order No. R-5137, which authorized the disposal of produced salt water into the San Andres formation through the open-hole interval from approximately 4000 feet to 5000 feet in applicant's Blinebry-Drinkard SWD System Well No. A-22, located in Unit A of Section 22, Township 22 South, Range 37 East, Blinebry-Drinkard-Langlie Mattix Area, Lea County, New Mexico. Said order, as amended, limited surface injection pressures to 800 psi, and applicant seeks its amendment to permit surface injection pressures up to 1500 psi.